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The Marine Bivalve Molluscs of the Canadian Arctic

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ABSTRACT

The fauna of marine bivalve molluscs of the shallow water region of the Canadian Central and Eastern Arctic was studied on the basis of the extensive collections of the Fisheries Research Board and the National Museum of Canada, identified by the author, as well as on the basis of materials in Museums on this Continent. In a total of over 1000 samples from the region studied, sixty-two species of bivalves were found, re-described, and their areas of distribution mapped.

It is shown that the recent patterns of distribution of these molluscs developed on the basis of their post-Wisconsin migrations and subsequent readjustments to the isostatic land rebound. This pattern is deeply influenced by the recent shallowness of the region and by the distribution of Arctic, Subarctic and Atlantic waters.

A zoogeographic zonation of the Canadian Arctic Region based on the distribution of bivalves is proposed, and its relation to the adjacent zoogeographic regions discussed.

MARINE BIVALVE MOLLUSCS OF THE CANADIAN ARCTIC

by Irene Lubinsky

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I. INTRODUCTION 1

HISTORY OF EXPLORATION OF THE CANADIAN ARCTIC BIVALVE FAUNA..... 5

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INTRODUCTION

The marine shallow water region of the Canadian Arctic is one of the most important zoogeographic areas of high latitudes. It is situated between the Arctic and Atlantic Oceans and close to the Pacific Ocean. The Canadian Shield separates the deep water regions of these oceans, except for a shallow water connection over the submerged north-eastern part of the continent.

The formation of the marine fauna of the Canadian Arctic was greatly influenced by the geological events of the Pleistocene. The Canadian Shield was probably the centre of more than one glaciation. The grounded ice of the glaciers destroyed the marine fauna and caused extensive migrations on its periphery. The recent marine fauna of the Canadian Arctic is basically Pleistocene in origin, and was formed in the wake of the retreating Wisconsin glacier. The marine fauna migrated with the transgression, extending over the areas freed by the glacier. The pattern of recent marine distributions can be explained only on the basis of events of the Post Wisconsin period.

The Canadian Arctic has attracted the attention of explorers since the beginnings of the search for the North-West Passage. The first samples of marine bivalves from this region were collected by the first expedition of John Ross in 1818. Regular faunistic and oceanographic investigations of the Canadian

Arctic initiated in 1947 by the Fisheries Research Board of Canada, and by the National Museum of Canada, resulted in rapid accumulation of oceanographic data and of samples of marine animals, including bivalves.

Data on bivalve molluscs of this region, scattered in various publications, have never been reviewed, and the rich collections of bivalves dispersed in different museums were only partly identified and catalogued. No comprehensive reviews of this fauna have been published.

The bivalve fauna from non-Canadian Arctic regions was discussed by Thorson (1951), Ockelmann (1958, Greenland), G.O. Sars (1878, Norway), Filatova (1948, 1957, 1962, Eurasian Arctic), Dall (1871, 1916, 1919), Krause (1885), N. MacGinnitie (1959, North American Western Arctic) and by many other authors. A zoogeographic scheme for the Eurasian seas was worked out by Filatova (1957, 1962). It was thus desirable to study the bivalve fauna of the Canadian Arctic and to determine its zoogeographic position within the circumarctic fauna.

Aims of the present study were as follows:

1. To collect the data on the Canadian bivalve fauna scattered in the literature by studying materials in the museums of Canada and the U.S.A.
2. To study the zoogeographic distribution of species in relation to the marine environment, in the first place to the depth and the water masses.
3. To investigate the possible influence of the last glacial

an. postglacial periods on the formation of the fauna.

4. To investigate the distribution of different faunistic elements within the fauna and produce a zoogeographic scheme for the region.

5. To investigate changes in the fauna of bivalves from the Arctic to the Boreal zone.

6. To study the relations of the bivalve fauna of the Canadian Arctic to that of the neighbouring shallow water regions, and to the circumarctic fauna in general.

The progress of biological sciences has changed the aims and methods of zoogeographic studies. Reactions of organisms to the changing environment have been studied and marine distributions explained in terms of the physiological adaptability of species. The biological species concept has rapidly replaced the old morphological one. The importance of temperature as a single master factor determining marine distributions was questioned. These distributions were shown to be dependent on the marine waters of different types. It was found that the physical and chemical properties of the water masses determine the parameters of environment and consequently influence the composition of animal communities. Descriptive zoogeography has evolved into biogeography, analysing the distribution of the plants and animals and its causes, and studying the ecosystems in their development in space and time.

Fundamental views on the development of the ecosystem in high latitudes were expressed by Dunbar (1968), who regards

the development of life in the north as an "adaptation of the whole ecosystem to the Arctic conditions." He states that the ranges of distribution "express rather the total ability of environment to support the greater or lesser variety of species, or the necessity for high fecundity, in an environment of such highly oscillating productivity as the Arctic." As the developing ecosystem requires a certain period of adjustment, the time factor becomes of prime importance in the Arctic distributions and in the development of the Arctic ecosystem.

From the standpoint of evolutionary biogeography, each member of the ecosystem, be it plant or animal, participates in its own manner in the development of this ecosystem. The marine bivalves reflect in their distribution, variations, and biology their capabilities and limitations in adaptation to the changing environment of high latitudes.

The Pleistocene events in the Canadian Arctic region present an excellent background for the study of the formation of recent patterns of distribution of marine bivalves and of the fauna in general. The patterns of distribution of bivalves are regarded here as a temporary balance established between the organisms and their changing environment.

HISTORY OF THE EXPLORATION OF THE MARINE BIVALVE FAUNA OF THE CANADIAN ARCTIC

Discussing the history of Arctic explorations, Greely (1910, p.6) states that, "polar research has passed through three distinct phases: first for strictly commercial purposes in connection with trade to the Indies; second, for the advancement of geographical knowledge, and third, for scientific investigations connected with the physical sciences."

These phases can be discerned in the history of exploration of the Canadian Arctic. Despite the remoteness of this region from Europe its exploration has been initiated by European countries searching for the north-western passage to the Indies via the Canadian Archipelago. Expeditions of the "classical" period were sponsored mainly by Great Britain and the Scandinavian countries. This period begins with the journey of Frobisher, 1758, and ends in 1859 with the search for the ill-fated expedition of Franklin. In attempting to pass through the Archipelago, the expedition of this period contributed to the knowledge of geography and oceanography, but only incidentally to that of biology.

The second period, 1860-1947, was characterized by a decline in the participation of European countries, and by intensification of exploration by the Canadian government.

The third, recent, period begins in 1947 with the

expeditions of the Fisheries Research Board of Canada. Since 1950 the National Museum of Canada also participated in the biological investigations of the Central and Eastern Canadian Arctic. The exploration of the Canadian Arctic by the Pleistocene Group of the Geological Survey of Canada, its Oceanographic Branch, and the Bedford Institute of Oceanography, contributed greatly to the knowledge of geology, oceanography and marine biology of this region.

The early collecting of bivalves in the Canadian Arctic was done in a haphazard manner. Biological research was only a byproduct of oceanography and geographic studies. Biological materials were collected only when time and situation permitted.

Shallow water molluscs were the first to be collected. The samples contained mostly a few specimens and the labelling was often vague; as an example, "Collected by the Arctic Expedition", or "From the Arctic Regions." Such collecting and labelling resulted in publication of indiscriminate listings of bivalves collected by the expeditions along the entire route, which often passed through different zoogeographic zones.

Biological reports almost never were published simultaneously with the "Report of Progress" of the expeditions. They usually appeared much later, scattered in both the European and the American literature. Therefore the search

for original papers is often difficult. And yet, despite all the drawbacks, the foundations of Canadian marine zoogeography were laid in this early period, and a considerable number of species of marine bivalves was collected, many new to science.

Since 1947, the Fisheries Research Board of Canada has been intensively investigating both the biology and the oceanography of the Central and Eastern Canadian Arctic. Its efforts resulted in a rapid accumulation of extensive biological materials. Numerous samples of marine bivalves were collected, sufficient for an intensive study of the composition of the fauna, distribution of species, their variability, growth rates, etc.

Before discussing the results of the present study it is necessary to review the published data on this group of molluscs from the Canadian Arctic. The lists of the Canadian Arctic bivalves identified and published by different authors are given in Tables 1, 2 and 3. They record only the first findings of each species in this region. For complete lists of species found by the expeditions the original papers should be consulted. In the tables are given both the names of species used by the original authors and those of the recent nomenclature. Species with the type locality in the Canadian Arctic are marked by an asterisk.

Bivalve molluscs of the Archipelago (Table 1.)

The earliest collections of bivalves came from the

Table 1. Bivalves of the Central Canadian Arctic listed according to the time of the first record.

First record	Name used in the record	Recent name
Leach 1819	Phleobia rugosa L.	Hiatella arctica (L. 1767)
"	Pandora glacialis n. sp.	Pandora glacialis Leach 1819
"	Macoma tenera n.g., m.sp.	Macoma calcarea (Gmelin 1792)
"	Crassina semisulcata n. sp.	Astarte borealis (Schum. 1817)
"	Nicania striata n. sp.	A. striata (Leach 1819)
"	N. banksi n. sp.	A. banksi (Leach 1819)
"	Crassina scotica Mat. & Rach.	A. sp.
"	Modiola arctica n. sp.	Musculus sp. ?
Gray 1824	Mya truncata L.	Mya truncata L.
"	Nucula arctica n. sp.	Portlandia arctica (Gray 1824)
"	N. rostrata Lam.	Nuculana minuta (Fabr. 1776)
"	Glycymeris siliqua Lam.	Cyrtodaria kurriana Dunker 1862
"	Nicania crenata n. sp.	Astarte crenata (Gray 1824)
"	Crassina arctica n. sp.	A. arctica (Gray 1824)
"	Cardium radiatum (Donovan)	Serripes groenlandicus Brugg. 1789
"	Arca glacialis n. sp.	Bathyarca glacialis (Gray 1824)
"	Modiola nigra n. sp.	Musculus niger (Gray 1824)
"	M. laevigata et var. B. substriata n. sp., n. var.	M. discors L. var. laevigatus et. var. substriatus (Gray 1824) Jensen 1912
"	Pecten vitreus n. sp.	Pecten vitreus Gray 1824
Sutherland 1852	Montacuta substriata Mont.	Montacuta substriata (Montagu 1804)

Table 1 (continued)

First record	Name used in the record	Recent name
Reeve 1855	Lima subauriculata Mont.	Lima subauriculata Montagu 1808
"	Nucula portlandica n. sp.	Portlandia arctica (Gray 1824) var. portlandica (Hitchcock 1836)
"	N. siliqua n. sp.	P. siliqua (Reeve 1855)
"	N. sulcifera n. sp.	P. sulcifera (Reeve 1855)
"	N. expansa n. sp.	Nucula belloti Adams 1856
"	N. sapotilla Gould	Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954
"	Leda buccata Steenstrup	Nuculana buccata (Steenstrup 1842)
"	Modiola marmorata Forbes	Musculus sp. ?
"	Astarte richardsoni n. sp.	Astarte borealis (Schum. 1817) juv.
"	A. fabula n. sp.	A. fabula Reeve 1855
"	A. globosa Møller	A. globosa Møller 1842
"	Cardium ciliatum Fabr.	Clinocardium ciliatum (Fabr.1780)
"	Pandorina arenosa Møller	Lyonsia arenosa (Møller 1842)
Stimpson 1864	Crassina elliptica Brown	Astarte elliptica (Brown 1827)
"	Crenella faba Müller	Crenella faba (Müller 1776)
Smith 1877	Leda pernula Müll.	Nuculana pernula (Müller 1779)
"	Axinus gouldi Phil.	Thyasira gouldi Phil. 1845
Jefferys 1877	Naera subtorta G.O. Sars	Cuspidaria subtorta (G.O. Sars 1877)
Grieg 1909	Leda pernula costigera Leche	Nuculana pernula costigera (Leche 1878)
"	Tellina torelli Steenstrup	Macoma torelli (Steenstrup) Jensen 1905
"	T. moesta Deshayes	M. moesta (Deshayes 1854)
"	T. loveni Steenstr.	M. loveni (Steenstrup) Jensen 1905
"	Thracia septentrionalis Jef.	Thracia septentrionalis Jeffreys 1872

Table 1 (continued)

First record	Name used in the record	Recent name
Grieg 1909	T. truncata Turton	Thracia sp. ?
Dall 1919	Astarte vernicosa n. sp.	Astarte warhami Hancock 1876
"	Macoma oneilli n. sp.	Macoma moesta (Deshayes 1854)
"	Liocyma beckii n. sp.	Liocyma fluctuosa (Gould 1841)
"	L. viridis n. sp.	L. fluctuosa (Gould 1841)
"	Mya intermedia Dall 1898	Mya pseudarenaria Schlesch 1931
"	Pseudamusium andersoni n. sp.	Delectopecten groenlandicus (Sowerby 1842)
"	Mytilus edulis L.	Mytilus edulis L. 1758
"	Musculus corrugatus Stimpson	Musculus corrugatus (Stimpson 1851)
Dall 1924	Bathyarca pectunculoides Sacchi	Bathyarca pectunculoides (Scacchi 1833)
"	Pseudamusium ringnesia n. sp.	Pseudamusium ringnesia Dall 1924
"	Yoldiella obesa Stimpson	Yoldiella obesa (Stimpson 1877)
Thorson 1951	Periploma abyssorum Verill et Bush	Periploma abyssorum Verill et Bush 1893
Ellis 1960	Nucula delphinodonta Mighee et Adams	Nucula delphinodonta Mighee et Adams 1842
"	Thracia myopsis Beck.	Thracia myopsis (Beck) Møller 1842
"	Axinopsis orbiculata G.O. Sars	Axinopsida orbiculata (G.O. Sars 1877)
"	Dacridium vitreum (Møller)	Dacridium vitreum (Møller) 1842)
Wagner 1962	Yoldiella frigida (Torell)	Yoldiella frigida (Torell 1859)
"	Yoldiella tamara (Gorbunov)	Yoldiella tamara (Gorbunov 1946)

Archipelago. They were collected by the expeditions of Ross (1818), Parry (1819-1820), and of Belcher (1852-1854). The routes of these expeditions are mapped by Taylor (1955), Figs. 3, 4, II. The bivalves were collected in Lancaster Sound, Barrow Strait, and off Melville Peninsula. Lists of bivalves, published by Leach (1819), Gray (1824) and by Reeve (1855), contain many common species and some rare ones, including several new to science (Table 1). The nomenclature used by the original authors is partially outdated, and some species have been obviously misidentified. The identity of species identified by Leach as Astarte scotica, and by Reeve as Modiola marmorata is doubtful. Another example is Nucula arctica Gray, whose identity was much discussed later (Whiteaves, 1901, p.127). Yoldia hyperborea (Loven) Torell was erroneously identified by Reeve as Y. sapotilla Gould (fide Ockelmann, 1958), and Cyrtodaria kurriana Dunker as Glycymeris siliqua Lam., Nucula expansa Reeve and N. inflata Hancock are regarded now as con-specific with N. belloti Adams (1836)(Schenk, 1931). N. MacGinnitie (1959) showed that Liocyma beckii and L. viridis Dall (1919) are synonymous with L. fluctuosa Gould (1841), and that Mya intermedia Dall (1898) is synonymous with M. pseudarenaria Schlesch (1931). Thus for the twenty-five species of bivalves described as new by Leach, Gray and Dall, only sixteen were really new. Even so, the sixteen species comprise almost one-third of all bivalve species collected by the early expeditions. Ellis, 1960 has collected twenty-one species

of bivalves in the inlets of Northern Baffin Land. New for this region were: Nucula delphinodonta Migh. et Adams, Dacridium vitreum Moller, Thracia myopsis (Beck) Moller and Axinopsida orbiculata (G.O. Sars). Specimens of Mytilus edulis L. with fresh soft parts were found on the shores.

The north-eastern part of the Archipelago was explored mostly by expeditions trying to reach the North Pole (Taylor, 1955, Figs. 15, 17 and 28). Species added to the fauna of the Archipelago by these expeditions are listed in Table 1 under Smith, 1877, Jeffreys, 1877, (collected by the expedition of Nares 1875-76), Stimpson 1863 (expedition of Hayes), Backer 1919 (MacMillan's Crocker Land Expedition, 1913- 1917).

Bivalves of the Western Archipelago have been collected by the expeditions of Sverdrup, 1898-1902, and of Stefansson, 1913-1919 (Canadian Arctic Expedition). The routes of these expeditions are shown in Taylor, 1955, Figs. 24 and 34. The molluscs collected were identified by Grieg (1909), who lists twenty-three species, five new to the region, and by Dall (1919 and 1924). This last author lists twenty-three species, six of which he believed to be new to science. According to N. MacGinnitie (1959), however, Liocyma beckii, L. viridis and Mya intermedia are synonyms of L. fluctuosa Gould and of Mya pseudarenaria Schlesch. Two species of bivalves new to the region, have been added by Wagner (1962).

Bivalve molluscs of the Canadian Eastern Arctic (Table 2)

Foxe Basin

Prior to the expedition of the Fisheries Research Board of Canada, Foxe basin was one of the least explored regions of the Canadian Eastern Arctic. Parry navigated this basin in 1821-23, and reached Fury and Hecla Strait. The same route was taken by Bartlett (Norcross Expedition) in 1933. I did not find any publications relating to the bivalves collected by these expeditions. In the Smithsonian Institution, U.S.N.M., I found six samples of bivalves collected by the Bartlett expedition, containing two species identified by me as Astarte striata (Leach) and Musculus laevigatus (Gray)(U.S.N.M., 406132, 464316,-18,-33,-34,-41, 4643453).

The fifth Thule expedition explored Foxe Basin in 1921-24, and collected only five common species of bivalves (Laursen, 1927). The expedition of the Fisheries Research Board of Canada of 1956 was the first to investigate in detail the bottom fauna of Foxe Basin, recording eighteen species of bivalves (Ellis, 1960). Though no new species were added to the fauna of the Canadian Arctic, the material collected proved to be zoogeographically important.

Hudson Bay, Hudson Strait and Ungava Bay

The first data on the bivalves of this region were published by Stimpson (1861) who lists several common species from Ungava Bay, and records for the first time in this

Table 2. Bivalves from the Canadian Eastern Arctic listed according to the time of the first record.

First record	Name used in the record	Recent name
Hancock 1846	Pecten islandicus Müller	Pecten (Chlamys) islandicus Müll. 1776
Cumberland Sound	P. groenlandicus Sowerby	P. groenlandicus (Sowerby 1842)
"	Nucula inflata n. sp.	Nucula belloti Adams 1856
"	Leda rostrata Lam.	Nuculana buccata (Steenstrup 1842)
"	L. minuta Fabricus	N. minuta (Fabr. 1776)
"	Modiola nigra Gray	Musculus niger (Gray 1824)
"	M. laevigata Gray	M. discors L. var. laevigatus (Gray 1824) Jensen 1912
"	Tellina calcarea Gm.	Macoma calcarea (Gmel. 1792)
"	Astarte semiculcata Leach	Astarte borealis (Schumucher 1817)
"	A. warhami n. sp.	A. warhami Hancock 1846
"	Cardium groenlandicus Chemn.	Serripes groenlandicus Bruggiere 1789
"	C. islandicum Chemn.	Cardium ciliatum Fabr. 1780
"	Mya uddevalensis Forbes	Mya truncata v. uddevalensis Hitchcock
"	Saxicava pholadis Chemn.	Hiatella arctica (L. 1767)
"	Lyonsia gibbosa n.sp.	Lyonsia arenosa (Møll. 1842)
Stimpson 1861 Ungava Bay	Nucula expansa Reeve 1885	Nucula belloti Adams 1856
	Mytilus edulis L.	Mytilus edulis L. 1758
Whiteaves 1881 Hudson Bay	Macoma baltica L	Macoma balthica L. 1758
	Astarte banksi Leach	Astarte banksi (Lea. 1819)
	Mya arenaria L. 1758	Mya sp.
"	Lyonsia arenosa Leach	Lyonsia arenosa (Leach 1819)

region Macoma balthica L. Stimpson also expressed the opinion that Astarte laurentiana Lyell still lives in this Bay.

Dall (1886) listed nine species from Ungava Bay, among them Mya arenaria L., though he did not state whether live specimens are found. Whiteaves (1881 and 1885) examined the bivalves collected by Capt. R. Bell in Hudson Bay and Hudson Strait. His papers, including that of 1901, provide the basic material on the bivalves of this region. Whiteaves lists twenty-six species of molluscs, amoung them Mya arenaria L. from Richmond Gulf and King George's Sound. I have re-examined the specimens from Richmond Gulf and found them to be subfossil shells of Mya pseudarenaria Schlesch. I had no opportunity to study Whiteaves' specimens of Mya arenaria from Hudson Bay. It is doubtful, however, that this species ever lived there. Whiteaves also found for the first time in the Canadian Arctic the zoogeographically important Chlamys islandica Mull., Venericardia borealis Conrad, and Yoldia myalis Couthoy, species found previously only south of Labrador. He also lists the rare Astarte elliptica Brown and Lyonsia arenosa Moller.

Halkett (1898), who studied collections of Capt. Wakeham's from eastern Hudson Bay, lists eight species already known from this region. Brooks Stanley (1902) lists six common species from Southampton Island.

Dall (1924), identified eighteen species of bivalves collected by the "Neptun" expedition in the northern part

of Hudson Bay. In this collection he found six species new to the Canadian Eastern Arctic. Ockelmann (1958), however, points out that Dall's Yoldia sapotilla Gould is Y. hyperborea hyperborea Ockelmann and that Lyonsia hyalina was a misidentification.

Dan Laursen (1937) lists four common species from the Canadian Eastern Arctic and adds Astarte crenata Gray from Roes Welcome Strait as a species new to the Eastern region.

Richards (1936 and 1941) published lists of a few Pleistocene and seventeen recent bivalves from James Bay and western Bay, In 1962 he published a list of twenty-seven species from the Canadian Eastern Arctic.

Wagner (1968) published a list of bivalves from Central Hudson Bay, containing twenty-six species, among them Bathyarca glacialis (Gray). This species I have also found in the materials of Clarke (National Museum of Canada) collected in 1960 in the south-eastern trench of the bay.

Bivalve molluscs from the Western shores of Baffin Bay

The first paper on the molluscs from this region is that of Hancock (1846). He identified fifteen species of bivalves, three of them believed to be new to science. However, Nucula inflata Hancock is regarded now as a synonym of N. belloti Adams and Lyonsia gibbosa of Hancock as a synonym of L. arenosa Moller. New to the Canadian Arctic were Crenella decussata Mont., Turtonia minuta Mont., and Cyrtodaria kurriana Dunker. Lists of bivalves by Dall (1878), Pfeffer (1886) (German North Polar Expedition) and by Rodger

(1894) added nothing new to the fauna of the Canadian Arctic.

The above papers list thirty-two species of bivalves of the Canadian Arctic, two of them with type localities in this region.

Bivalve molluscs from the Labrador coast (51°- 55°N) (Table 3)

Bivalves of southern Labrador are better studied than those from its northern shores. Packard (1863) collected in 1860 material at Caribou Island, and later extended his collecting area northwards to Hopedale (Packard 1867). Bush published in 1884 Packard's study of the molluscs of the Stearns Expedition to Labrador of 1882. Packard's studies showed that besides the common northern species, the fauna of Labrador contains several boreal species, most of them restricted to the southern shores and not penetrating north of the Strait of Belle Isle. In Table 3 these species are marked with an asterisk. Only a few boreal species reach northern Labrador.

The presence of boreal species off the southern shores of Labrador and their scarcity north of the Strait of Belle Isle indicate that in the region of this strait a drastic change in the fauna of bivalves takes place: here the arctic fauna still persists on the shelf, some species, however, submerge into the Labrador Sea and the Gulf of St. Lawrence, and boreal species appear.

The perusal of the literature on the bivalves of the

Table 3. Bivalves of the southern shores of Labrador (51° - 55°N.), listed according to the time of the first record. Asterisk indicated species not found north of the Strait of Belle Isle.

First record	Name used in the record	Recent name
Packard 1867	Anomia aculeata Gm	*Anomia aculeata Gm.1792
"	A. ephippium L.	*A. ephippium L. 1758
"	Astarte banksii Leach	Astarte banksi(Leach 1819)
"	A. compressa (Linn)	A. elliptica (Brown 1827)
"	A. striata Leach	A. striata (Leach 1819)
"	Cardium islandicum Chemnitz	Cardium ciliatum Fabricus 1780
"	C. hayesii Stimpson	C. hayesi Stimpson 1862
"	Pecten tenuicostatus Migh. and Adams	*Placopecten grandis (Solander 1786)
"	P. islandicus Müll.	Pecten islandicus (Müller 1776)
"	Limatula sulculus Leach	Lima subauriculata (Montagu 1808)
"	Nucula tenuis Turton	Nucula tenuis(Montagu 1808)
"	N. expansa Reeve	N. belloti Adams 1856
"	Yoldia sapotilla Stimpson	*Yoldia sapotilla Gould 1841
"	Leda buccata Stimps	Nuculana buccata (Stimpson 1842)
"	L. minuta (Fabr.)	N. minuta (Fabr. 1776)
"	Crenella glandula Totten	*Crenella glandula (Totten 1834)
"	Modiolaria corrugata Stimpson	Musculus corrugatus (Stimpson 1851)
"	M. laevigata Gray	M. laevigatus (Gray 1824)
"	M. faba Fabricus	Crenella faba (Müll.1776)
"	M. discrepans Müll.	Musculus niger(Gray 1824)
"	Mytilus modiolus L.	*Modiolus modiolus(L.1758)
"	M. edulis L.	Mytilus edulis L. 1758
"	Cryptodon gouldii Philippi	Thyasira gouldi (Philippi 1845)
"	Cardita borealis Conrad	Venericardia borealis (Conrad 1831)
"	Cardium pinnulatum Conrad	*Cardium pinnulatum (Conrad 1831)
"	Serripes groenlandicus Beck	Serripes groenlandicus (Bruggière 1789)
"	Gemma totteni Stimp.	*Gemma gemma Totten 1834
"	Tapes fluctuosa Sowerby	*Liocyma fluctuosa (Gould 1841)
"	Mactra solidissima Chemnitz	*Spinsula solidissima (Dillwyn 1817)

(Table 3 continued)

First record	Name used in the record	Recent name
Packard 1867	M. polynema Stimps.	*S. polynyma (Stimps.1860)
"	Mesodesma jauresii Joannis	*Mesodesma arctatum (Conrad 1831)
"	Macoma fusca Stimps.	Macoma balthica(L. 1858)
"	M. sabulosa Stimps.	M. calcarea (Gmelin 1792)
"	Solen ensis Lam.	*Ensis directus (Conr.1842)
"	Thracia conradi Couthoy	*Thracia conradi (Couthoy 1839)
"	T. myopsis Beck	T. myopsis (Beck) (Møller 1842)
"	Anatina papyracea Say	*Periploma papyratia (Say 1822)
"	Pandora trilineata Say	*Pandora trilineata (Gould 1841)
"	Pandorina arenosa Møller	Lyonsis arenosa (Møller 1842)
"	Cyrtodaria siliqua Daudin	*Cyrtodaria siliqua (Spengler 1793)
"	Mya truncata L.	Mya truncata L. 1958
"	M. arenaria L.	M. arenaria L. 1758
"	Saxicava rugosa L.	Hiatella arctica(L.1767)
Bush 1883	Crenella decussata Montagu	Crenella decussata (Montagu 1808)
"	Astarte borealis Schumacher	Astarte borealis (Schumacher 1817)
"	Cryptodon obesus Verrill et Bush	Cryptodon obesus (Verrill et Bush)
"	Kennerlia glacialis Leach	Pandora (Kennerlia) glacialis (Leach 1819)
"	Axinopsis orbiculata G.O. Sars	Axinopsida orbiculata (G.O. Sars)
"	Astarte arctica Gray	Astarte arctica(Gray 1824)

Canadian Arctic indicates that the fauna in this region is relatively will studied. There remain still some less explored regions, e.g. the deep areas of Hudson Strait and of Foxe Channel, the shelf of northern Labrador, the Gulf of Boothia, the middle shelf of Baffin Land, and the deep trenches of the northern Archipelago.

And yet our relatively adequate knowledge of the bivalve fauna extends only as far as the list of species comprising it goes. The lower taxa, below the species level, have had almost no study. The areas of distribution of the species are insufficiently known, and so is the ecology of the Arctic bivalves. At present we are almost at the end of cataloguing the Canadian Arctic bivalves and are starting ecological zoogeographic studies. It is hoped that new data on the distribution of bivalves based on the materials of the Fisheries Research Board and of the National Museum of Canada will contribute to our knowledge of this fauna.

MATERIALS

The aim of the present study is to survey the fauna of marine bivalves in the shallow water region of the Canadian Arctic situated between Parr Inlet, Alert, in the north, Cape Bathurst in the south-west, and the Strait of Belle Isle in the south-east. A comprehensive list of bivalves of this region has never been compiled and their areas of distribution remain almost unknown. Therefore, it was necessary to catalogue the bivalves and to study their distribution by reviewing the literature and identifying the materials available in the scientific institutions of this continent. Sources of information were:-

1. Data obtained from the perusal of scientific reports of expeditions, starting with that of Parry (1819-1820), till the last expeditions of the Fisheries Research Board of Canada, National Museum of Canada, Geological Survey of Canada, Bedford Institute, and other scientific marine operations. These data have been discussed in the previous chapter and the lists of species compiled from them are in Tables 1, 2 and 3.

2. I have studied the collections of bivalves from the Canadian Arctic in the following museums of Canada and of the United States: National Museum of Canada, Ottawa;

Redpath Museum, McGill University, Montreal; American Museum of Natural History, New York; Smithsonian Institution, Washington; Museum of Comparative Zoology, Harvard University, Cambridge, Mass.

Specimens of bivalves for comparative studies were obtained from the National Museum of Canada; Academy of Natural Sciences, Philadelphia; Stanford University,, California; Smithsonian Institution, Washington; and from Helsingor Biological Station, Denmark.

3. The basic sources of material were the extensive collections of the Fisheries Research Board and of the National Museum of Canada, which were kindly made available to the author.

In the course of this work the following materials were identified:

1. Bivalves from the Archipelago.

a) Materials of the National Museum of Canada.

Molluscs of the MacDonald expedition, 1952-54, collected in zoologically unexplored regions of the Archipelago: Parr Inlet, Alert, and Slidre Fjord in Ellesmere Land; Mould Bay (Prince Patrick Island) and Hole-in-Fog Bay (Isachsen Island). Eleven samples from these localities contained eighteen species of bivalves, four of them new to the region, two new to science. Portlandia sulcifera Reeve

(1855), was found here for the first time since its description.

b) Materials of the Fisheries Research Board of Canada:

Collections of the expeditions of 1958-65 to the south-eastern and central part of the Archipelago. Forty-six species of bivalves were identified in one hundred and forty samples.

2. Bivalves from the Canadian Eastern Arctic.

a) Materials of the National Museum of Canada.

Bivalves of the expedition of F. Johannsen to Hudson Bay and James Bay in 1920.

Eighteen species were identified from twenty samples available.

Materials of the A. Clarke expedition to south-eastern Hudson Bay in 1963; forty-three samples contained thirty- four species.

b) Materials of the Fisheries Research Board of Canada:

Extensive materials collected by the expeditions of M. Dunbar and E. Grainger. The regions studied, numbers of samples and the numbers of species identified in the course of the present work are listed below:

Marine Regions:	Year of Collection	Number of Samples	Number of Species
Ungava Bay and Eastern Hudson Strait	1947-1950	148	43

Frobisher Bay and Cumberland Sound	1951,1952	39	20
Western and northern Hudson Bay	1953,1954	49	30
Foxe Bay and Foxe Channel	1955,1957	96	36
Eastern Hudson Bay, Belcher Ids.	1958	73	35
Southern Hudson Bay, James Bay	1959	32	38
Belcher Island, Hudson Bay	1960	15	21
North-western Hudson Bay	1961	26	30

Bivalves from Foxe Basin have been partially identified by Ellis (1961).

Although the collections of the Fisheries Research Board contain only a few species of bivalves new to the Canadian Eastern Arctic, they provide extensive data on the areas of distribution of these molluscs. The samples often contain numbers of specimens sufficient for the study of intraspecific variation and of growth rates. The hydrological studies of the Fisheries Research Board provide oceanographic data on almost all locations, permitting the study of environmental factors influencing bivalve distribution.

3. Bivalves from Labrador

Collections made by Steele from Nain (1957), containing nineteen species in twenty-six samples of molluscs,

and providing data on the distribution of southern species over the shelf of Labrador.

In the course of the present work I have identified bivalves in seven hundred and thirty samples from the Canadian Central and Eastern Arctic and found sixty-two species, five of them new to the region, and two to science. The results of the study of the bivalves of the shallow water region of the Central and Eastern Canadian Arctic are presented in the form of a catalogue, with the species listed and briefly described, and their areas of distribution outlined; the arrangment of higher taxa in the catalogue follows that by M. Keen (1963). Species within these taxa are listed in alphabetical order. Data on the systematic composition of the fauna are summarized in Table 4.

Most of the bivalves from the Canadian region have never been illustrated; it was therefore desirable to photograph at least some of the specimens studied. The distribution of bivalves in the Canadian Arctic is represented in Maps 1 to 61. The stations from which bivalves were identified or seen by me are indicated by black circles; areas based on published papers are indicated by slanted hatching, e.g. those off West Greenland and Labrador. Most of the areas of distribution are based on a considerable number of samples and therefore can be regarded as a fair approximation to reality. They provide material for the

study of the zoogeography of marine bivalves and on some factors determining their distribution.

The material examined was limited to qualitative samples; some quantitative data from Foxe Basin were provided by Ellis (1962). Rough estimations of the abundance are, in the present paper, of necessity limited to expressions such as "abundant", "common", and "rare". Larger series of specimens needed for the study of intraspecific variation and of growth rates were available for a limited number of species.

The material on which the present research is based is listed in the appendix, according to the geographic origin and year of collection:

Part 1. Archipelago, 1962-64
2. Foxe Basin, 1955-57
3. Eastern shores of Hudson Bay, 1958
4. South-eastern Hudson Bay including James Bay and Belcher Islands, 1959
5. Northern Hudson Bay, Hudson Strait, Ungava Bay, Cumberland Sound and Frobisher Bay, 1947-54

Listed are the stations of collection, species of bivalves arranged in systematic order, and number of specimens identified. The oceanographic data on the stations where bivalves were collected are published in the report of the

Fisheries Research Board of Canada.

The list of species collected by the National Museum of Canada in the Archipelago and in Eastern Hudson Bay and which I identified is also appended.

II. BIVALVE FAUNA OF THE CANADIAN ARCTIC

CATALOGUE AND DESCRIPTION OF SPECIES..... 22

Order Protobranchia

Suborder Paleotaxodontida

Superfamily Nuculacea

Family Nuculidae

Genus Nucula Lamarck 1799

Subgenus Ennucula Iredale 1931

Nucula (Ennucula) belloti Adams 1856,
Pl. 1, figs. 1-5; Pl. 2, figs. 6-8.

Nucula belloti Adams 1856, Proc. Zool. Soc. London, Pt. 24, p. 51.

Nucula belloti - Hanley, 1860, Pl. 229, fig. 128.

Nucula belloti - Schenk, 1939, Pl. 6, fig. 19-21, pl. 8, figs. 10, 11, 13, 16, 17-20.

(= Nucula inflata Hancock 1846, N. expansa Reeve 1855).

Distribution in the Canadian Arctic: Map 1.

Published records:

Nucula inflata - Hancock 1846, Cumberland Sound; Smith 1877, N.W. Baffin Bay; Whiteaves 1882-84, Hudson Strait; Baker, 1910, N.W. Baffin Bay.

Nucula expansa - Reeve 1855, Canadian Archipelago; Stimpson 1861, Hudson Bay; Packard 1891, Labrador; Richards 1936, James Bay.

Nucula tenuis - Bush 1883, Labrador; Packard 1891, Labrador; Rodger 1895, Eglinton Harbour, Baffin Land; Whiteaves 1901, Hudson Bay; Grieg 1909, Canadian Archipelago; Dall 1919, Canadian Archipelago; Dall 1924, Canadian Archipelago; Johnson 1926, Labrador; Thorson 1951, N. W. Baffin Bay; Ellis 1960, N. Baffin Land, Pond Inlet; Foxe Basin.

Nucula belloti - Wagner 1968, Hudson Bay.

New records: Archipelago, Foxe Basin, Hudson Strait, Hudson Bay, Ungava Bay, Frobisher Bay, Cumberland Sound; collected by FRBC and NMC (App.I.).

Since the first arctic explorations all northern specimens of Nucula have been identified as N. tenuis (Montagu 1808), whose type locality is Dunbar, Scotland. (Montagu, Test. Brit. Suppl. p. 56). However, three other forms of Nucula have been described from the Canadian Arctic, all related to the above species. These are: N. inflata Hancock, 1846; N. expansa Reeve, 1885; and N. belloti Adams, 1856. Relationships between these nuculas usually have been disputed. They have been regarded as synonymous with N. tenuis, or as its varieties (Whiteaves, 1901; Soot-Ryen, 1932; Filatova, 1948; Thorson, 1951; N. MacGinitie, 1959; Ockelmann, 1958; also Hanley, 1861 and Gould, 1870).

Schenk, 1939, revising the nomenclature of nuculids, has shown that the northern forms, known as N. inflata Hancock and N. expansa Reeve, are conspecific with N. belloti

Adams 1856. As the first two names are homonyms of N. inflata and N. expansa of Wissman, 1841, the sole available name for the northern specimens in question was that of N. belloti Adams (ibid.). This last name is used in the present paper.

N. belloti is an abundant and common species in the Canadian Arctic. It occurs over the whole region at a depth of 10 to over 200 meters in soft bottom (Map 1). However the size and shape of shells differs in many basins.

Archipelago: Measurements of two specimens (in mm.) from Mould Bay, Isachsen Island, are the following:

l	h	w	h/l	w/l
15.2	13.0	7.5	0.85	0.50
13.0	11.0	7.5	0.81	0.55

The specimens in Archipelago are almost round in outline. Peculiar features, pointed out by Schenk (ibid.), are clearly visible on pl. 1, figs. 1-3 and pl. 2, figs. 6-7 of the present paper.

Foxe Basin: Abundant in the shallow and in the deep water (177 meters). Specimens attain 17 mm. in length. Shells of larger animals are dark green, swollen and short; smaller are elongated, narrower and lighter colored.

The dimensions and h/l and w/l ratios of four shells of N. belloti Adams from Station 723, FRBC, are as follows:

l	h	w	h/l	w/l
17.0	13.0	9.5	0.76	0.56
17.0	13.1	10.0	0.76	0.59
15.0	11.0	8.0	0.73	0.53
13.0	10.0	8.1	0.78	0.51

Hudson Bay: Abundant and widely distributed. Shells are lighter colored and smaller than in the Foxe Basin; the size decreases gradually toward James Bay where only few specimens attain a size of 6 mm. The shells are thin and brittle. Shells of dead animals are numerous. This species is seemingly retreating from the James Bay region.

Dimensions of four shells from central Hudson Bay (Station 59-68, FRBC) were the following:

l	h	w	h/l	w/l
12.0	9.5	7.0	0.78	0.58
11.0	7.5	5.0	0.75	0.50
10.0	8.0	6.0	0.80	0.60
9.5	8.0	6.0	0.89	0.63

Baffin Bay-Labrador sea: Specimens collected off the shore are large, dark green, swollen, shells strong. The largest specimens have been taken in Hebron Fjord and off the Button Islands.

Discussion. N. belloti Adams differs strongly from N. tenuis Montagu. Canadian Arctic specimens of N. belloti are arcuate in outline, high and swollen (pl. 1, figs. 1-5;

pl. 2, figs. 6-8). Pouting anterior upper part gives the shell a "winged" appearance. This part is separated from the rest of the shell by a large slanted longitudinal ridge, with corresponding broad groove on the interior side of the shell. Lunula and escutcheon are well defined; lunula cordiform, separated by the ridge from the rest of the shell. Hinge plate is less arcuate than the upper margin of the shell. There are 15-18 long, slender, anterior teeth, bent outward, and 8-10 strong, crowded posterior teeth. The resilifer is narrow, long, slightly pressed to the anterior row of the teeth. Fine radial striation spreads all over the inner surface of the shell. There exist both very broad, short forms and narrow, elongated ones. Both occur throughout the whole Canadian Arctic.

The largest shells originate from the coldest regions of the Canadian Arctic, the smallest from James Bay.

The variability of the shape of the shell is considerable. The ratios h/l and w/l of 180 specimens from different parts of the Canadian Arctic are as follows:

Basin	No. of sp.	l	h/l	w/l
Foxe Basin	40	8-17	0.73-0.85	0.49-0.65
Hudson Bay	80	6-12	0.70-0.90	0.49-0.67
Ponds Inlet	10	7-14	0.77-0.82	0.47-0.67
Wellington Ch. and Frobisher Bay	14	10-16	0.78-0.86	0.49-0.64
Labrador	16	10-16	0.79-0.90	0.54-0.64

The following table shows the distribution of indices w/l and h/l of 80 specimens from Hudson Bay and an equal number from other basins in the Canadian Arctic.

Ratio h/l:	.70-.71	.72-.73	.74-.75	.76-.77	.78-.79	.80-.81	.82-.83	.84-.85	.86-.87	.88-.89	.90-.91
No. of specimens:											
Hudson Bay	2	2	5	6	10	14	16	13	8	4	0
Other basins	-	1	2	10	12	15	19	14	4	2	1
Total:	2	3	7	16	22	29	35	27	12	6	1

Ratio w/l:	.47-.48	.49-.50	.51-.52	.53-.54	.55-.56	.57-.58	.59-.60	.61-.62	.63-.64	.65-.66	.67-.68
No. of specimens:											
Hudson Bay	2	6	7	9	16	12	13	4	6	3	2
Other basins	-	5	7	4	22	13	12	8	7	1	1
Total:	2	11	14	13	38	25	25	12	13	4	3

The table shows that the w/l and h/l ratios of the populations from Hudson Bay and from other basins are more or less normally distributed. The mode and the mean ratios (h/l = 0.82; w/l = 0.56) in both groups are similar. The inflated specimens (Nucula inflata of Hancock) and the elongated, narrowed ones (N. expansa of Reeve) are only extreme variants of a unimodal population of N. belloti. There are no indications of the presence of two separate forms of this species in the Canadian Arctic.

Data on N. belloti from the Canadian Arctic enables the comparison of the Canadian specimens with those from other arctic regions.

Shells from East Greenland are as large as those from the Foxe Basin; their h/l ratio (0.75-0.85) is similar; w/l ratio (0.48-0.55) is much lower. The East Greenland shells are similar to the narrowest shells in Canada. Ockelmann (1958, p. 15) identifies the East Greenland Nucula as N. expansa Reeve.

Molluscs with h/l and w/l ratios of 0.75 and 0.48 respectively occur in all the Eurasian Arctic seas. In the East Siberian seas, however, the large specimens with high h/l and w/l ratios (0.80-0.90 and 0.60 respectively) prevail. In the Canadian Arctic similar specimens occur only in the Foxe Basin-Hudson Strait region.

Soot-Ryen (1932, p. 4-5) stresses that in the East Siberian sea the difference between the wide and narrow

specimens is so great that it is difficult to regard them as conspecific; the expanded specimens (N. inflata) are 20-30% higher and 20-25% wider than the narrow ones (N. expansa). The above data show that the populations of larger and wider specimens occur mainly in the coldest regions of the American and the Eurasian Arctic but not on East Greenland. It would be interesting to compare growth rates of the elongated and expanded specimens of N. belloti Adams.

Distribution outside Canadian Arctic:

Greenland and Iceland.

Eurasian Arctic seas: The "complex inflata-expansa" (Filatova 1948) occupies the coldest regions of the seas from the deep waters of Barenz Sea toward and including the Bering Sea.

In deeper waters north of 75°N this species is abundant and individual size the largest. Filatova's drawings of N. expansa and N. inflata (1948, pl. CV, figs. 1, 2) represent the specimens of N. belloti Adams.

American Western Arctic: All Nucula in collections of Krause from Bering Strait and of N. MacGinitie from Pt. Barrow are Nucula belloti Adams. They have been labelled as N. tenuis Mont., N. inflata Hancock and N. expansa Reeve.

Nucula belloti Adams is a circumpolar panarctic species. In the boreal and partially in the subarctic zone

it is replaced by the closely related form, possibly a subspecies, known as Nucula tenuis Mont. Further study of the relationship of the forms of N. tenuis s. lato is needed.

Nucula (Ennucula) delphinodonta Mighel and Adams 1842

Nucula delphinodonta Mighel and Adams, 1842, Bost. J. Nat. Hist., vol. 4, p. 40, pl. 4, fig. 5.

Distribution in the Canadian Arctic: Map No. 2.

Published records:

Nucula delphinodonta - Johnson 1926, Labrador.

Nucula delphinodonta - Ellis 1960, Eclipse Sound, N. Baffin Land.

New records: Hudson Strait (Dr. Oughton Coll., 1939).

Nucula delphinodonta has been found in Ponds Inlet, at a depth of 43 meters, and in Hudson Strait (locality not specified). Though Ockelmann (1958, p. 194) states that N. delphinodonta is present off "Parry Islands", it is doubtful that this species occurs in inland waters of the Central or Eastern Canadian Arctic. The southern boundary of this species in N. W. Atlantic is at New Jersey.

Distribution outside Canadian Arctic:

West Greenland from 65° to 75°N; absent in East Greenland and Iceland.

Eurasian Northern Seas: The coasts of Norway, Murman and the southern shores of the Barenz Sea.

N. delphinodonta is an Atlantic subarctic-boreal species, penetrating northward in areas of warm currents.

Family Nuculanidae

Genus Nuculana Link 1807.

Nuculana pernula (Muller 1779).

Pl. 3, figs. 9-14; Pl. 4, figs. 15-18.

Leda pernula Muller, 1779, Verh. Ges. Naturf. zu Berlin, Vol. 4, p. 55.

Leda pernula - G.O. Sars, 1878, pl. 5, figs. 1 a-d.

Leda pernula costigera Leche, 1883, vol. 3, p. 447, pl. 33, figs. 23, 24, 25.

Leda buccata Steenstrup 1842, in Sowerby, Thes. Conch., pl. 228, figs. 63, 64.

Leda jacksoni Gould, 1870, p. 163, fig. 469.

Distribution in the Canadian Arctic: Map No. 3.

Published records:

Leda pernula - Packard, 1867, Labrador; Smith, 1877, N.W. Baffin Bay; Whiteaves, 1882-84, Hudson Strait; Whiteaves, 1901, Hudson Bay; Backer, 1919, N.W. Baffin Bay; Dall, 1919, Arctic Archipelago; Johnson, 1926, Labrador; Richards, 1936, Hudson Bay; Thorson, 1951, N.W. Baffin Bay; Ellis, 1960, N. Baffin Land.

Leda rostrata - Hancock, 1846, Cumberland Sound.

Leda buccata - Hancock, 1846, Cumberland Sound; Reeve, 1855, Arctic Archipelago; Packard, 1891, Labrador; Richards,

1941, James Bay.

Leda jacksoni - Gould, 1870, Labrador; Bush, 1882, Labrador; Packard, 1891, Labrador; Dall, 1924, Archipelago.

New records: Canadian Archipelago (Coll. of NMC and FRBC), Eastern Canadian Arctic (Coll. of FRBC). (App. I.).

Nuculana pernula is widely distributed and abundant. Two subspecies and many local races of this variable species have been found in the Canadian Arctic.

Canadian Archipelago: The single subspecies found in the Archipelago is N. p. costigera Leche. The specimens are figured in Pl. 3, figs. 9-11. It is characterised by its elongated, narrow shape and slender, upturned rostrum, which is twice as long as the anterior part of the shell. Its periostracum is thin, ribbing irregular. Supporting rib on the inner side of the shell is long, turned downward. There are 14-16 anterior and 16-19 posterior teeth, long and slender. Resilifer long, tightly pressed to the posterior hinge plate. Angle between the anterior and posterior parts of hinge plate is obtuse (Pl. 3, fig. 10). Three specimens from Prince Patrick Island (Sta. 10-55, NMC) have the following dimensions:

l	h	w	h/l	w/l
29.0	13.0	6.5	0.44	0.21
29.0	14.5	7.4	0.50	0.25
25.2	11.0	6.5	0.40	0.25

Foxe Basin, Foxe Channel and northern Hudson Bay: The species is abundant. Molluscs are large with well formed shells. There have been found specimens of N. p. costigera, N. p. buccata and the forms intermediate between these two. The first subspecies occurs mainly in Foxe Basin and Foxe Channel, but in Hudson Bay occur also specimens of N. p. buccata. The last is an expanded and high form, with rostrum short and straight. The sculpture is strong, coarse, regular. The dark radial stripe of fine ribbing on the anterior part of the shell is well developed. Crossing of this radial ribbing with the longitudinal basic sculpture produces a fine, meshlike design (Pl. 4, fig. 17). Teeth strong, short, crowded. Hinge plate robust, posterior and anterior parts meet at the narrow angle (Pl. 3, fig. 13).

Dimensions of specimens of N. p. buccata from Foxe Basin (Sta. 901, FRBC) were as follows:

l	h	w	h/l	w/l
23.2	12.5	8.0	0.53	0.34
22.0	12.7	7.2	0.57	0.32
20.5	11.7	7.9	0.57	0.35
17.8	10.0	6.0	0.56	0.30

Southern Hudson Bay: All specimens of N. pernula are small, shells thin and brittle; the subspecies hardly can be recognized. Measurements of the larger specimens (Sta. 59-68, FRBC) are as follows:

l	h	w	h/l	w/l
20.0	10.0	5.5	0.45	0.25
17.0	9.0	4.2	0.45	0.25
15.0	8.0	4.2	0.50	0.27

Labrador: The single form occurring at Labrador is N. p. buccata with features peculiar to the subspecies clearly developed (Pl. 4, figs. 15-17). Its shell is extremely robust, very rough periostracum and strong crowded teeth. Measurements of specimens of this type (USNM 455394, Labrador, Bryant; USNM 455392, Labrador, Bartlett) are as follows:

l	h	w	h/l	w/l
30.3	16.7	10.9	0.51	0.36
29.0	16.0	10.5	0.55	0.36
24.0	13.3	8.7	0.55	0.36
22.0	12.0	8.2	0.55	0.37

At Labrador was found a peculiarly small (up to 20 mm. long) but very high and wide N. buccata var. brevis Müller (Pl. 3, figs. 12-14). (USNM 455390, 95821; MCZ 5470). It has been identified as N. buccata Steenstrup by Verill and Packard. However it differs from the Labrador forms of N. p. buccata by being much shorter, broader, almost triangular. It has a strongly arcuate lower margin, short rostrum and wide escutcheon delimited by two strong ridges. Teeth short and crowded, hinge plates meet at 90°. Indices h/l (0.60)

and w/l (0.40) of 20 specimens were the highest in this species in the Canadian Arctic.

Discussion. Two main forms of N. pernula have been found in the Canadian Arctic, N. p. costigera and N. p. buccata, each of them occurring in their own areas, but joined by the intermediate populations in the neighbouring zone. N. p. costigera occurs in the area of the arctic waters. The intermediate forms occur in the zone of overlap of these areas and in Hudson Bay. In the last basin the shells of both subspecies degenerate. Their indices become similar and the subspecies can be separated only by the peculiar outlines of their shells and by the structure of the periostracum. Thus in the Canadian Arctic there is a succession of subspecies of Nucalana pernula in the latitudinal direction: N. p. costigera occupies the most northern region; to the south it is replaced by N. p. buccata, which in its turn is replaced southward by N. pernula Muller. The last is a boreal form which occurs in the western North Atlantic from Nova Scotia to Massachusetts. The specimens from its area of distribution (Gulf of Maine) are small, light green, thin and brittle. (See Coll. No. 451297, Newport Cove; 451410, Schowdie Harbour; 451352, Bar Harbour; 462660, Frenchman Bay - Coll. MCZ; 73022, 73073, 15977 of the U.S. Fish Commission, and others.)

Figure 1. H/L and W/L indices of Nuculana pernula (Müller) in the Canadian Arctic and N.W. Atlantic.

Observation limits of variation: thin line.
Mean: transverse line.
$\pm \hat{\sigma}$: thick bar.

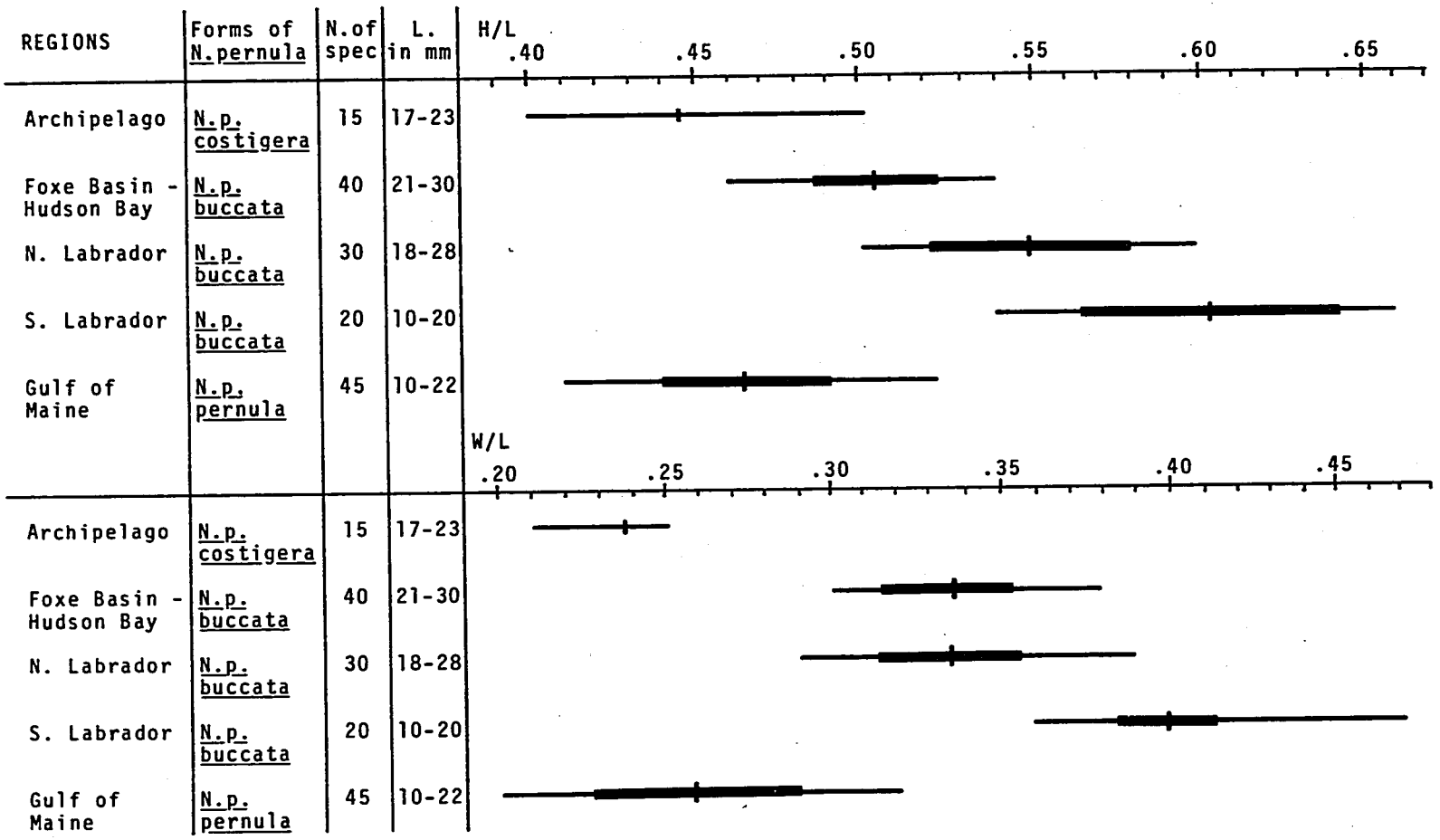

REGIONS
Forms of N.pernula
N.of spec
L. in mm
H/L
.40
.45
.50
.55
.60
.65
Archipelago
N.p. costigera
15
17-23
Foxe Basin - Hudson Bay
N.p. buccata
40
21-30
N. Labrador
N.p. buccata
30
18-28
S. Labrador
N.p. buccata
20
10-20
Gulf of Maine
N.p. pernula
45
10-22
W/L
.20
.25
.30
.35
.40
.45
Archipelago
N.p. costigera
15
17-23
Foxe Basin - Hudson Bay
N.p. buccata
40
21-30
N. Labrador
N.p. buccata
30
18-28
S. Labrador
N.p. buccata
20
10-20
Gulf of Maine
N.p. pernula
45
10-22

Figure 1

Dimensions of some of these specimens were as follows:

l	h	w	h/l	w/l
19.0	9.0	3.8	0.47	0.21
10.0	4.0	2.2	0.48	0.22
15.0	7.0	3.6	0.40	0.24
14.0	6.0	2.8	0.42	0.20
11.0	5.0	3.0	0.46	0.27

The largest of the specimens examined was 23 mm. long. Indices h/l and w/l of 40 specimens were 0.46 (0.41-0.52) and 0.26 (0.20-0.32) respectively.

The subspecies of N. pernula s. lato occurring in the Canadian Arctic differ in many respects; one of them is the difference in the relation of the height and width of the shell to its length. In Fig.1 are presented w/l and h/l ratios of N. p. costigera and N. p. buccata from the Canadian Arctic and those of N. pernula from Massachusetts. The data show that a trend in the latitudinal direction exists in these ratios. Ratios are the lowest in N. p. costigera; they are larger in N. p. buccata, and the shells themselves are larger. The highest are the ratios in N. p. var. brevis, whose shells are the smallest. Indices of N. pernula are the smallest, and similar to those of N. p. costigera. The similarity of indices does not, however, indicate that these subspecies are identical. They differ in outlines, in structure of teeth, periostracum, etc.; they occur in ecologically and zoogeographically different zones. N. p. costigera

occurs in the coldest regions of the Arctic: in the Archipelago, East Greenland, and in Siberian seas. In its distribution it is bound to the area of polar water. N. p. buccata has been found in the area of mixed waters of the subarctic zone in the Eastern Canadian Arctic and in Western Greenland. This subspecies is possibly endemic in the Northwest Atlantic because the specimens occurring in the Barenz and in the White sea differ from Canadian specimens and are regarded as N. pernula f. typica by Filatova (1948, pl. CV, fig. 4).

N. pernula s. lato is a panarctic-boreal species. It has produced several subspecies in the polar, subarctic and the boreal zone of the Atlantic. Its area is possibly interrupted in the Pacific sector of the Arctic.

Nuculana minuta (Fabricius 1776)

Arca minuta Fabr. 1776, Fauna Groenl., p. 414.

Leda minuta - Ockelmann 1958, pl. 1, fig. 10.

Distribution in the Canadian Arctic: Map 4.

Published records:

Arca minuta - Gray, 1824, Eastern Canadian Archipelago.

Leda minuta - Hancock, 1846, Cumberland Sound; Smith, 1877, N.W. Baffin Bay; Packard, 1866-69, Labrador; Halkett, 1898, Hudson Bay; Whiteaves, 1882-84, Hudson Strait; Whiteaves, 1901, Hudson Bay; Packard, 1891, Labrador; Bush, 1883, Labrador; Rodger, 1892-95, Hudson Strait; Greig, 1909, S.W. Archipelago; Backer, 1919, N.W. Baffin Bay; Dall, 1924, Eastern Canadian Arctic; Johnson, 1926, Labrador; Thorson, 1951, N.W. Baffin Bay; Ellis, 1960, N. Baffin Land; Wagner, 1968, Hudson Bay.

New records: Archipelago and Canadian Eastern Arctic (coll. FRBC); Southeastern Hudson Bay (coll. NMC). (App. I.)

N. minuta occurs throughout the Canadian Arctic, but is rare in the central part of the Canadian Archipelago. Its southern boundary is at Massachusetts. Two forms of this species have been recognized, a tumid and a flattened one, both of them found in the Canadian Arctic. The distribution

of these forms is not well known. The largest specimen of N. minuta from the Canadian waters measured 16.5 x 8.5 x 5.7 mm.

Distribution outside the Canadian Arctic:

Greenland: The entire shore of West Greenland, southern shores of East Greenland. Iceland.

Eurasian Arctic Seas: Southern shores of the Barenz Sea, rare in Kara Sea, absent eastward; reappears in the Chuckcha and Bering Seas; present in the Bofort Sea.

N. minuta is a subarctic-boreal species with its area disrupted in high-arctic regions.

Genus Yoldia Møller 1842

Yoldia hyperborea hyperborea (Loven) Torell 1859

hyperborea Ockelmann 1954

Pl. 5, Fig, 19-20

Yoldia hyperborea hyperborea (Loven) Torell 1859, p. 149, Pl. 2, Fig. 6 a-b.

Yoldia hyperborea hyperborea Ockelmann 1954 Pl.1, Fig. 1; Pl. 2, Fig. 3.

Distribution in the Canadian Arctic: Map 5.

Published records:

Nucula sapotilla - Reeve 1855, Wellington Channel.

Yoldia hyperborea - Grieg 1909, Arctic Archipelago.

Yoldia limatula - Dall, 1919, Arctic Archipelago.

Yoldia limatula - Dall 1924, Arctic Archipelago.

Yoldia hyperborea - Ellis 1960, Foxe Basin.

New records: Archipelago, Foxe Basin, Hudson Bay, Ungava Bay (coll.of FRBC). (App. 1).

The revision of this species by Okelmann (1954) greatly contributed to our knowledge of its intraspecific variation and of the distribution of lower taxa in the Arctic.

In the Canadian Arctic Y. hyperborea has been recorded as Y. sapotilla by Reeve 1855, and as Y. limatula

by Dall 1924 (fide Ockelmann 1954). However, neither of these two species have been found north of the Strait of Belle Isle.

All specimens of Y. hyperborea from the Canadian Arctic belong to subspecies hyperborea Ockelmann 1954. They are elongate-ovate and high; the broad anterior and posterior parts end in broad sinuations at their lower margins. The posterior margin meets the upper margin almost at right angles (pl. 5, fig. 19-20).

Dimensions of a few specimens of this subspecies from the Canadian Arctic were as follows:

	l	h	h/l	f/b
Foxe Basin, Sta. 715, FRBC	25.0	15.0	0.60	1.38
	24.2	15.5	0.64	-
	20.8	14.0	0.67	-
Hudson Bay, Sta. 613, FRBC	32.0	17.0	0.52	1.38
	27.0	14.0	0.50	1.36
Ungava Bay, Sta. 334, FRBC	42.0	22.0	0.52	1.28
	17.0	9.0	0.47	1.30

The largest specimens from the Canadian Arctic were 42 mm. long, the highest number of teeth was 32/25 and usually 15/11 to 29/21. Ratio of the number of teeth in front and behind of umbo (index f/b) varied from 1.28 to 1.38; h/l ratio from 0.47 to 0.67.

Map of distribution (5) shows that Y. h. hyperborea has been found in the eastern part of the Archipelago and throughout the Canadian Eastern Arctic, in the area of distribution of mixed waters.

Distribution outside the Canadian Arctic:

Greenland: Middle and southern shores of West Greenland; south of East Greenland. Western shores of Iceland.

Eurasian Arctic Seas: In all the Arctic seas of Eurasia.

Y. hyperborea s. lato is a panarctic species of circumpolar distribution.

Yoldia myalis (Couthoy 1838).

Nucula myalis Couthoy 1838-1839, Bost. J. Nat. Hist., v. 2, pl. 3, fig. 7.

Yoldia myalis Ockelmann, 1954, pl. 2, fig. 5.

Distribution in the Canadian Arctic: Map 6.

Published records:

Yoldia myalis - Whiteaves, 1901, Hudson Strait.

New records: None.

The area of Yoldia myalis is disrupted in the high-arctic region of North America. It occurs in the Pacific northern area from the Point Barrow to Puget Sound and in the Atlantic from Hudson Strait to the Bay of Massachusetts.

This is a subarctic species probably of the Pacific origin, rare in the Canadian Arctic.

Yoldiella tamara (Gorbunow, 1946).

Ledella tamara Gorbunow 1946, Tr. Dreif. St., v. 2, table 3, fig. 4, a, b.

Distribution in the Canadian Arctic: Map 8.

Published records:

Ledella tamara - Wagner, 1964, shelf of N.W. Archipelago.

New records: None.

This small species (L.-3.3 mm, H-2.4 mm) was described by Gorbunow from the 3700 mtrs deep station in the Beaufort Sea. It was collected in the Canadian western Arctic at the depth of 400-500 mtrs.

Y. tamara is a higharctic deep water species, emerging on the Canadian western shelf.

Genus Yoldiella Verill and Bush 1897

Yoldiella intermedia (M. Sars 1865)

Pl. 5 , fig. 2I.

Portlandia intermedia M. Sars, 1865, p. 38, figs. 92-96.

Portlandia intermedia - G. O. Sars, 1878, pl. 4, figs. 9 a-b.

Portlandia intermedia - Ockelmann 1958, pl. 1, fig. 12.

Distribution in the Canadian Arctic: Map 8.

Published records:

Portlandia intermedia - Thorson 1951, off Lancaster Sound.

New records: Arctic Archipelago (Coll. FRBC and NMC) (App. I.).

Few specimens of this species have been found in the Archipelago, one in Hudson Bay. The depth of collection was over 100 ft.

Distribution outside the Canadian Arctic:

Greenland: West Greenland fjords of the Umanak-Utah and Upernavik districts. Single specimens have been found off Julianehaab.

East Greenland: In shallow and deep waters of northern shores; it has been taken only at the greater depth

of 200-600 meters in the south. Larger specimens are found in the fjords.

Iceland: At greater depth along the northern shores.

North Eastern Atlantic: Y. intermedia reaches south to Waranger Fjord, Norway; also at Bohuslan, Sweden.

Eurasian Arctic Seas: Abundant in the colder and deeper regions of the Barents and Kara Seas; on the slopes of the Eurasian shelf north from 75°N. Absent in the Chuckchi Sea.

Western North American Arctic: No records.

Y. intermedia is a high-arctic deep water species now retreating from the southern boundaries of Greenland, Iceland, and Norway, and confined to the coldest regions of the Arctic. Here it grows to a larger size, and is called Y. intermedia var. major of Leche (1878, p. 24).

Yoldiella lenticula (Møller 1842)

Pl. 5, fig. 23.

Portlandia lenticula Møller 1842, Index moll. Groenl.

Portlandia lenticula - G.O. Sars, 1878, pl. 4, fig. 10 a-b.

Portlandia lenticula - Ockelmann, 1958, pl. 1, fig. 12.

Distribution in the Canadian Arctic: Map 7.

Published records: From the Canadian Arctic - None.

New records: Archipelago (Coll. NMC and FRBC); Hudson Bay, James Bay, Richmond Gulf (Coll. FRBC). (App. I.)

Y. lenticula has been found in the Archipelago (Slidre Fjord, Ellesmere Land, 168 ft., and Creswell, Sommerset Island), and also in South Eastern Hudson Bay. It occurs in mud with an admixture of pebbles at a depth of 10-130 meters and submerges in the North Western Atlantic. Verrill and Bush (1897) have found it in deep water off Cape Cod and suggest that this is the southern boundary of its area.

Distribution outside the Canadian Arctic:

Greenland: Off the middle and southern shores of West Greenland and in the middle part of East Greenland.

Eurasian seas: Coast of Barenz Sea, eastward to the Laptev Sea. Mainly in the deep waters north of 75°N and in the trenches of the Kara Sea.

It is possible to expect that in reality within the large area of Y. lenticula there may be two species (or a southern subspecies) - one of them in the Arctic. At present Y. lenticula is considered a panarctic species distributed in the Atlantic sector of the Arctic.

Yoldiella frigida (Torell 1859)

Pl. 5, fig. 22.

Yoldia frigida Torell 1859, Bidrag Molluskfauna, pl. 1, fig. 2.

Distribution in the Canadian Arctic: Map 7.

Published records from the Canadian Arctic: Wagner, 1964, polar shelf.

New records: Canadian Archipelago (Coll. NMC, FRBC).

Y. frigida has been found in Mould Bay, Prince Patrick Island (Sta. 62-2082, FRBC - 1 specimen).

Y. frigida reaches Cape Cod in the deep waters of the N.W. Atlantic.

Distribution outside the Canadian Arctic:

Greenland: Off the shores of West Greenland from 70° to 75° N., in East Greenland in Scoresby Sound and Franz Josef Fjord.

Iceland: Off the northern and eastern shores.

Eurasian Arctic Seas: Shores of the Barenz and Kara Sea and off East Siberian Islands, in deep waters in the Laptev Sea.

Yoldiella frigida is a high arctic Atlantic speices. It is more restricted in its southern distribution than is usually believed (see Ockelmann 1958).

Genus Portlandia Mørch 1857

Portlandia arctica (Gray 1824)

Pl. 6, figs. 25-30; Pl. 7, figs. 31-33.

Nucula arctica Gray 1824, Shells.
In: Suppl. to App. Parry Nat. Hist.
No. 10, Zoology.
Nucula siliqua - Reeve 1855, Pl. 111,
figs. 3 a-b.
Nucula portlandica - Reeve 1855,
Pl. XXXIII, figs. 44 a-b.
Portlandia arctica - G.O. Sars 1878,
Pl. 4, figs. 7 a-b.
Yoldia arctica - Mossevich 1928,
Pl. 1, figs. 1-5.

Distribution in the Canadian Arctic : Map 9, 10.

Published records:

Nucula arctica Gray 1824, Canadian Archipelago.

Nucula portlandica Reeve 1855, Canadian Archipelago.

Nucula siliqua Reeve 1855, Canadian Archipelago.

Yoldia arctica - Sutherland, 1852, Barrow Strait.

Portlandia glacialis - Whiteaves, 1901, Richmond Gulf.

Yoldia arctica - Grieg, 1909, Canadian Archipelago.

Portlandia arctica - Ockelmann, 1958, N. Baffin Bay.

Portlandia arctica - Ellis, 1960, Foxe Basin.

New records: Canadian Archipelago (Coll. FRBC, NMC); Foxe Basin, Hudson Bay (Coll. FRBC); Labrador (Coll. USNM).

Portlandia arctica occurs throughout the Canadian Arctic region. It is living in the epicontinental basins from a depth of 10 meters down to the deepest bottom, and submerges to greater depths in the western Archipelago, Hudson Strait, Labrador sea, and the Gulf of St. Lawrence.

Three forms of this species occur in the Canadian Arctic: P. a. arctica (Gray 1824), P. a. var. portlandica (Hitchcock), and P. a. siliqua (Reeve 1855). (Maps 9, 10).

Canadian Archipelago: Two forms of this species have been found in basins of the Canadian Archipelago: P. a portlandica occurring in the shallow water at river mouths and off glaciers, and P. a. siliqua, found in deeper waters of the eastern channels and in Baffin Bay (maps 9, 10).

P. a. portlandica is a low, narrow form with light green, soft periostracum. It seldom exceeds a length of 15 mm. The h/l and w/l ratios are low: h/l varies from 0.52 to 0.62 (M=0.57); w/l varies from 0.31 to 0.40 (M=0.35) (see data on fig. 2x). P. a. siliqua is a large, tumid form with stout, short tip. Periostracum brown or dark green, rough, with distinct radial striation formed by the rows of small dots. Dimensions and the h/l and w/l ratios of three shells from Wellington Channel (USNM 199561) are as follows:

l	h	w	h/l	w/l
21.7	13.0	10.0	0.60	0.46
20.4	14.5	9.6	0.60	0.40
20.0	13.5	9.5	0.68	0.48

The h/l and w/l ratios of 12 specimens varied from 0.60 to 0.64 and from 0.40 to 0.47 respectively (fig. 2). Specimens of P. a. siliqua from the Archipelago have been identified as Nucula arctica (USNM 219683); Yoldia glacialis (USNM 12299); Leda arctica truncata (USNM 199561); Leda arctica lutescens (USNM 199563).

Foxe Basin: A single and abundant form in this basin is P. a. siliqua (Pl. 7, figs. 30-32). It has been taken from depths ranging from 20 to 200 meters. Specimens are of a stature typical for this form: short, wide and robust. Hinge short with crowded strong teeth. Muscle and liver scars are distinct.

Dimensions of some specimens from Foxe Basin (Sta. 723, FRBC) and of the type specimens of Leche from Laptev Sea are almost identical:

	l	h	w	h/l	w/l
Foxe Basin:	19.0	13.0	10.0	0.68	0.57
	19.0	12.0	10.0	0.65	0.53
	15.2	10.3	7.8	0.69	0.52
Laptev Sea:	19.9	12.0	10.0	0.63	0.53
	16.0	11.0	9.0	0.69	0.56
	10.0	7.5	6.0	0.75	0.60

Figure 2. H/L and W/L indices of Portlandia arctica (Gray) in the Canadian Arctic.
Observed limits of variation: thin line.
Mean: transverse line.
: thick bar.

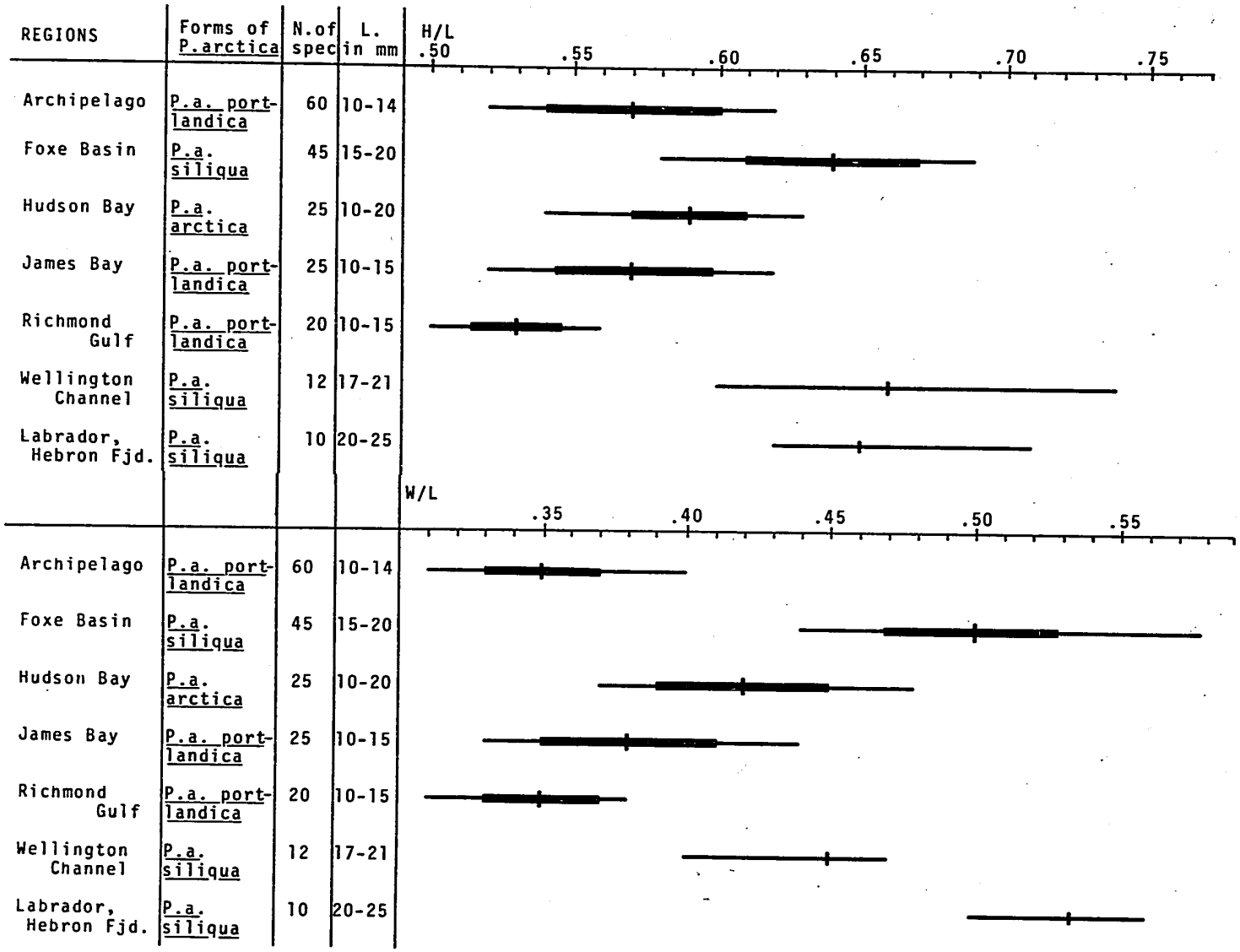

REGIONS
Forms of P.arctica
N.of spec
L. in mm
H/L
.50
.55
.60
.65
.70
.75
Archipelago
P.a. portlandica
60
10-14
Foxe Basin
P.a. siliqua
45
15-20
Hudson Bay
P.a. arctica
25
10-20
James Bay
P.a. portlandica
25
10-15
Richmond Gulf
P.a. portlandica
20
10-15
Wellington Channel
P.a. siliqua
12
17-21
Labrador, Hebron Fjd.
P.a. siliqua
10
20-25
W/L
.35
.40
.45
.50
.55
Archipelago
P.a. portlandica
60
10-14
Foxe Basin
P.a. siliqua
45
15-20
Hudson Bay
P.a. arctica
25
10-20
James Bay
P.a. portlandica
25
10-15
Richmond Gulf
P.a. portlandica
20
10-15
Wellington Channel
P.a. siliqua
12
17-21
Labrador, Hebron Fjd.
P.a. siliqua
10
20-25

Figure 2

The h/l and w/l ratios of the shells from Foxe Basin varied from 0.58 to 0.69 (M=0.64) and from 0.44 to 0.58 (M=0.50) respectively (see data Gr. No. 2, 3).

Hudson Bay: In this basin occur P. a. arctica, P. a. portlandica, and intermediate specimens (Pl. 6, figs. 23-27). P. a. arctica lives in the deeper and colder waters, P. a. portlandica in the shallower and more brackish regions. The specimens are small, rarely 15 mm. in length. The h/l and w/l ratios of 25 specimens vary from 0.54 to 0.63 and from 0.37 to 0.48 respectively (see fig. 2). The shells are light green, thin and brittle.

Richmond Gulf: The specimens of P. a. portlandica prevail; they are extremely low and narrow (Pl. 6, fig. 30). Periostracum lightly colored, valves brittle. Ratios of 20 specimens vary from 0.50 to 0.56 and from 0.31 to 0.38 respectively. These are the most extended and low shells of this species in the Canadian Arctic (fig.2).

Labrador: P. a. siliqua prevails on the shelf. The shape and size of specimens differ in almost every basin along the Labrador shores. Dominant in Hebron Fjord is P. a. siliqua, a large, angular, and darkly colored form resembling those from the eastern part of the Archipelago.

The dimensions of the shells (Hebron Fjord, depth of 100 meters, USNM 600864) were as follows:

l	h	w	h/l	w/l
25.0	15.5	12.8	0.62	0.50
24.0	16.0	13.0	0.67	0.50
23.0	14.0	12.8	0.63	0.55
22.5	15.0	12.0	0.67	0.54
21.6	15.5	11.3	0.71	0.52

The h/l and w/l ratios of 10 specimens varied from 0.62 to 0.71 and from 0.50 to 0.56 respectively (fig. 2).

In contrast to these large forms taken at Labrador were the dwarfed specimens of P. siliqua from Melville Sound (USNM 604898, 598581, 598602). The measurements of larger adults were as follows:

l	h	w	h/l	w/l
8.0	5.5	3.7	0.68	0.46
8.0	4.8	3.2	0.60	0.40
7.8	5.0	4.0	0.64	0.51
7.8	5.0	3.8	0.64	0.49
7.4	4.8	3.2	0.65	0.39

The dwarfism in this population is locally induced; the sample taken at the entrance to the Sound contains molluscs of the same shape as those taken at the head of the Sound, but of normal size.

Discussion. The relationship between the lower taxa of P. arctica has been discussed by Mossevich, 1928. He considers as a typical form of the species, P. a. arctica (Gray) that is living on the shelf of larger and saltier arctic seas. In the shallow, less saline epicontinental basins occurs P. a. portlandica Hitchcock, 1846 (P. a. portlandica Reeve 1885). These two forms are connected by the populations of intermediate specimens and produce a cline from the open shelf toward the shallower and brackish regions of inland waters. The clinal changes involve lowering and elongation of the shell and therefore indices h/l and w/l become gradually lowered. The second form of P. arctica found in the Canadian Arctic and discussed by Mossevich, 1928, is P. a. siliqua Reeve, 1885, which differs greatly from the above forms and occurs in an area of its own.

Comparing specimens of P. arctica figured on pl. 1 of Mossevich, 1928, with specimens collected in the Canadian Arctic, we see that P. a. arctica in its typical form has been taken only from the deeper station of the Northern Labrador shelf. It does not occur in the inland waters of the Canadian Arctic. The indices h/l and w/l of the shells indicate that in the inland populations there originate already clinal changes toward P. a. portlandica. These changes become more pronounced in the populations in northern Hudson Bay and increase toward James Bay and in Richmond Gulf.

These changes are indicated by the lowering of the h/l and w/l ratios. The data presented in tables show gradual decrease in both indices of the shells of P. arctica; the lowest and narrowest specimens occur in the more brackish regions in James Bay and in Richmond Gulf.

P. a. siliqua in the Canadian Arctic differs greatly from the above forms of P. arctica. Map 8 shows that it occurs in a separate area close to the shores of Baffin Bay and on the shelf of Labrador. The exception in this respect is the population in Foxe Basin which, however, may be an isolated area of that in the Archipelago. It is a large form with indices h/l and w/l higher than in previous forms of P. arctica (see fig. 2). These indices vary but little throughout the whole area in the Canadian Arctic.

Data of Mossevich, 1928, on P. a. siliqua in the Eurasian seas, and ours on the specimens from the Canadian Arctic indicate that this form is well separated from the other forms of P. arctica in the structure of its shell as well as in the area of distribution. These data indicate that P. a. siliqua Reeve is possibly a separate species, though related to P. arctica (Gray). It should be designated as Portlandia siliqua (Reeve 1885).

Distribution of P. arctica outside the Canadian Arctic:

Greenland: The species occurs presently only at the northern shores of West Greenland. Abundant in East Greenland, where P. a. siliqua is dominant.

Eurasian Arctic Seas: In all regions with the exception of the Chuckchi Sea.

Western North American Arctic: Shores of Alaska and Point Barrow. Also in Canadian Western Arctic.

P. arctica s. lato is a high arctic species with southern outposts in the deep waters in the subarctic region.

Portlandia sulcifera (Reeve 1855)

Pl. 8, figs. 34-39.

Nucula sulcifera Reeve, Acc. of the shells, App. Belcher, Last of the Arct. Voy., vol. 2, p. 397, pl. 33, figs. a, b, c.

Distribution in the Canadian Arctic: Map II.

Published records:

Nucula sulcifera Reeve, 1855, Wellington Channel.

New records: Archipelago (Coll. by FRBC and NMC). (App. I.)

P. sulcifera was described on the specimens from Wellington Channel. Since 1855 its name has been used in the literature only once, by Thorson, 1951, in discussing distribution of Yoldia intermedia M. Sars. Portlandia sulcifera usually has been regarded as species dubious.

Examination of specimens of Portlandia in new materials from the Archipelago has shown that P. sulcifera Reeve is indeed a separate species, only superficially resembling P. arctica Gray. It has been found only in the Archipelago. Specimens of P. sulcifera do not exceed 17 mm. in length. Their periostracum is light-green, soft, of a structure peculiar to the Genus Portlandia. Dimensions of four larger specimens were as follows:

Figure 3. H/L and W/L indices of Portlandia sulcifera (Reeve) in the Canadian Arctic.
Observed limits of variation: thin line.
Mean: transverse line
: thick bar.

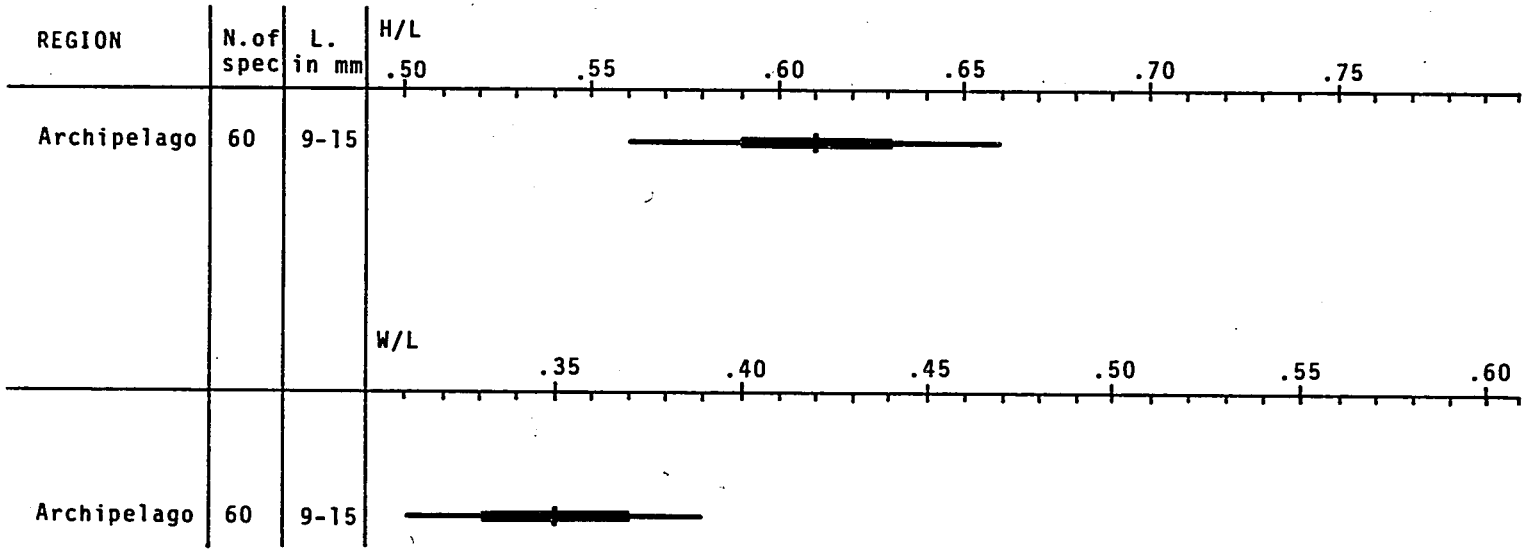

REGION
N.of spec
L. in mm
H/L
.50
.55
.60
.65
.70
.75
Archipelago
60
9-15
W/L
.35
.40
.45
.50
.55
.60
Archipelago
60
9-15

Figure 3

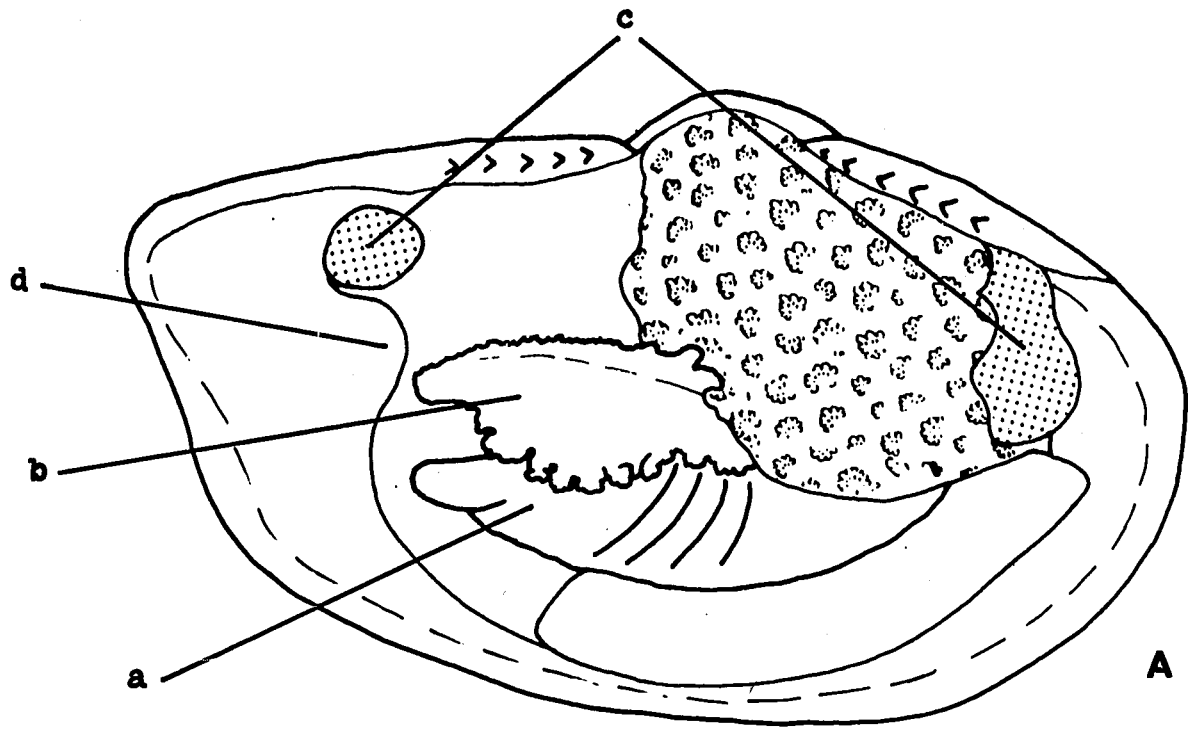
l	h	w	h/l	w/l
16.5	10.0	5.8	0.60	0.38
15.9	10.0	5.0	0.63	0.36
12.3	7.6	4.0	0.62	0.32
10.2	6.6	3.6	0.63	0.35

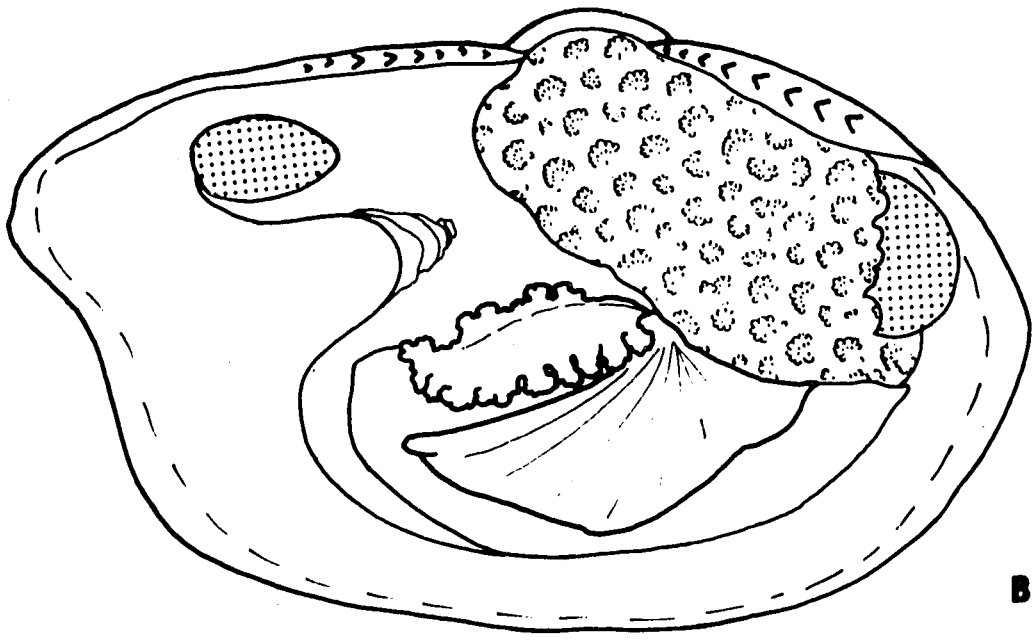
Shells of P. sulcifera are high, short and extremely narrow. h/l and w/l of 100 specimens were as follows: h/l= 0.61 (0.47-0.66); w/l= 0.35 (0.31-0.39). The shells in side view are broadly rounded and more symmetrical than in P. arctica. Central portions of valves are flattened. Their beaks are small, well defined, situated immediately anteriad the middle of the shell. (Fig. 3).

The anterior and posterior parts of the shell are almost equal in length, both broadly rounded. Anterior and posterior upper margins are equally slanted. Lower margin is straight. Anterior portion of the upper margin is straightened. Posterior part of the shell is shortened, broadly truncate. Tip short, tapering. Shell under the tip broadly rounded.

Hinge is delicate and small, both parts of it slant equally. The hinge plates are narrow; they join the resilifer at the same level. Resilifer is therefore symmetrical; its straight lower margin does not extend beyond the adjacent ends of the hinge plates. Each hinge plate has about 13 small, slender and straight teeth.

Fig.4. Some features of gross anatomy of Portlandia arctica(Gray)-A, and P. sulcifera (Reeve)-B. Note: form and position of labial palps, proboscides, muscle scars and pallial sinus. (a, b, c, d correspondingly)





Figure

The pallial line is far above the lower margin of the shell. Posteriorly it produces broad curvature parallel to that of the outer margin of the shell.

Pallial sinus short, not extending beyond the anterior margin of the posterior muscle scar.

The labial palps and proboscides are slanted toward the postero-ventral part of the shell. (fig. 4).

P. sulcifera differs in many respects from the closely related P. arctica. The main features in the structure of the shell and of the soft parts of the body, by which these two species can be separated are the following:

P. arctica (Gray). Pl. 6, 7.	P. sulcifera (Reeve). Pl. 8, 9.
Shell elongate, swollen; w/l=0.42 (0.37-0.38).	Shell short, narrow; w/l= 0.35 (0.31-0.39).
Anterior part broadly rounded, higher than the posterior, which is elongated and tapering.	Anterior and posterior parts of the shell are equally high, posterior part rounded.
From 1/3 to 1/2 of the length of posterior part of the shell tapers. Tip large, straight or up turned, situated almost at the half of the height of the shell.	Only 1/4 to 1/5 of the posterior part of the shell tapers. Tip small, well defined, straight or turned down, situated far above the middle of the height of the shell.
Posterior ridge straight or up turned.	Posterior ridge straight or down turned.
Surface smooth, periostracum coarse.	Surface sulcate, periostracum soft.
Hinge strong, teeth long.	Hinge weak, teeth small, thin,
Posterior plate joins resilifer at a level lower than the anterior plate.	Anterior and posterior hinge plates join resilifer on the same level.

Resilifer large, strong; its lower rounded margin extends below the proximal end of the anterior hinge plate.	Resilifer short, weak; its straight lower margin level with that of the proximal end of the anterior hinge plate.
Pallial line close to the lower margin of the shell. It does not produce curvature in the postero-ventral part of the shell.	Pallial line distant from the lower margin of the shell. It forms broad curvature in truncated postero-ventral part of the shell.
Sinus long, extends to, and beyond anterior margin of the posterior muscle scar.	Sinus short, does not extend beyond the anterior margin of the posterior muscle scar.

P. sulcifera and P. arctica differ in the structure of the soft body (fig. 4 a,b).

In P. sulcifera the labial palps are short, fan-like, without impression of the liver margin. The palps and proboscides are slanted postero-ventrally toward the truncate lower end of the shell.

In P. arctica the labial palps are elongated, narrow; they parallel the longitudinal axis of the shell, pointing toward its tip.

P. sulcifera differs from all other forms of Portlandia in the Canadian Arctic in size and relationship of both indices (w/l and h/l). The data on figs. 2 and 3 show that, while by the indices h/l P. sulcifera is close to the highest shells of P. arctica (those of P. a. arctica and P. a. siliqua), in respect to the w/l indices they are similar to the narrowest shells of P. a. portlandica. Therefore, in their high but extremely narrow shells, P. sulcifera stands apart from the forms of P. arctica.

P. sulcifera is a high arctic species. It has been found in the Canadian Archipelago and is endemic in it.

Family Arcidae

Genus Bathyarca Kobelt 1891

Bathyarca glacialis (Gray 1824)

Pl. 5, fig. 24.

Arca glacialis Gray 1824. Shells. In: Suppl. App. Capt. Parry Voy., 1819-20.

Distribution in the Canadian Arctic: Map 12.

Published records:

Arca glacialis Gray 1824, Wellington Channel; Dall, 1919, 1924, Canadian Archipelago.

Bathyarca glacialis (Gray)-Wagner, 1968, Hudson Bay.

New records: Canadian Archipelago (Coll. NMC and FRBC). (App. I.).

B. glacialis has been described by Gray on the basis of materials of the Parry expedition to the Canadian Arctic. This species is abundant in the Archipelago; and in deep water of the Hudson Bay. The larger specimen measured 11.3 x 7.7 x 5.6 mm. B. glacialis is a deep water species emerging into the Canadian Arctic shallow waters, where it is quite abundant at depths of 15-30 meters.

Distribution outside the Canadian Arctic:

Greenland: Off Umanak-Upernavik and Yulianehaab in West Greenland, off the entire coast of East Greenland. In

the north it occurs at depths of 6-10 meters, but submerges to depths below 300 meters off the southern part of the shores. The largest specimen from Greenland was 32 mm. long.

Iceland: Off the northern shores at 80 meters and deeper.

Eurasian Arctic Seas: In deeper waters from the Barenz Sea eastward to Vrangel Island and in the bathial of the Polar Ocean. Emerges in the East Siberian Sea.

B. glacialis is an Atlantic species occurring on the shelf in the coldest regions of the Arctic: Canadian Archipelago, East Siberian Seas and North East Greenland. Considering the high-arctic distribution of this species, it is advisable to check the southern boundaries of its area of distribution, believed to be in the Mediterranean Sea.

Bathyarca pectunculoides (Scacchi 1833)

Arca pectunculoides Scacchi, 1833, Test. Napolitani.

Arca pectunculoides - Ockelmann, 1958, p. 41-42.

Distribution in the Canadian Arctic: Map 13.

Published records:

Arca pectunculoides - Dall, 1924, Canadian Archipelago; Thorson, 1951, North-western Baffin Bay.

New records: Arctic Archipelago (Coll. NMC). (App. I.).

This species has been taken off Ellef Ringness Island and in Lancaster Sound (depth 680 meters).

According to Ockelmann, 1958, A. pectunculoides s. str. is probably absent from the Arctic regions where it is replaced by A. p. grandis Leche and A. p. septentrionalis G. O. Sars.

Distribution outside the Canadian Arctic: Trenches of Eurasian shelf seas and bathyal of the adjacent part of the Polar Ocean. Known from the Atlantic sector of the Arctic only.

Geographical variability and distribution of this species needs further investigation.

Order Pteroconchida

Family Mytilidae

Genus Mytilus Linnaeus 1758

Mytilus edulis L. 1758

Pl. 9, figs. 40-45; Pl. 10, figs. 46, 47.

Mytilus edulis Linne. 1758, Syst. Nat., ed. 10, p. 705.

Mytilus pellucidus Pennant, 1777, Brit. Zool.

Distribution in the Canadian Arctic: Map 14.

Published records:

Mytilus edulis - Stimpson, 1861, Hudson Bay; Whiteaves, 1882-84, Hudson Strait; Packard, 1867, Labrador; Bush, 1883, Labrador; Whiteaves, 1881, Hudson Bay; Dall, 1886, Ungava Bay; Halkett, 1896, Hudson Bay; Packard, 1891, Labrador; Whiteaves, 1901, Hudson Bay, Richmond Gulf; Dall, 1919, Western Canadian Archipelago; Richards, 1936, James Bay; Laursen, 1946, Ponds Inlet; Brooks Stanley, 1935, Southampton Is.; Richards, 1941, Western Hudson Bay; Ellis, 1955, Padloping Island, Baffin Land; 1960, Ponds Inlet; Lubinsky, 1958, Canadian Eastern Arctic.

New records: Hudson Bay (Coll. FRBC, NMC); Bathurst Inlet, Coronation Gulf (Coll. Geol. Survey of Canada). (App. I.).

Mytilis edulis L. occurs in the Canadian Eastern Arctic southward from Foxe Channel, and Padloping Island. It has been collected in Pond Inlet by Oughton and Craig (personal communication), Laursen (1946) and Ellis (1961). The last author found near the Salmon River, Pond Inlet accumulations of shells with well preserved flesh. Though established colonies have not been found, Ellis states that "there exists a distinct possibility of the intertidal populations of Mytilis edulis in this area". In the Western Canadian Arctic Mytilis has been found in Dolphin and Union Strait (Dall, 1919); in Bathurst Inlet (Geological Survey of Canada) and off the mouth of the Mackenzie River (FRBC). Living M. edulis has not been found in the Central Archipelago between Kent Peninsula, Ponds Inlet and Foxe Channel. Southern boundary of M. edulis in the North-West Atlantic is at Cape Hatteras.

In the Canadian Arctic M. edulis varies greatly in size and is, on the average, smaller than in the Atlantic. The largest specimens, 80 mm. long, have been found in Ungava Bay (Lubinsky, 1958) and 70 mm. long, at the Belcher Islands (Lubinsky, 1958, 1967).

Hudson Bay: M. edulis is remarkably abundant off the Belcher Islands. Their shells are dark brown or black (pl.9). Valves thin and transparent in all young and in many adult specimens. The pattern of blue and whitish rays is distinct, ochra-red spots are often present (pl. 10). The

surface of the shell is finely striated. The size and h/l and w/l ratios of specimens from the Belcher Islands were as follows:

	N. of sp.	length	h/l	w/l
Sta. 60-6, L. 2 FRBC	26	12-70	0.46-0.55	0.34-0.47
Sta. 60-8, L. 3 FRBC	17	22-50	0.47-0.58	0.38-0.46
Shool Site Mr. Freeman Coll.	35	20-47	0.48-0.59	0.37-0.47

The oldest specimens were 15-17 years old.

Richmond Gulf: M. edulis were collected by Johannsen, 1920, at a depth of over 10 feet on sandy bottom with some vegetation. Length of two to four year old specimens did not exceed 15 mm. Older specimens were not found. The colonies possibly could not establish themselves on this type of bottom and survive temporarily. Well established colonies have been found on the rocky northern shores of Richmond Gulf. Their shells are dark-blue with bent, heavy, battered shells. The largest was 35 mm. long.

James Bay: (Pl. 9). All Mytilus in the Bay are of the same type: small, shells translucent, light-tan colored. They are rounded, side ridges obsolete, beaks low, situated far from the anterior end of the shell and above it. Growth lines are crowded but clearly visible. The shells are low and extremely narrow. The h/l ratio of 40 specimens was 0.49 (0.43-0.53); w/l ratio was 0.33 (0.29-0.43).

Cumberland Sound: Few adult specimens with heavy black shells and scale-like growth marks were collected by FRBC. The largest measured 56.0 x 28.5 x 23.0 mm. and was 13 years old.

Pond Inlet: Specimens collected by Dr. Ellis are black, small, shell strong with scale-like growth marks. Their dimensions were as follows:

l	h	w	h/l	w/l	age
67.7	33.0	22.0	0.49	0.29	14
20.0	10.0	7.2	0.50	0.36	5
14.7	9.0	6.0	0.61	0.40	4
6.0	3.5	2.3	0.59	0.38	3

Discussion: Populations of M. edulis in the Canadian Arctic contain many specimens with the radial pattern peculiar to M. pellucidus Pennant 1777 (Lubinsky 1958; Pl. IO of this paper). One has to agree with Dodge, 1952 (p. 214) that M. edulis of Linne 1758 is M. pellucidus Pennant 1777. But it is difficult to regard M. pellucidus as a subspecies of M. edulis (Dodge, ibid.): presence of the radial pattern is observed in thinner translucent shells and is concealed in thicker ones. Thickness of shells is subject to variation in connection with local conditions. Although specimens with transparent shells and the radial pattern occur singly throughout the Atlantic area of M. edulis, the populations in south-eastern Hudson Bay and in James Bay

consist almost entirely of specimens with small, translucent shells with clear radial pattern. Changes in shells of M. edulis from the normal type toward the pellucid type in James Bay develop gradually and are of clinal type: molluscs in James Bay are small, with smoothened outlines, light and translucent. My investigations have shown that reduction in size is caused by decrease of growth rates (.). This cline extending into James Bay is the result of unfavorable environment for M. edulis. The water exchange is lowered; brackishness of water increases, and may prevent the whole measure of Ca deposition in the shell. Food may be scarce because there may be changes in plankton composition. Increase in temperature of the water in summer and the extension of the growing season may not compensate for other depressing factors. In these conditions growth slows and the life span decreases: the great majority of the adults were eight years old. The cline is situated in James Bay and extends along the south-eastern shores of Hudson Bay to Port Harrison within the area of distribution of brackish waters moving out of James Bay.

Mussels in the Pond Inlet region are small, but their shells are thick and heavy, with clear-cut marks of arrested growth. The color is black-brown. The largest specimen was 17 years old.

Distribution outside the Canadian Arctic:

Greenland: Abundant at the southern shores of West Greenland. Isolated colonies occur up to Thule district. Southern shores of East Greenland.

Iceland: "Occurring in abundance all around the country" (Madsen, 1949).

Eurasian Arctic Seas: Along the southern shores of the Barents Sea and in the White Sea. The last small colonies in this area occur at the western shores of the Kara Sea at the promontorium Jugorsky Shar.

Pacific sector of the Arctic: Chukchi Sea, Alaska, Pt. Barrow.

Canadian Western Arctic: Mouth of Mackenzie River to Bathurst Inlet.

The largest size in the Arctic was: 83 mm. in East Greenland, 81 mm. in Canadian East Arctic, 50-70 mm. in Eurasian Seas.

Mytilus edulis L. is a boreal subarctic species. It penetrates into the Arctic within the zone of the offshore currents of the Atlantic and Pacific subarctic waters. It occurs also in the warmed-up layers of the polar waters.

Genus Dacridium Torell 1859

Dacridium vitreum (Moller, 1842)

Modiola vitrea Moller, 1842, Kroyer's Naturh. Tidskr., vol. 4, p. 92.

Dacridium vitreum - Ockelmann, 1958, Pl. 1, fig. 19.

Distribution in the Canadian Arctic: Map 15.

Published records:

Dacridium vitreum - Ellis, 1960, Pond Inlet, N. Baffin Land.

New records: Canadian Archipelago (Coll. FRBC), South Eastern Hudson Bay, James Bay (Coll. NMC).

This tiny species has been taken in only two areas in the Canadian Arctic, but it could have been easily overlooked because of its small size and similarity to juvenile Mytilus edulis. It occurs at depths of 6 - 2,434 fathoms on muddy sediments.

The distribution of this species in the N.W. Atlantic is very little known. It has been found by Whiteaves in the Gulf of St. Lawrence in 200-600 meters and by Verrill off Nova Scotia at 200 metres. It occurs in the North Atlantic down to 850 metres (Clarke, 1962).

Distribution outside the Canadian Arctic:

Off the middle shores of both East and West Greenland, and off the eastern and southern shores of Iceland.

Eurasian Arctic Seas: In the deepest and coldest regions and in the Arctic Ocean northward from 75°N.

Not known from the Western North American Arctic.

Ockelmann 1958 has shown that within the area of distribution of this species in the N. Atlantic there occur four different forms of Dacridium which Ockelmann regards as separate species. He states that D. vitreum s. str. is a panarctic species in the Atlantic sector of the Arctic. The Canadian Archipelago is probably its western boundary of distribution.

Genus Musculus Röding

Musculus corrugatus (Stimpson 1851)

Pl. 11, Figs. 48-53.

Mytilus corrugatus Stimpson 1851, Shells of New England, p. 12.

Modiolaria corrugata - Gould, 1870, fig. 491.

Modiolaria corrugata - Jensen, 1912, pl. 2, figs. 7 a-d.

Distribution in the Canadian Arctic: Map 16.

Published records:

Modiolaria corrugata - Packard, 1862, 1891, Labrador; 1883, Labrador; Dall, 1919, Arctic Archipelago; Dall, 1924, Burwell; Ellis, 1960, Pond Inlet.

New records: Canadian Central and Eastern Arctic (Coll. FRBC). (App. I.). Canadian Eastern Arctic (Coll. NMC).

M. corrugatus is rare in the Candian Arctic. It has not been found in the central Archipelago and in N.W. Hudson Bay. Southward it reaches Cape Cod.

This species attains a size of 20 mm. in Foxe Basin, and is more abundant there (P. 11, figs. 48, 49). In Hudson Bay few specimens attain a length of 15 mm.

The northern specimens are dark coloured, external sculpture very distinct (Pl. 11, figs. 48, 49). In Hudson Bay

M. corrugatus are small, light coloured, external features smoothed (Pl. 11, fig..53). In James Bay even the large specimens are less than 8 mm. long and are deformed (Pl. 11, fig. 53).

Distribution outside the Canadian Arctic:

Greenland: Rare off western shores; absent in East Greenland and in Iceland.

Eurasian Arctic Seas: In all Arctic seas but rare everywhere.

Western American Arctic: Shores of Alaska, Canadian Western Arctic, S. E. Archipelago.

M. corrugatus is a panarctic-boreal circumpolar species, avoiding high arctic regions.

Musculus discors (Linne 1767) var. laevigatus et var. substriatus (Jensen 1912)

Pl. I2, figs. 54-59.

Mytilus discors Linne, 1767, ed. 12, p. 1159.

Modiola laevigata et v. substriata Gray, 1824, Parry Voy., Nat. Hist. Suppl. to App., p. 244-245.

Modiolaria discors var. laevigata Jensen, 1912, pl. 3, figs. 4 a-b.

Modiolaria discors var. substriata Jensen, 1912, pl. 3, figs. 5 a-c.

Distribution in the Canadian Arctic: Map I7.

Published records:

Modiola laevigata with var. substriata Gray, 1824, Canadian Archipelago; Hancock, 1846, Cumberland Sound.

Modiolaria laevigata - Reeve, 1855, Wellington Channel; Packard, 1862, Labrador; Packard, 1891, Labrador; Smith, 1877, N. Baffin Bay; Whiteaves, 1882-84, Hudson Strait; Pfeiffer, 1886, Cumberland Sound; Dall, 1886, Ungava Bay; Grieg, 1909, N. Baffin Bay; Laursen, 1937, Ponds Inlet; Hudson Bay; Ellis, 1960, Foxe Basin.

Modiola discors - Sutherland, 1852, N. Baffin Bay.

Modiolaria discors - Bush, 1883, Labrador; Packard, 1891, Labrador; Whiteaves, 1901, Hudson Bay; Brooks 1935, Hudson Bay.

Modiolaria substriata - Baker, 1919, N. Baffin Bay; Dall, 1924, Burwell.

Modiolaria laevis - Dall, 1924, Ponds Inlet; Burwell.

Musculus laevigatus - Dall, 1919, Dolphin and Union Strait.

Musculus substriatus - Johnson, 1926, Labrador.

New records: Canadian Central and Eastern Arctic (Coll. FRBC and NMC). (App. 1.).

Musculus discors in both its forms, f. laevigata and f. substriata, is common and abundant in the Canadian Arctic. In the North Western Atlantic it reaches Cape Cod. It usually occurs in waters up to 50 meters deep, but occasionally has been taken from greater depths. Specimens in Foxe Basin, Baffin Bay and Hudson Bay are large, up to 38 mm. long, but those from James Bay attain a length of only 12 mm. (Pl. I2, fig. 56).

In James Bay the small, brittle shells with smoothened outlines and ribbing resemble Musculus discors L. from boreal regions (Pl. I2, fig. 58,59).

The dimensions of some specimens from the Canadian Arctic are as follows:

	l	h	w	h/l	w/l
Foxe Basin, Sta. 723, FRBC	33.0	21.0	15.0	0.64	0.45
	29.0	19.0	16.0	0.65	0.55
	28.0	18.0	15.0	0.64	0.53
Sta. 716, FRBC	38.0	24.0	16.0	0.65	0.42
Frobisher Bay, Sta. 331, FRBC	37.0	23.0	18.0	0.62	0.49
	35.0	22.0	15.0	0.63	0.43
James Bay, Sta. 59-11, FRBC	11.0	7.0	5.0	0.64	0.45
	7.0	5.0	3.5	0.72	0.50
	6.5	5.0	3.0	0.77	0.46
Sta. 50-15	8.0	6.0	3.0	0.67	0.37
	8.0	5.0	3.0	0.63	0.37

H/l ratio of 25 specimens from Foxe Basin was 0.63 (0.59-0.67). In James Bay it was 0.70 (0.60-0.78)

Distribution outside the Canadian Arctic:

Greenland: Middle and southern shores of Western and Eastern Greenland; off the entire coast of Iceland.

Eurasian Seas: In all the Eurasian Arctic region. Southward from Lofoten the northern forms are replaced by Musculus discors s. str.

American Western Arctic: Shores of Alaska and of the Canadian Western Arctic.

Discussion. This species has been described as "Modiolaria laevigata and var. substriata" by Gray 1824, on specimens from the Canadian Archipelago. Because of its similarity with M. discors (Linne 1767) described from the boreal zone, the relationship between these species has been often discussed. Jensen, 1912, was the first to point out that "the true Modiolaria discors Linne does not occur at Greenland, Jan Mayen or Iceland. The species is represented here by "Modiolaria laevigata Gray" and "Modiolaria substriata Gray", which I do not consider separate species, but varieties of a species which also embraces "Modiolaria discors Linne". The last name has the prior right by age and must consequently have the advantage in the designation of the species." (Ibid. p. 57).

Our studies have shown that the opinion of Jensen is correct. M. discors s. str. does not occur in the Canadian Arctic. There occur gradual changes in molluscs in the latitudinal direction from the molluscs of type described by Gray toward the southern specimens of the type of M. discors of Linne. Similar changes have been observed in the eastern North Atlantic.

Relationship of the two forms of M. discors: M. discors var. laevigata and M. discors var. substriata of Jensen 1912, has not been studied. The two varieties differ in the development of the ribbing and in the outlines of the shells, which are correlated; shells with more prominent

ribbing are lower, and vice versa. The characters peculiar to each form develop with age. Young specimens are intermediate, the intermediate adults are rare. The two forms occur throughout the whole area of the species. Plate 12 represents forms of this species from England (sample 55164, Acad. of Natural Sciences, Philadephia).

Both forms can be found enclosed in the same "nest", a capsule made of the threads of byssus. This indicates that they interbreed, and thus belong to the same species.

It seems that M. discors L. should be regarded at present as a polymorphic species. The nomenclature applied should be that of Jensen 1912.

The species is more abundant and attains larger size in northern regions and decreases in the boreal zone.

M. discors L. is a circumpolar panarctic species with outposts into the boreal zone.

Musculus niger (Gray 1824)

Pl. I3, figs. 60-64.

Modiolaria nigra Gray, 1824, Shells, in Suppl. App. No. 10, Nat. Hist.; Zool., p. 244.

Modiolaria nigra Gould, 1870, p. 191, fig. 488.

Distribution in the Canadian Arctic: Map I8.

Published records:

Modiolaria nigra - Gray 1824, Canadian Archipelago; Hancock, 1846, Cumberland Sound; Reeve 1855, Canadian Archipelago; Whiteaves, 1882-84, Hudson Strait; Bush 1882, Labrador; Packard, 1891, Labrador; Whiteaves, 1901, Hudson Bay; Grieg, 1909, Archipelago; Dall, 1919, Archipelago; Dall, 1924, Hudson Strait; Johnson 1926, Labrador; Thorson, 1951, N. Baffin Bay; Ellis 1960, N. Baffin Land.

New records: Archipelago (Coll. FRBC, NMC); Eastern Canadian Arctic (Coll. FRBC, NMC). (App. I.).

Musculus niger is common in the Canadian Arctic. It occurs in shallow water at depths of 10-70 m. and is not abundant. Its southern boundary is at Cape Hatteras.

There is a considerable difference between the shells from the north and the south of the Canadian Arctic (Pl. I3, figs. 60,64). Specimens from Archipelago, Foxe Basin and

Ponds Inlet are small. Their periostracum is lustrous, brown. Shells are angular, with well developed beaks and side ridges; sculpture is distinct. Younger specimens greatly resemble M. corrugatus Stimpson, and often have been confused with it.

In Hudson Bay and southward, the shape of M. niger changes: it attains a larger size, becomes elongated, more flattened, with smoothened outlines and external features. The changes have the character of a cline. The largest specimen (80 mm. long) was collected on Ungava Bay.

Distribution outside the Canadian Arctic:

Greenland: Off the entire coasts of West and East Greenland; off Iceland.

Eurasian Seas: Norway, southward to the Baltic Sea. In all the Arctic seas of Eurasia, Bering Strait, and North American Western Arctic.

The largest specimens, up to 75 mm. long, were collected in Iceland.

M. niger is a panarctic-boreal species of circumpolar distribution.

N.B. The specimen depicted by Oldroyd, 1924, vol. 1, pl. 14, figs. 8, 9, represents M. niger, not M. corrugatus Stimpson, as stated.

Genus Crenella Brown 1827

Crenella faba (Muller 1776)

Pl. 14, figs. 65-67.

Mytilus faba (Muller, 1776) Prods. Zool. Danicae, p. 250.

Modiolaria faba - Jensen, 1912, pl. 3, figs. 8 a-c.

Distribution in the Canadian Arctic: Map 20.

Published records:

Modiolaria faba - Packard, 1867, Labrador; Packard, 1891, Labrador; Ellis, 1960, Foxe Basin.

Crenella faba - 1883, Labrador; Pfeiffer, 1882-83, Cumberland Sound; Dall, 1879, Cumberland Sound; Dall, 1886, Ungava Bay; Whiteaves, 1901, Hudson Strait; Grieg, 1909, Baffin Bay; Baker, 1919, N. Baffin Bay; Dall, 1924, Ungava Bay; Johnson, 1926, Labrador; Laursen, 1946, Hudson Bay, Pond Inlet.

New records: Canadian Eastern Arctic (Coll. FRBC, NMC, and of Dr. Oughton).

C. faba is common in the Canadian Eastern Arctic and in the South-Eastern Archipelago. Stimpson, 1863, and Backer, 1919, recorded this species from Smith Sound without indicating the exact location. Laursen, 1946, found it in Ponds Inlet, Baffin Land. It lives in shallow waters down

to a depth of 50 meters.

C. faba attains its largest size in the colder regions of the E. Arctic - Foxe Basin, Northern Hudson Bay and in Hudson Strait. The largest specimen, 8 years old, was 18 mm. long. In Southern Hudson Bay, James Bay, and in Ungava Bay C. faba is rare and not over 10 mm. long. Measurements of 9 larger specimens from the Canadian Arctic were as follows:

	l	h	w	h/l	w/l
Foxe Basin Sta. 828, FRBC	17.0	12.0	8.0	0.74	0.47
	11.5	8.5	5.0	0.74	0.54
Foxe Basin Sta. 901, FRBC	8.0	6.5	3.5	0.82	0.44
	16.0	12.0	8.0	0.75	0.50
	9.0	7.0	5.0	0.78	0.56
Foxe Channel USNM 406121	18.0	13.0	9.0	0.72	0.50
Burwell Sta. 226, FRBC	17.0	13.0	8.5	0.77	0.50
	11.0	8.0	7.0	0.72	0.64
	9.0	6.8	4.5	0.75	0.50

H/l ratios of 25 specimens from Foxe Basin varied from 0.69 to 0.82, and w/l from 0.44 to 0.56.

C. faba shows a peculiar correlation between the relative height of the shells and the development of the ribbing: the higher the shell, the less conspicuous is the ribbing. A similar correlation was observed in Musculus

discors (see p. 81). However, smooth forms of C. faba similar to the laevigata form of Musculus discors have not been found.

The area of C. faba overlaps in the south with that of a related species - C. pectinula Gould. It is possible that C. pectinula is a southern subspecies of C. faba. Some authors, e.g. Gould, 1870, Whiteaves, 1901, regard it, however, as a distinct species.

The thin, brittle, transparent "C. pectinula" from southern Hudson Bay, identified as such by Whiteaves (Coll. Johannson 1920, NMC) is a "Kummer Form" of C. faba.

Distribution outside the Canadian Arctic: C. faba is endemic in the western North Atlantic. It occurs in the Canadian Arctic and in West Greenland.

C. faba is a subarctic N. W. Atlantic species.

Crenella decussata (Montagu 1808)

Mytilus decussatus Montagu, 1808, Test. Brit. p. 69.

Crenella decussata - G. O. Sars, 1878, pl. 3, fig. 4.

Distribution in the Canadian Arctic: Map 19.

Published records:

Crenella decussata - Bush, 1883, Labrador; Rodger, 1892-95, Hudson Bay; Johnson, 1926, Labrador; Whiteaves, 1901, Hudson Bay.

New records: Ungava Bay (Coll. FRBC); South Eastern Hudson Bay (Coll. NMC). (App. I:).

C. decussata has seldom been collected in the Canadian Arctic; however it could have been overlooked because of its small size (4.5 x 3.8 x 2.5). It has been recorded only from the southern part of the Canadian Eastern Arctic. Southward it reaches Cape Hatteras.

Distribution outside the Canadian Arctic:

Greenland: Middle and southern shores of West Greenland, and southern shores of East Greenland. Off the entire coast of Iceland.

Eurasian Arctic Seas: Only in the White and Barents Seas. Abundant in shallow water in sandy sediments.

Records of this species off Barbados and in the Mediterranean are in need of confirmation.

C. decussata is a boreal Atlantic species entering the subarctic zone with the Atlantic waters.

Crenella glandula (Totten 1834)

Modiola glandula Totten, 1834, fig. 3.

Crenella glandula Gould, 1870, fig. 492.

Distribution in the Canadian Arctic:

Published records:

Crenella glandula - Packard, 1862, Labrador; Bush, 1882, Labrador; Packard, 1891, Labrador.

New records: None.

C. glandula is a boreal West Atlantic species, occurring from southern Labrador to Cape Hatteras.

Superfamily Pectinacea.

Family Pectinidae

Genus Chlamys Roding 1798

Chlamys islandica (Müller 1776)

Ostrea islandica O. F. Muller, 1776, Prodr. Zool. Dan., p. 248.

Pecten islandicus - G. O. Sars, 1878, pl. 2, fig. 2.

Distribution in the Canadian Arctic: Map 21.

Published records:

Pecten islandicus - Hancock, 1846, Cumberland Sound; Stimpson, 1861, Hudson Bay; Packard, 1867, Labrador; Bush, 1883, Labrador; Whiteaves, 1881, Hudson Strait; Whiteaves, 1882-84, Hudson Bay; Whiteaves, 1901, Hudson Bay; Brooks 1935, Hudson Bay; Dall, 1924, Northern Hudson Bay; Johnson, 1926, Labrador; Richards, 1936, Western Hudson Bay; Richards, 1941, James Bay; Thorson, 1951, Labrador.

New records: Hudson Bay, Cumberland Sound (Coll. FRBC, NMC). (App. I.).

C. islandica occurs in the Canadian Eastern Arctic southward from Foxe Channel and Cumberland Peninsula. Living specimens are rare. Numerous large subfossil shells indicate, however, that the present scarce populations are

remnants of past abundance. Specimens collected in Ungava Bay are the largest, attaining 8.2 mm. in height. Its southern boundary is at Cape Cod.

Distribution outside the Canadian Arctic:

Greenland: In West Greenland from Thule southwards. In East Greenland at the head of the Franz Josef Fjord only. However, this species has been found in the raised beaches as far north as Cape Bismark. In East Greenland Chlamys islandica is a relic species. Recent young specimens are abundant, adults very rare; the largest measured 91.0 x 88.0 mm.

Iceland: Off all the shores; in fjords as well as at the open sea. The largest specimen was 90.0 mm. high.

Eurasian Arctic seas: Southern shores of the Barenz and in the White Sea; at the south-western shores of the Kara Sea. Its southern boundary is at Stavanger Fjord, Norway.

Pacific sector of the Arctic: Chukchi Sea, Bering Sea.

Arctic shores of Western North America: Up to Pt. Barrow. The largest specimen at Pt. Barrow was 80 mm. high.

Chlamys islandica is a subarctic-boreal species, occurring in the Arctic in the regions of penetration of both Atlantic and Pacific waters.

Genus Delectopecten Grau 1959

Delectopecten groenlandicus (Sowerby 1845)

Pl. 14, fig. 67.

Pecten groenlandicus Sowerby, 1845, Th. Conch., v. 1, p. 57.

Pecten groenlandicus - G.O. Sars, 1878, pl. 2, figs. 4 a-c.

Propaemussium (Actinula) groenlandicum - Ockelmann, 1958, pl. 2, fig. 2.

Distribution in the Canadian Arctic: Map 22.

Published records:

Pecten groenlandicus - Hancock 1846, Cumberland Sound; Grieg, 1909, Baffin Bay; Backer, 1919, N. W. Baffin Bay; Whiteaves, 1901, Richmond Gulf; Ellis, 1960, Elipse Sound; Baffin Bay; Thorson, 1951, off Lancaster Sound; also Exeter Sound, Baffin Land.

Pecten andersoni Dall, 1919, Dolphin-Union Strait.

Pseudamussium binominatus Hanna-Wagner, 1968, Hudson Bay.

New records: Canadian Archipelago, Foxe Basin, Hudson Bay. (Coll. FRBC and NMC). (App. I.)

The new records show that D. groenlandicus is widely distributed and abundant in the Canadian Arctic. It is found in the Archipelago in the shallow water zone of 5-30 meters, but usually below 50 meters. In the Canadian Eastern Arctic it is confined to deeper and colder waters

and submerges in Baffin Bay, the Labrador Sea, and the Gulf of St. Lawrence. Single specimens have been found in the N. Atlantic at the depth of 2000 fms. (Clarke, 1962). Its southern boundary is in the deep waters off Cape Cod.

The largest shells of D. groenlandicus, 30 mm. high, have been found in the Archipelago. Dimensions of larger specimens from Sta. 10-55, NMC, Slidre Fjord, Ellesmere Land, were as follows:

h	l	w
30.0	32.0	7.0
28.0	39.0	7.0
27.0	31.0	6.6
26.0	28.0	6.4
23.0	24.0	5.0

D. groenlandicus decreases in size in Foxe Basin. It attains only 10 mm. in height in the central part of Hudson Bay, and is still smaller in James Bay.

Discussion: Presence of populations consisting of specimens of small size in the Atlantic Ocean, and of large specimens in the Arctic region, has been observed already by the first explorers. Locard, 1898, referred to the Atlantic specimens as D. groenlandicus f. minor. Large Arctic specimens were often referred to as forma major.

Ockelmann, 1958, has shown that the Atlantic and the Arctic specimens differ not only in the size of the shell,

but also in the structure of the body, and in reality they are two different species (Species A and B, ibid. p. 72). Species A occurs in the Arctic, Species B in the Atlantic Ocean (Iceland, Faroes, Newfoundland and, possibly, Gulf of St. Lawrence).

According to the kindly identification by Ockelmann of Canadian specimens (sent to him by the present writer), only one occurs in the Canadian Arctic - the Arctic Sp. A.

Studies of growth rates of specimens of D. groenlandicus by the present writer have shown that difference in size in specimens from the Archipelago and from Hudson Bay originates as a result of the lowered growth of this species in Hudson Bay and in James Bay.

Distribution outside the Canadian Arctic:

Greenland: Northern coast of West Greenland, entire coast of East Greenland. The largest specimens, 32 mm. in height, occur at East Greenland.

Iceland: Off the southern and eastern shores. Largest specimens are 12 mm. high.

Eurasian seas: Abundant in deeper water from the Barents Sea to approximately 165°E in the East Siberian Sea. Attains height of 32 mm. in the coldest regions.

Pacific sector of the Arctic: D. groenlandicus has not been found in the shallow water of the Chukchi Sea and of the Beaufort Sea.

Family Limidae

Genus Limatula Wood 1839.

Limatula subauriculata (Montagu, 1908)

Pecten subauriculata Montagu, Test. Brit. suppl. 1808, pl. 63, pl. 29, fig. 2.

Distribution in the Canadian Arctic: Map 23.

Published records:

Lima subauriculata - Reeve, 1855, Arctic Archipelago, Wellington Channel.

New records: None.

This species has been recorded only once from the Canadian Arctic - the Wellington Channel. This record extends the area of distribution of Limidae into the Central Arctic. Previously it was know to occur only in the North Western Atlantic.

Distribution outside the Canadian Arctic:

Greenland: Middle and southern shores of West Greenland; southern shores of East Greenland. South-eastern shores of Iceland.

Eurasian Seas: Faroes, Norway, Murman.

Eastern Pacific: Bering Sea to California.

In the revision of Limidae of the North Atlantic, Jensen 1912 and Ockelman 1958 point out that L. subauriculata often has been confused with the southern deep water species, Lima similis Jensen. I have had no opportunity to examine specimens from the Canadian Arctic. The distribution of these two species has yet to be studied.

N.B. For Lima read: Limatula pg. 234, Tables 4,5,6 and 8.

Order Heterodontida

Suborder Diogenodontina

Superfamily Astartacea

Family Astartidae

Introductory remarks.

Family Astartidae in the Canadian Arctic is presented by a large group of species of only one genus, Astarte. Ecologically it is a composite group consisting of species with different requirements in regard to depth, bottom sediments, temperature and salinity.

Areas of the majority of species extend over more than one zoogeographic zone, but there are species endemic in the high arctic zone. The boreal species are rare and occur in southern Labrador.

Although the genus Astarte is one of the oldest living bivalves, the northern fauna contains some species which have originated very recently, possibly as late as the Pleistocene.

Astarte are very variable and sometimes closely resemble each other. The taxonomy of Astarte is therefore involved, and synonomy abundant and complicated. Dall, 1903 (p. 837) was the first to compile the list of North American species of Astarte. He subdivided the genus into three sections, of which only two occur in the Canadian arctic. Into each section he has placed species differing from each other in many important characters. In the present

paper I will not use the subgeneric taxon referred to by Dall as a "Section". The species will be arranged, however, in the order used by Dall, 1903.

Family Astartidae

Genus Astarte Sowerby 1816

Astarte borealis (Schumacher 1817)

Pl.. I5, figs.69,70.

Triodonta borealis Schumacher, 1817, p. 47, pl. 17, fig. 1.

Triodonta borealis - Sars, 1878, pl. 5, fig. 8.

Crassina semisulcata Leach, 1819, Ross voy. Ed. 2, vol. p. 172, App. 4.

Astarte borealis - Jensen, 1912, pl. 4, figs. 1 a-f.

Distribution in the Canadian Arctic: Map 26.

Published records:

Crassina semisulcata: Gray, 1824, Arctic Archipelago.

Astarte richardsoni Reeve, 1855, Lancaster Sound.

Astarte semisulcata - Hancock, 1846, Cumberland Sound; Smith 1877, Smith Sound.

Astarte lactea - Whiteaves, 1881, 1882-84, Hudson Strait.

Astarte borealis - Dall, 1879, Cumberland Sound; Bush, 1883, Labrador; Grieg, 1909, Ellesmere Land; Baker, 1919, N. Baffin Bay; Dall, 1919, Western Canadian Archipelago; Dall, 1924, Hudson Bay, Beechey Island, Melville Island; Brooks 1935, Hudson Bay; Johnson, 1926, Labrador; Richards, 1936, James Bay; Laursen, 1936,

Pond Inlet; Richards, 1941, W. Hudson Bay; Ellis, 1960, Arctic Bay, N. Baffin Land; Foxe Basin.

New records: Canadian Archipelago (Coll. NMC); Eastern Arctic (Coll. FRBC, NMC). (App.1.).

A. borealis is widely distributed in the Canadian Arctic. It has been found at the northernmost shores of Canada and of Greenland: Alert, Ellemere Land, and Independence Bay. Southward it reaches Massachusetts.

It is a very variable species with numerous forms and correspondingly large synonymy. In the Canadian Arctic two forms are found: A. borealis placenta Mørch, and A. borealis var. withami Wood.

The typical form with var. withami occurs mainly in the southern part of the Canadian Arctic (Hudson Bay, Ungava Bay and Labrador).

A. borealis placenta is the sole form in the Arctic Archipelago and in Foxe Basin. It is an elongated and extremely narrow form(PL. 15, figs. 68-70). The shells of this type are depicted by Jensen (1912, Pl. 4, fig. 1f), MacGinitie (1959, Pl. 22, figs. 5,6), Filatova (1947, Pl.CX fig. 2, ar, 2 an). The periostracum of A. b. placenta is greyish-brown, thick peels off easily. Their beaks are small, elevated, tapering,turned forward. Ribs are small near beaks become larger at the middle of the shell and disappear towards the outer margins. In young specimens

they cover the whole shell. Such specimens were described as A. rhomboidalis Leche. Dall, 1903, regarded A. borealis placenta as the young specimens; however I have found many specimens of A. borealis placenta which were 5 years old.

The dimensions of A. borealis placenta from the Canadian Arctic are given below:

	No. of sps.	l	h/l	w/l
Arctic Archipelago	25	20-36	0.76 (0.70-0.84)	0.30 (0.24-0.36)
Foxe Basin	25	30-41	0.76 (0.68-0.83)	0.36 (0.30-0.40)
Pond Inlet	15	30-40	0.76 (0.69-0.80)	0.35 (0.30-0.39)

A. borealis placenta is a high arctic form abundant in shallow water of low salinity. It is the sole form of this species occurring in the Archipelago, Foxe Basin, Ponds Inlet and in East Greenland. It is also in all Eurasian Arctic seas.

The second form of A. borealis found in the Canadian Arctic is A. borealis var. withami Wood. This is a rounded form, with black-brown periostracum. It attains a length of 40 mm.; h/l and w/l indices of Canadian specimens were from 0.80 to 0.90 and from 0.43 to 0.47 respectively.

A. borealis s. str. is a boreal form; A. borealis placenta Mørch occurs in polar waters. A. borealis s. lato is a circumpolar panarctic species with boreal outposts in the Atlantic (Massachusetts, Northern Sea) and in the Pacific

(Japan, Aleutians.). In the Arctic it occurs mainly in shallow water, but in the Atlantic it has been found down to 1,483 fathoms (Clarke, 1962).

Astarte arctica (Gray 1824)

Crassina arctica Gray 1824, App. Parry voy. p. 243.

Astarte borealis - Jensen, 1912, pl. 4, fig. 1 a-b.

Astarte arctica - Filatova, 1948, pl. CX, figs. 4; 1957, p. 54.

Distribution in the Canadian Arctic: Map 24.

Published records:

Crassina arctica Gray, 1812, Arctic Archipelago.

Astarte arctica - Sutherland, 1852, Barrow Strait; Bush, 1883, Labrador; Stimpson, 1861, Ungava Bay; Packard, 1891, Labrador; Baker, 1919, N. Baffin Bay.

New records: Ungava Bay, Diana Bay (Coll. FRBC). (App. I.).

This rare species has been found in the Eastern Archipelago, Ungava Bay and off Labrador.

In the collection of the Blue Dolphin expedition, 1952, I have found specimens of A. arctica in samples from the Canadian shores of Baffin Bay and Davis Strait (USNM 95729, Frobisher Bay; 95730, Cumberland Gulf; 181921, Labrador).

Distribution outside the Canadian Arctic is not known. A. arctica has been often considered as a variety of A. borealis and listed under this name.

Greenland and Iceland: Dall, 1903, states that A. arctica occurs in Greenland. This statement has not been confirmed by Greenlandic explorers (Jensen, 1912; Thorson, 1951; Ockelmann, 1958). Collections of the "Valorous" Expedition in USNM contain specimens of A. artica taken in West Greenland (USNM 169659, 169656, 169657). The specimens of Astarte from Iceland, depicted as A. borealis by Jensen, (1912, pl. 4, fig. 1 a, b) is that of A. arctica Gray.

Eurasian Arctic Seas: A. arctica occurs in the Barents and the White Sea. Also in Spitzbergen, Murman and Norway (Filatova, 1948, 1957).

Discussion: A. arctica differs from the closely related A. borealis by its light, chestnut-brown periostracum, which is lustrous, finely striated, thin, and firmly attached to the shell. A few thin narrowly spaced ribs may be present on the apex, though the ribs may be absent.

The periostracum in A. borealis is dull, chalky, thick and peels off easily. The ribs are large and with broad interspaces always present. In young specimens they cover the entire shell.

The shell of A. arctica is well rounded or ovate, with high beaks. Both the lunula and the escutcheon are well developed and delimited. The shell expands under the beaks and gradually narrows toward the margins. In outline it strongly resembles the Cyprinoid shell. Margins

of the shells are sharp. Pallial line is situated at a distance from them. Marginal portion of the shell is flat, well separated from the central concave part.

Ten specimens from Greenland, 29 to 37 mm. long, had h/l ratio varying from 0.79 to 0.90, and w/l ratio from 0.39 to 0.50.

A. arctica is possibly an Atlantic subarctic species.

Astarte crenata (Gray 1824)

Pl. I5, figs. 71-73; Pl. I6, figs. 74-79.

Nicania crenata Gray, 1824, Shells, App. to Parry Voy. Nat. Hist., p. 242.

Astarte crenata - Jensen, 1912, pl. 4, figs. f-g.

Astarte crenata - Filatova, 1948, pl. CIX, figs. 5-7.

Astarte crenata - Ockelmann, 1957, pl. 1, figs. 20-21.

Distribution in the Canadian Arctic: Map 27,28.

Published records:

Nicania crenata Gray, 1824, Prince Regent Inlet, Archipelago.

Astarte crenata - Johnson, 1926, Labrador; Whiteaves, 1901, Richmond Gulf, Hudson Bay; Laursen, 1937, Western Hudson Bay; Thorson, 1951, Jones Sound, Lancaster Sound, Archipelago.

New records: Pond Inlet, N. Baffin Land (Dr. Ellis Coll.). (App. I.).

Relationship of closely related forms within Astarte crenata Gray has not yet been sufficiently investigated. This group includes the following species of old authors: A. crebricostata MacAndrews and Forbes, 1847; A. subaequilatera Sowerby, 1855; A. acuticostata Jeffreys and Friele,

1877; A. crenata var. inflata Hagg. 1904. Dall, 1903, regarded the above forms as valid species; Jensen 1912, as varieties of A. crenata. Filatova 1948, Ockelmann 1958 considered them as subspecies of A. crenata. These authors have shown that off the shores of East Greenland and in the Eurasian Arctic seas, each of these forms occupies a separate area, but these populations are interconnected by intermediate forms. A. crenata crenata occurs off open shores in high arctic regions at depths of 30-300 meters, whereas A. acuticostata is a deep water high arctic species which emerges toward the heads of fjords. A. subaequilatera Sowerby (= A. crebricostata MacAndrews) occurs in the warmer regions of the Arctic and the Atlantic. It seems justified to regard these forms as the subspecies of A. crenata Gray (see Ockelmann, 1958, p. 94).

In the Canadian Arctic A. c. crenata Gray occurs in the Archipelago and the colder regions of Eastern Canadian Arctic; A. crenata crebricostata MacAndrews and Forbes, in a deep trench in south-eastern Hudson Bay.

They occur at depths of 20 to 680 meters in the Archipelago and at 160 meters in Hudson Bay, on a bottom of sandy-mud and pebbles.

Specimens of A. crenata crenata are straw colored, glossy, with thin, regular ribs near the apex, disintegrating into striations toward the margins of the shell. Their outlines are arcuate, the apex high. The largest specimen

measured 23.0 x 18.0 x 12.0 mm. (see pl. 16, figs. 74).

Specimens of A. c. crenata found in Hudson Bay are very peculiar: their shells are small, rounded and greatly expanded (pl. 16, figs. 76-79). Shells of adult specimens are covered with about 50 ribs. Dimensions of 3 specimens of A. crenata from Sta. 59-15, B. 13, FRBC, were as follows:

l	h	w	h/l	w/l
22.8	18.5	13.8	0.81	0.60
20.0	17.2	11.5	0.86	0.57
19.2	16.0	11.5	0.83	0.60

These ratios are the highest observed in this species in the Canadian Arctic.

A. crenata crebricostata MacAndrews and Forbes collected in Hudson Bay (pl. 15, figs. 71-73) are elongated, with attenuated anterior part of the shell. The periostracum is rough, ribbing distinct; ribs (30-50) are large, separated by wide interspaces, unequal and covered with wrinkles. Periostracum is similar to that of A. subaequilatera Sowerby 1855, discussed by Ockelmann, 1958, p. 96, pl. 1, fig. 7. The shells resemble those of A. subaequilatera var. whiteavesi Dall 1903, from the Gulf of St. Lawrence, but are much more expanded and shortened with heavier valves thickened toward the margins.

This isolated population of A. crenata crebricostata in the deep region of Hudson Bay is probably a relic from

the period of broader communication of Canadian Arctic basins with the Atlantic Ocean.

Distribution outside the Canadian Arctic:

Greenland: Coldest regions of West and East Greenland (see fig. 5, p. 95 of Ockelmann, 1958).

Eurasian Arctic Seas: From Barents to Chukchi Sea. A. crenata crenata and A. c. crebricostata occur only in the western part of the Eurasian Arctic (see Filatova 1957, p. 54).

American Western Arctic: Point Barrow.

Astarte crenata s. lato is a panarctic circumpolar species.

Astarte elliptica (Brown 1827)

Crassina elliptica Brown, 1827, Ill. Conch. Gr. Brit. and Ireland, pl. 18, fig. 3.

Astarte elliptica - Gould, 1870, p. 124, figs. 435, 436.

Astarte elliptica - Jensen, 1912, pl. 4, figs. 4 a-g.

Astarte elliptica - Filatova, 1948, pl. CIX, fig. 10.

Distribution in the Canadian Arctic: Map 29.

Published records:

A. compressa Linne - Whiteaves, 1882-84, Hudson Strait.

Astarte elliptica - Packard, 1891, Labrador; Bush, 1883, Labrador; Johnson, 1926, Labrador.

New records: Pond Inlet (Coll. Ellis); Frobisher Bay (Coll. FRBC). (App. I.).

The synonymy of this species is confusing (see Gould, 1870, p. 124; Whiteaves, 1901, p. 130; Dall, 1903, p. 941; Thorson, 1951, p. 75). Many records from the Canadian Arctic are erroneous. Study of specimens in museums and of material from the Canadian region shows that A. elliptica occurs only off the Eastern shores of the Canadian Arctic from the Archipelago to Labrador and further southward it extends to Massachusetts.

Distribution outside the Canadian Arctic:

Greenland: West and East Greenland and Iceland.

Eurasian Arctic Seas: Barents and White Sea, southern shores of Kara Sea.

A. elliptica is a panarctic-boreal species, occurring in the Atlantic sector of the Arctic.

Astarte soror Dall 1903

Pl. I7, figs. 80-82.

Astarte soror Dall, 1903, p. 947, pl. LXII, fig. 11.

Distribution in the Canadian Arctic: Map 30.

Published records:

A. soror Dall, 1903, Wellington Channel (Coll. Belcher); Pierce Bay (Coll. Feilden).

New records: None.

A. soror has been described by Dall from Disco Bay, West Greenland. This is a species of a larger stature, with rough periostracum and a heavy shell. Dall, 1903 suggested its close relationship with pleistocene A. laurentiana Lyell. The comparison of specimens of this fossil species in collections of the Redpath Museum and in USNM with specimens of A. soror Dall in USNM (168821 and 169622) has shown that A. soror Dall is more closely related to the Tridonta-group of species than to those of the Nicania-group to which A. laurentiana belongs (see pl.I9 , figs. 93,94 and pl. I5, figs. 69-73 of the present paper).

Area of distribution: A. soror has been found in basins close to Baffin Bay. It is an arctic species endemic in the Canadian-Greenlandic Region.

Astarte montagui(Dillwyn I8I7).

Remarks on taxonomy of Astarte montagui Dillwyn 1817

In the Canadian Arctic occurs a group of small Astarte placed by Leach (1819) into the genus Nicania, and known at present under the collective name of "Astarte montagui" Dillwyn (Jensen, 1912; Filatova, 1948, 1957; Ockelmann, 1958; N. MacGinitie, 1959). The following species of old authors have been included in this group by Jensen 1912: Venus compressa Montagu, 1808; V. montagui Dillwyn 1817; Nicania banksi Leach, 1817; N. striata Leach, 1819; Astarte fabula Reeve, 1855; A. globosa Møller, 1842; A. pulchella Jonas 1845; and A. warhami Hancock 1846. (See also discussion by Dall 1903).

The extreme variability of northern Astarte and lack of large series for the comparative studies, resulted in description of numerous species. In the course of the last decade the synonymy became increasingly involved because almost all northern Nicania have been lumped under one name, A. montagui Dillwyn (Jensen 1912). As a result of this arrangement, the identity of species was lost and the areas of distribution became indiscernible. The situation became more complicated when it was found that in the report of Gray (1893) the numbers of the figures representing A. banksi and A. striata have been interchanged.

An attempt to organize the chaos within "A. montagui" was that of Jensen (1912) who, on the basis of height to length relation of shells, recognized three lower taxa

(varieties of Jensen) within the "species". He named the varieties by using the specific names of the original species included in the group. The elongated form was named A. montagui var. warhami, the shortened - A. montagui var. striata, and the shortest A. montagui var. banksi. These varieties according to Jensen (ibid.) have different areas of distribution within the area of the "species": A. montagui var. warhami in the northern, A. montagui var. striata in the central, and A. montagui var. banksi in the southern part of the area of the "species".

Ockelmann, 1957, confirmed the observation of Jensen and has pointed out that the h/l ratio of the shells increases toward the higher latitudes, and that this gradation has the character of a cline (ibid. p. 84). Filatova, 1948, 1957, and N. MacGinitie, 1959 (pl. 67) followed the scheme of Jensen.

The study of specimens of Astarte from the Canadian Arctic included in "A. montagui" by Jensen (in the collections of FRBC, Nat. Mus. of Canada, U. S. Nat. Mus. and Mus. Comp. Zool, Harvard) and of those from Greenland (kindly sent to the author by Ockelmann, from Helsingor Marine Laboratories) has shown that A. montagui sensu Jensen embraces three distinct species of old authors: A. banksi Leach, A. striata Leach, and A. warhami Hancock. The ranges of w/l and h/l indices of these species overlap and a shortened A. warhami may have indices of specimens of A. striata and even A. banksi and superficially resemble them. The ratios h/l and

w/l, though helpful in the study of variability in populations of a single species, are not reliable as a tool for separating the above species. These species, however, can be identified on the basis of the original descriptions and subsequent re-descriptions (Smith, 1877, Dall, 1903, and others). I have found the following features useful in the identification of species lumped into a group of "A. montagui":

A. warhami Hancock 1846: Ribs in adults do not reach the lower margin of the shell, but disintegrate gradually (or abruptly as in A. fabula Reeve) into striations. Young specimens 8-10 mm. long have about 30 ribs. These are broad, rounded and irregular, resembling loosely woven yarn. At the apex of the shell, and near the anterior and posterior parts of the shell, the ribs divide and often coalesce with the neighbouring ones. The interspaces between these are shallow, not well defined. The illustration (Fig. 92, pl. I8) represents a young specimen of A. warhami with the characteristic pattern of this ribbing reminiscent of that of A. esquimalti Baird 1863.

The periostracum of A. warhami is chestnut-brown with silky lustre. A few radial rows of dot-like impressions run from beaks to the outer margins of the shell (fig. 87, pl. I8).

The hinge-plate under the anterior lateral tooth of the right valve is continuous with that of the cardinal teeth. The anterior lateral tooth is narrow, long and low.

Muscle scars are large, their height about 1/3 of the height of the shell; the scars are situated near the middle of the height of the shell and their longer axes are almost vertical.

A. striata Leach 1819: Ribs in adults extend to the lower margin of the shell, run parallel to each other, and never coalesce (pl. I7, figs. 83-85).). Ribs are sharp, interspaces narrow and deep. Young specimens 8-10 mm. have about 50 ribs. Periostracum light or dark brown, chalky, never lustrous. Anterior lateral tooth of the right valve triangular, short and high, its hinge-plate separated from that of the cardinal teeth. Muscle scars small, less than 1/3 of the height of shell, situated mostly above the level of the middle of the shell. Their longer axes are slightly tilted toward the apices of the shell.

A. fabula Reeve 1855: Specimens labelled as A. fabula in the collections of Astarte of the FRBC, Nat. Mus. of Canada, Smithsonian Institution, MCZ and USNM are those of A. warhami Hancock 1846. The sudden change in the sculpture of the shell, believed to be a specific character, is almost certainly a result of interrupted growth. Young A. warhami are completely covered with ribs, which gradually disappear in the process of subsequent growth. If the growth is suddenly interrupted, a heavy check mark appears. The resumption of growth results in the formation of the striated portion of the shell peculiar to the shells of higher age. It is noteworthy that young specimens of A. fabula have never been found.

The observations of Jensen, 1912, and of Ockelmann, 1958, concerning the elongation of the shells of "A. montagui" toward higher latitudes, are basically correct. Indeed, A. warhami, a northern species, is more elongated than the rounded southern A. striata. But these changes are not clinal, but involve three distinct species, gradually replacing each other in latitudinal direction, with their areas overlapping.

Without examining numerous specimens of these species artificially united into one group, it is difficult to single out each of them and to determine their areas of distribution. However, after a study of material from the Canadian Arctic in the collections of museums of Canada and of the United States, I have been able to trace approximately the distribution of A. banksi Leach, A. striata Leach and A. warhami Hancock in the Canadian Arctic and in adjacent regions.

Astarte globosa Møller 1842

Astarte globosa Møller, 1842, Index Moll. Groenl. Naturhist. Tidskr., ser. 1, vol. 4.

Distribution in the Canadian Arctic: Map 25.

Published records:

Astarte globosa - Reeve, 1855, Wellington Channel.

New records: Prince Patrick Island (Coll. NMC); Ungava Bay (Coll. FRBC). (App. I.).

This "species" is probably an aberrant form of A. montagui. It is rare in the Canadian Arctic. It was also recorded from Greenland and the Barenz Sea.

Astarte laurentiana Lyell 1845, Pleistocene

Pl. 19, figs. 93-94

Lyell, 1945, Travels in North America, p. 126, figs. 15 a-c.

A. laurentiana has been found in Pleistocene deposits of Eastern Canada and of New England. It has been often asked whether A. laurentiana has left any descendants. Dall regarded it as identical with his A. soror (Dall, 1903, p. 943, pl. LXII, fig. 11, Astarte (laurentiana Lyell, 1845 var.?) soror).

Comparison of specimens of A. laurentiana Lyell with those of A. soror Dall (USNM) and of A. striata Leche showed that A. laurentiana is much closer to this last species than to any other northern species of Astarte. There is a great resemblance in many characters, e.g. size, shape, ribbing, structure of the hinge and in the shape of the muscle scars. (Comp. figs. on plates 17 and 18).

Astarte montagui Dillwyn 1817

Venus montagui Dillwyn, 1817, Descr. Cat. of Rec. Shells, p. 167.

Nicania banksi Leach, 1819, App. to Ross Voy. p. 62.

Astarte banksi Leach, 1839, App. Voy. Blossom, pl. 44, fig. 9.

Distribution in the Canadian Arctic: Map 25.

Published records:

Astarte banksi: Whiteaves, 1882-84, Burwell; Resolution Islands; Dall, 1924, Burwell; Packard, 1867, 1891, Labrador; Bush, 1883, Labrador; Richards, 1941, Hudson Bay.

New records: Ungava Bay (Coll. FRBC). (App. I.).

The area of distribution of this species in the Arctic is not well known because of the taxonomic difficulties discussed above. It has been recorded in Greenland, Iceland, Barents, White Sea.

A. montagui is a boreal species with outposts in the subarctic zone.

Astarte striata (Leach, 1819)

Pl. 17, figs. 83-86.

Nicania striata Leach, 1819, Ross Voy., App. 2, p. 62.

Astarte montagui var. striata Jensen, 1912, pl. 14, fig. 2b.

Astarte montagui var. striata Filatova, 1948, pl. CX, fig. 7.

Distribution in the Canadian Arctic: Map 31.

Published records:

Nicania striata Leach, 1819, N. W. Baffin Bay; Gray, 1824, N. W. Baffin Bay, Archipelago.

Astarte striata - Smith, 1878, Pierce Bay, Baffin Bay; Stimpson, 1861, Hudson Bay; Packard, 1891, Labrador; Johnson, 1926, Labrador; Richards, 1936, Hudson Bay.

New records: Foxe Basin (Coll. USNM); Hudson Bay, Ungava Bay (Coll. FRBC). (App. I:).

A. striata has been found in southern Foxe Basin, in Hudson and Ungava Bays, in the southeast of the Archipelago, off Labrador, Newfoundland and in the Gulf of St. Lawrence. Its southern boundary is not known because it has often been confused with the group of species known as "A. montagui".

The dimensions of five specimens of A. striata from the southern end of Melville Peninsula, USNM 434676, were as follows:

l	h	w	h/l	w/l
13.7	10.5	6.0	0.77	0.44
13.5	11.0	6.5	0.81	0.45
11.9	9.0	4.8	0.80	0.44
12.0	9.0	5.0	0.75	0.42
10.2	8.5	5.0	0,83	0.50

The h/l and w/l ratios of 25 specimens 10 to 15.5 mm. long were 0.80 (0.75-0.88) and 0.46 (0.40-0.52) respectively.

Distribution outside the Canadian Arctic:

Greenland: Entire shore of West Greenland and southern shores of East Greenland. Iceland.

Eurasian Arctic Seas: From Barenz to Bering Sea. From Barents Sea southwards to Bay of Biskaya (Filatova, 1948, 1957).

A. striata is a subarctic species with boreal outposts.

Astarte warhami Hancock 1846

Pl. 18, figs. 87-92.

Astarte warhami Hancock, 1846, Ann. Mag. Nat. Hist. vol. 18, p. 336, pl. 5, figs. 15-16.

Astarte fabula Reeve, 1855, Belcher, Last of the Arctic Voy vol. 2, pl. 33, figs. 5 a-b.

Astarte montagui var. warhami Jensen 1912, pl. 4, fig. 2 c.

Astarte pulchella Jonas, 1845, fide Dall, 1903, p. 942.

Distribution in the Canadian Arctic: Map 32.

Published records:

Astarte warhami Hancock, 1846, Cumberland Sound; Smith, 1877, N. Baffin Bay; Gray, 1901, N. W. Baffin Bay.

Astarte fabula Reeve, 1855, Wellington Channel; Smith, 1877, N. Baffin Bay; Baker, 1919, Smith Sound; Dall, 1924, Melville Island; Johnson, 1926, Labrador.

New records: Canadian Archipelago (Coll. FRBC); Foxe Basin and Ponds Inlet (Coll. Ellis, FRBC); Hudson Bay, Ungava (Coll. FRBC, NMC); Labrador (Coll. Steele). (App. I.).

A. warhami occurs throughout the whole Canadian Arctic and is the sole and abundant representative of the Nicania group in the Archipelago. Here and in the Foxe Basin

A. warhami attains its largest size and its most characteristic form. It decreases in size and becomes less abundant in the southern Hudson Bay and in the Ungava Bay, where its shape becomes very variable.

A. warhami has been taken from the depths of 5 to 200 meters but submerges towards the Labrador Sea.

Dimensions of four specimens from the Archipelago (Isachsen Island, Sta. 15-52, NMC) are given below:

l	h	w	h/l	w/l
28.0	21.5	12.3	0.76	0.44
19.8	15.5	7.5	0.77	0.38
17.5	13.8	6.5	0.79	0.37
16.1	13.2	6.3	0.81	0.47

Specimens from the Archipelago and Foxe Basin are elongated, with lower margin straight or only slightly arcuate, with beaks situated close to the middle of the shell (Pl. 26, fig. 94-99).

Locality	No. of sps.	Length in mm.	h/l	w/l
Pr. Patrick Island Sta. 15-52, NMC	30	12-28	0.79 (0.73-0.86)	0.42 (0.37-0.50)
Ellesmere Land Sta. 10-55, NMC	15	16-20	0.80 (0.76-0.84)	0.40 (0.36-0.45)
Foxe Basin Sta. 723, FRBC	26	16-23	0.78 (0.70-0.85)	0.42 (0.37-0.53)
Coburg Id. USNM 466686	9	12-17	0.83 (0.80-0.87)	0.40 (0.38-0.46)

The East Greenlandic specimens of similar size (Ockelmann, 1958, p. 85) are lower and more elongate than those from the Canadian Arctic, but almost of equal width. A. warhami occurs throughout the Canadian Central and Eastern Arctic. Its southern boundary is at Newfoundland or possibly at Nova Scotia.

Distribution outside the Canadian Arctic:

A. warhami has often been referred to as A. montagui and therefore its area of distribution can be established only after examination of the original material.

Greenland: Off the northern shores of W. Greenland; in East Greenland it is "... by far the commonest form" (Ockelmann 1958, p. 87).

Eurasian Arctic Seas: Both A. warhami and A. fabula are recorded from Kara Sea to the Chukchi Sea (Filatova, 1957, p. 54). A. warhami is the sde representative of the Nicania group in the collection of N. MacGinitie from Point Barrow, examined by the present author.

A. warhami is a high arctic circumpolar species, occurring in waters of polar origin.

Astarte sp. No. 1

Pl. 20, figs. 95-97.

Four specimens of a probably new species of Astarte have been found off the east end of Coburg Island, northern Baffin Bay (USNM 466686, coll. Bartlett). The large specimen measured 19.0 x 14.0 x 9.0 mm.

The general outlines of the shells, their size, the thick periostracum covered all over the shell with fine striation, also the structure of the hinge of the shell, show that the specimens belong to the Triodonta-group.

They differ from A. borealis Schum. and from A. borealis placenta Mörch by their unusually shiny, silky, mouse-gray periostracum and by expanded form of the shell near its middle (Pl. 15, fig. 69-70). Their shells are almost as high as those of A. borealis, but more expanded; their h/l ratio is 0.47 as compared to 0.25-0.30 of A. borealis placenta.

Differs from A. arctica in its color, heavy striation, more elongate shell with a lower apex.

Astarte sp. No. 2

pl. 21. figs. 98, 99.

Specimens of this Astarte have been collected off Labrador, St. Lewis Is., Foxe Harbour, collected by Verrill (USNM 34372). The largest specimen in the sample measured 15.0 x 13.0 x 7.0 mm.

This Astarte differs from all northern species of this genus. By its size and outlines it is reminiscent of A. striata Leach. However, its periostracum is yellow brown and lustrous. Ribbing is very distinct: ribs are large, triangular, interspaces broad and flattened. The hinge is typical of Nicania-group of species. The particular feature of hinge is the straight lower margin of the cardinal hinge plate.

This Astarte is probably a boreal species. It does not belong, however, to the known boreal species of this genus seen by the writer in the museums of U.S.A. and Canada.

Family Carditidae

Genus Venericardia Lamarck 1801

Section Cyclocardia Conrad 1867

Venericardia borealis (Conrad 1831)

Cardita borealis Conrad 1831, Amer. Mar. Conch. p. 39.

Cardita borealis - Gould 1870, p. 146, fig. 455.

Distribution in the Canadian Arctic: Map 33,

Published records:

Cardita borealis - Whiteaves, 1882-84, Hudson Strait; Packard, 1867, Labrador.

Venericardia borealis - Bush, 1883, Labrador; Whiteaves, 1901, Ashe Inlet, Hudson Strait; Packard, 1891, Labrador; Dall, 1924, Burwell, H. Strait; Johnson, 1926, Labrador.

New records: Digges Island, N. Hudson Bay (Coll. FRBC). (App. I.).

Venericardia borealis is endemic to the North Western Atlantic. Its recent area extends from the mouth of Hudson Bay to Cape Hatteras.

In the Canadian Arctic V. borealis usually occurs at depths of over 25 meters.

Off the coast of Nova Scotia its area overlaps with that of V. novangliae Morse, which is often regarded as a

southern form of V. borealis.

V. borealis is a single representative of the genus Venericardia in the Canadian Arctic. In the Pacific and Eurasian sectors of the Arctic occur other species of this genus. Their relationship with V. borealis has been discussed by Nesis, 1963. Filatova, 1948, has recorded V. novangliae from Eurasian seas. This record is in need of confirmation.

V. borealis is a boreal species penetrating into the subarctic zone of the Canadian Arctic.

Family Monacutidae

Genus Montacuta Turton 1822

Montacuta substriata Montagu 1808

Testacea Britannica, vol. 2.

Distribution in the Canadian Arctic: Map 34.

Published records:

Montacuta substriata - Sutherland, 1852, Assistance Bay, Barrow Strait.

New records: None.

M. substriata was known previously only from the Eastern Atlantic (Madsen, 1949, Ockelmann, 1958). I have not seen specimens taken from the Canadian Arctic.

Superfamily Cyamyacea.

Family Turtonidae.

Genus Turtonia Fabricius 1780

Turtonia minuta (Fabricius 1780)

Venus minuta Fabricius, 1780, Fauna Groenland, p. 412.

Cyamium minutum - G. O. Sars, 1878, pl. 19, figs. 14 a-c.

Turtonia minuta - Filatova, 1948, pl. CX, figs. 18 a-d.

Distribution in the Canadian Arctic: Map 35.

Published records:

Turtonia minuta - Dall, 1924, Canadian Eastern Arctic.

New records: None.

In the Canadian Arctic, T. minuta has been found only once, in Cumberland Sound. In the North West Atlantic it occurs from Newfoundland to Cape Cod.

Distribution outside the Canadian Arctic:

W. Greenland: Disco Bay. Iceland. Faroes. Norway.

Eurasian Arctic Seas: Barenz, White Sea. Bering Sea.

N. American Western Arctic: No records.

T. minuta is a boreal species which does not penetrate north of Cumberland Sound.

Superfamily Lucinacea.

Family Thyasiridae.

Genus Axinopsida Keen and Chavan 1951

Axinopsida orbiculata (G. O. Sars, 1878)

Axinopsis orbiculata G. O. Sars, 1878, p. 63, pl. 12, figs. 11 a-d.

Axinopsis orbiculata - Ockelmann, 1958, pl. 2, fig. 7, 8.

Distribution in the Canadian Arctic: Map. 36.

Published records:

Axinopsis orbiculata - Bush, 1883, Labrador; Packard, 1891, Labrador; Ellis, 1960, N. Baffin Land.

New records: Creswell, Archipelago; Foxe Basin, Hudson Bay, Hudson Strait, Frobisher Bay (Coll. FRBC). (App. I.).

A. orbiculata occurs usually together with T. gouldi Phill. and is often mistaken for it. It has been taken on South-eastern Archipelago and in the Canadian Eastern Arctic.

The southern boundary of distribution of A. orbiculata is off Cape Cod. Adult specimens from Canada attain a size of 4.6 x 4.4 x 2.8 mm. In the Canadian Arctic A. orbiculata has been taken at depths of from 3 to 40 meters, in East Greenland down to 400 meters.

Distribution outside the Canadian Arctic:

Greenland: Middle shores of West Greenland and off the Thule district. Off the whole East coast of Greenland and off Iceland.

Eurasian seas: All Arctic seas including Bering Sea.

Arctic Western N. America: No records.

A. orbiculata is a panarctic Atlantic species.

Genus Thyasira Lamarck 1818.

Thyasira dunbari sp. n.

Pl. 22, figs. 100-103. Map No. 37.

Type locality: Isachsen Island, Hole-in-Fog Bay, Arctic Archipelago (Sta. 14-54, NMC). Cotype specimens - 15. Deposited in National Museum of Canada.

Description of the type specimen:

Dimensions: length 6.2 mm.; height 7.8 mm.; width 4.8 mm.

Shell elongate-pyriform, expanded and highly asymmetrical. Periostracum greyish-tan, rough. Lines of arrested growth distinct. Hinge part of the shell, from the level of the distal ends of lunula and escutcheon, almost half the height of the shell. Beaks elevated, tapering, prosogyrate. Anterior and posterior margins of the hinge part are of equal length and meet at approximately right angles. Anterior margin is straight, posterior highly arcuate. Lunula large, cordate, bottom straight, deeply set in. Escutcheon long, narrow, sunken, delimited by a sharp crest. Disk of the shell extended down and forwards; its posterior margin slants down and forwards. Prodissoconch 160 microns long.

Surface of the shell with four shallow radial furrows broadening towards periphery of the shell and ending in slight incurvation of its margin. A shallow furrow surrounds the lunula. One broad and shallow furrow runs

over the middle of the shell from the beaks to the lower margin. There are two shallow furrows on the posterior end of the shell, one surrounding the escutcheon, the other below and at a considerable distance from the first. The lower furrow is broad and ends in a shallow long sinuation of the posterior lower margin of the shell.

Hinge thin, weak, long. Anterior plate straight, almost obsolete. Posterior plate strong, highly arcuate, of even width. A weak callous thickening present under the beaks, on hinge plate of the right valve. There is a shallow depression on the hinge plate of the left valve to receive this thickening.

Dimensions of 5 cotype specimens were as follows:

l	h	w	h/l	w/l
6.5	8.6	5.1	1.29	0.77
6.5	8.2	5.2	1.29	0.77
6.4	8.1	5.0	1.26	0.78
6.1	8.0	4.8	1.24	0.78
6.2	7.8	4.8	1.26	0.77

The h/l ratio of 15 cotype specimens was 1.23 (1.16-1.29) and w/l - 0.75 (0.70-0.84). The h/l ratio is age dependent, and higher in older specimens. Young specimens are more rounded and more symmetrical.

T. dunbari has been collected in the following locations in the Canadian Archipelago:

Parr Inlet, Alert, Ellesmere Land. NMC sta. July 27 - Aug. 3, 1951. 5 sps.

Hole-in-Fog Bay, Isachsen Island. NMC sta. 15-54, depth 91 feet. 25 sps.

Mould Bay, Prince Patrick Island. NMC sta. 13-52, depth 100-130 feet. 2 sps.

Ellesmere Island. Sta. 62-3001, 3003, FRBC, depth 2-7 mtrs. 5 sps.

Cornwallis Island. Sta. 52-4006, depth 5-15 mtrs. 1 sp.

Victoria Island. Sta. 62-7004, 7005, depth 0-25 mtrs. 4 sps.

T. dunbari differs from other northern species of the genus by its extremely elongated and asymmetrical shape, high hinge part and disk elongated downward and forward.

Dr. W. K. Ockelmann kindly informed me that T. dunbari occurs also in East Greenland. He considers this species a northern counterpart of boreal T. equalis Verill and Bush 1898.

Northern Thyasira are very little known. To facilitate the differentiation of T. dunbari from other northern species of Thyasira, a differential diagnosis between this species and T. gouldi Phil. is given below. The last species has been selected for comparison because it is a common northern species, repeatedly redescribed and illustrated, and which therefore can be reliably identified.

(Ockelmann, 1958, p. 103, Pl. 2, fig. 4, 5; Ockelmann, 1961, p. 50, 51; G. O. Sars, 1878, Pl. 19, figs. 1 a-b; Gould, 1870, p. 100, fig. 406).

Differential diagnosis:

Thyasira dunbari sp. n.	T. gouldi Phil.
Shell elongate, pyriform, strongly asymmetrical and expanded.	Shell rounded, slightly asymmetrical.
The h/l ratio - 1.16-1.29; w/l - 0.70-0.84.	The h/l ratio about 1.0; w/l 0.58-0.70.
Hinge part high, 30-50 per cent of the height of the shell; its h/l ratio is 0.5.	Hinge part low, 18-20 per cent of the height of the shell; its h/l ratio is 0.3.
Four shallow radial furrows terminate each in a slight incurvation of the margin. One furrow surrounds the lunula, the second runs along the middle of the shell. A deep furrow surrounds the escutcheon; there is another broad shallow furrow beneath the first one. It ends in an extensive incurvation of the	Two deep and narrow radial furrows on the posterior end of the shell terminate each in a deep and narrow incurvation of the margin.

Thyasira dunbari sp. n.	*T. gouldi* Phil.
lower posterior margin of the shell.	
Outlines of the shell angular, whole margin of disc undulate.	Outlines rounded, margin undulate only at the posterior end of the shell, where the margin of the shell forms a high arch between the radial furrows.
Hinge plates meet at a right angle.	Hinge plates meet at an obtuse angle.
Posterior hinge plate weak, thin, arcuate, of even width.	Posterior hinge plate strong, slightly arcuate.
Callus weak.	Callus strong.
Prodissoconch small, about 160 microns.	Prodissoconch large, about 250 microns.

Thyasira dunbari is a high arctic shallow water species occurring in the Canadian Archipelago and in East Greenland. It is endemic in the Canadian-Greenlandic Arctic region.

This species is named *Thyasira dunbari* to honor Prof. M. J. Dunbar, biologist and oceanographer, explorer of the Canadian marine Arctic.

Thyasira gouldi (Philippi 1845)

Lucina gouldii Philippi, 1845. Zeitschr. Malakol. vol. 2, p. 74.
Cryptodon gouldii - Gould and Binney, 1870, p. 100, f. 406.
Axinus gouldii - G.O. Sars, 1878, pl. 19, figs. 6 a-b.
Thyasira gouldi - Ockelmann, 1958, pl. 2, figs. 4-5.

Distribution in the Canadian Arctic: Map 38.

Published records:

Cryptodon gouldi - Packard, 1867, Labrador; Bush, 1883, Labrador; Whiteaves, 1901, Labrador;

Axinus gouldi - Smith, 1877, N.W. Baffin Bay; Baker, 1919, N.W. Baffin Bay.

Thyasira flexuosa - Dall, 1919, Dolphin and Union Strait.

Thyasira gouldi - Ellis, 1960, N. Baffin Land.

New records: Archipelago, Cresswell; Foxe Basin, Ungava Bay, Hudson Bay (Coll. FRBC, NMC). (App. I).

Thyasira gouldi is common and abundant in the Canadian Arctic. It occurs mostly in muddy sediments at depths of 2 to 50 meters, but was also taken in deeper waters. A large specimen measured 9.0 x 9.6 x 3.0 mm. Southward from the Canadian Arctic this species probably reaches Massachusetts.

Distribution outside the Canadian Arctic:

Ockelmann, 1958, has shown that T. gouldi has been often confused with T. flexuosa Mont., T. equalis Verill and Bush, and even with species of a related genus, Axinopsida. Therefore the area of distribution of T. gouldi is not well known. In the Canadian Arctic it has not been found west of Creswell, Wellington Channel.

Greenland, Iceland: Off the entire coast.

Eurasian Arctic seas: From northern shores of Norway to the Bering Sea.

N. American Western Arctic: One specimen found at Pt. Barrow (N. MacGinitie, 1959, p. 171).

T. gouldi is a panarctic and probably an Atlantic species.

Suborder Cyclodontida.

Family Cardiidae

Genus Clinocardium Keen 1936

Clinocardium ciliatum (Fabricius 1780)

Cardium ciliatum Fabricius, 1780, Fauna Groenlandica, p. 410.

Cardium ciliatum - G. O. Sars, 1878, pl. 5, figs. 4 a-b.

Distribution in the Canadian Arctic: Map 39.

Published records:

Cardium islandicum - Hancock, 1846, Cumberland Sound; Packard, 1867, Labrador; Whiteaves, 1881, Hudson Strait; Whiteaves, 1882-84, Hudson Bay; Whiteaves, 1901, Hudson Bay; Halkett, 1898, Hudson Strait; Johnson, 1926, Labrador.

Cardium ciliatum - Reeve, 1855, Wellington Channel; Packard, 1891, Labrador; Dall, 1886, Ungava Bay; Dall, 1919, Arctic Archipelago; Dall, 1924, Ungava Bay; Baker, 1919, N. W. Baffin Bay; Richards, 1936, Hudson Bay; Richards, 1941, James Bay; Ellis, 1960, N. Baffin Land, Foxe Basin.

New records: Canadian Archipelago and eastern Arctic (Coll. NMC and FRBC). (App. I,).

Clinocardium ciliatum occurs throughout the Canadian Arctic at depths of from 10 to 200 meters on muddy bottoms with gravel. It is rare in the Canadian Archipelago. The

largest specimen from Slidre Fjord, Ellesmere Land, measured 50.0 x 44.3 x 29.5 mm. In Hudson Bay and in Ungava Bay this species is abundant, but the shells are less than 40.0 mm. long. Living specimens amidst masses of empty shells form the so-called "Cardium bottom", which extends from shallow water down to 200 meters.

The largest specimens from the Canadian Arctic have been taken off Labrador. Those taken by Dr. Nutt (1952) measured as follows:

	l	h	w
Emily Harbor	65.0	68.0	42.0
USNM 604929	56.0	65.5	42.0
	57.0	61.0	42.0
Cape Harringam	45.0	48.0	32.0
USNM 598569	43.0	45.0	26.0
	40.0	42.0	28.0
Hebron Fjord	34.0	37.0	22.0
USNM 598527	32.0	35.0	21.0

The largest specimen of C. ciliatum from Iceland was 81 mm., from East Greenland and the Eurasian seas 60 mm. long.

Distribution outside the Canadian Arctic:

Greenland: Entire shores of W. and E. Greenland and Iceland.

Eurasian Arctic Seas: Abundant in shallow waters of Barents and Kara Seas, and in East Siberian shallows; occurs in deeper waters of the Laptev Sea.

Rare in Pacific sector of the Arctic, where only a few specimens were taken at Sea Horse Point and off Point Barrow. Southern boundary of distribution in the Atlantic is off Cape Cod and Finmarken; in the Pacific off Japan and Puget Sound.

Intraspecific variation of C. ciliatum and its relationship with C. hayessi Stimpson needs special investigation.

C. ciliatum is an arctic-boreal species with interrupted circumpolar distribution.

Genus Serripes Beck 1841

Serripes groenlandicus (Bruggiere 1789)

Cardium groenlandicum Bruggiere, 1789, Encycl. Method., Vers. vol. 1, pt. 1, p. 222.

Aphrodite groenlandica - G. O. Sars, 1878, pl. 5, figs. 3 a-b.

Distribution in the Canadian Arctic: Map 40.

Published records:

Cardium groenlandicum - Hancock, 1846, Cumberland Sound; Sutherland, 1852, Canadian Archipelago; Grieg, 1909, Canadian Archipelago.

Serripes groenlandicus - Reeve, 1855, A. Archipelago; Packard, 1867, Labrador; Whiteaves, 1882-84, Hudson Bay; Packard, 1891, Labrador; Halkett, 1898, Hudson Strait; Whiteaves, 1901, Hudson Bay; Dall, 1919, Arctic Archipelago; Dall, 1924, Burwell; Richards, 1936, James Bay; Rodger, 1935, N. Baffin Bay; Ellis, 1960, N. Baffin Land.

New records: Arctic Archipelago (Coll. NMC and FRBC); Canadian Eastern Arctic (Coll. FRBC and NMC). (App. I.).

S. groenlandicus occurs throughout the Canadian Arctic at depths of 20 to 80 meters. Its southern boundary is off Cape Cod.

In the Canadian Archipelago this species is not abundant and does not exceed 52 mm. in length. It is common

in the Eastern Arctic, where the specimens are smaller, and further decrease in size toward James Bay. The largest specimens have been taken off Labrador (exped. of Dr. Nutt, 1959). Their measurements were as follows:

	l	h	w
Emily Harbor	92.0	49.0	56.0
USNM 604849	66.0	58.0	36.0
Domino Harbor	91.0	79.0	54.0
USNM 598538	88.0	76.0	50.0
	60.0	50.0	32.0
Hamilton Inlet	89.0	72.0	47.0
USNM 598579	75.0	61.0	37.0

Specimens from Greenland were up to 94 mm. long, those from Eurasian Sea up to 100 mm.

Distribution outside the Canadian Arctic:

Greenland: Entire shores of Greenland and Iceland.

Eurasian Arctic Seas: From Possanger Fjord, Norway, eastwards up to and including Chukchi Sea. Abundant in trenches in Kara Sea.

W. North American Arctic: Extremely rare. Has been recorded from Teller, Alaska, and from the Canadian Western Arctic (one specimen).

Serripes groenlandicus protractus Dall from Labrador is regarded by Clench and Smith, 1944, as a synonym of S. groenlandicus Bruggiere.

Suborder Teleodontida

Family Veneridae

Genus Liocyma Dall 1870

Liocyma fluctuosa (Gould 1841)

Venus fluctuosa Gould 1841, p. 87, fig. 50.

Comphina fluctuosa - Ockelmann, 1958, pl. 2, fig. 9.

Liocyma fluctuosa - N. MacGinitie, 1959, pl. 2, figs. 1-8.

Distribution in the Canadian Arctic: Map 41;

Published records:

Liocyma fluctuosa - Bush, 1883, Labrador.

Liocyma beckii - Dall, 1919, Dolphin and Union Strait (fide N. MacGinitie, 1959).

Liocyma viridis - Dall, 1919, Dolphin and Union Strait (fide N. MacGinitie, 1959).

New records: Prince of Wales Strait, Archipelago (Coll. FRBC). (App. I.).

In the Canadian Arctic L. fluctuosa occurs in two widely separated areas - in the South Western Archipelago and off the southern shores of Labrador. Southwards it reaches Massachusetts.

N. MacGinitie revised the genus Liocyma in the Pacific sector of the Arctic (1959), and stated that the

difference between L. fluctuosa Gould, on one hand, and the northern species - L. viridis and L. beckii Dall, on the other, is not sufficient to regard these forms as separate species; thus the last two names should be regarded as synonyms of L. fluctuosa Gould. The records of L. beckii and L. viridis Dall, 1919, from Dolphin and Union Strait should be regarded as those of L. fluctuosa in the N. American Western Arctic.

Distribution outside the Canadian Arctic:

Greenland: Abundant in East Greenland and rare off West Greenland.

Eurasian Arctic Seas: In all Arctic Seas of Eurasia, including Chukchi Sea.

L. fluctuosa is a panarctic species with interrupted circumpolar distribution.

Superfamily Tellinacea

Family Tellinidae Subfamily Macominae.

Genus Macoma Leach, 1819

Macoma calcarea (Gmelin 1792)

Pl. 23, figs. I03-I06.

Tellina calcarea Gmelin, 1792, vol. 7, p. 3236.

Macoma calcarea - Jensen, 1905, fig. 2 a-b.

Distribution in the Canadian Arctic: Map 43..

Published records:

Tellina calcarea - Hancock, 1846, Cumberland Sound; Sutherland, 1852, N. W. Baffin Bay.

Tellina proxima - Reeve, 1855, Eastern Arctic Archipelago.

Macoma subulosa - Packard, 1867, 1891, Labrador; Bush, 1883, Labrador; Stimpson, 1861, Ungava Bay.

Macoma tenera - Dall, 1886, Ungava Bay.

Macoma calcarea - Whiteaves, 1881, Eastern Hudson Bay; Whiteaves, 1882-84, Hudson Strait; Whiteaves, 1901, Hudson Bay, Hudson Strait, Richmond Gulf; Baker, 1919, N. W. Baffin Bay; Dall, 1919, Dolphin and Union Strait; 1924, Ungava Bay; Richards, 1936, James Bay; 1941, Hudson Bay; Thorson, 1951, N. W. Baffin Bay; Ellis, 1960, N. Baffin Land.

New records: Canadian Central and Eastern Arctic (Coll. FRBC and NMC). (App. I.).

M. calcarea, widespread and abundant in the Arctic, seems to be rare in the central part of the Canadian Archipelago. It occurs at depths of 10 to 150 meters. Largest specimens, up to 45 mm. long, were found in the Canadian Eastern Arctic. Southwards it reaches Massachusetts.

Distribution outside the Canadian Arctic:

Greenland: Off the entire coasts of Greenland and Iceland.

Eastern Atlantic: British Islands, Zunds and Norway.

Eurasian Arctic Seas: In shallow water of all Arctic Seas.

Western North American Arctic: The entire coast including Dolphin and Union Strait.

Intraspecific variation of M. calcarea has not been studied. Soot-Ryen, 1932, mentioned two forms of this species from the East Siberian Sea. One of them, M. calcarea f. obliqua, Soot-Ryen, has been found also in the Foxe Basin (Sta. 808, FRBC) (Pl. 23, figs. 103-106); and in the Liverpool Bay (Sta. 61-1017, FRBC).

M. calcarea is a panarctic-boreal species with circumpolar distribution.

Macoma balthica (Linne 1758)

Tellina balthica Linne, 1758, Syst. Nat., Ed. 10, p. 677.

Tellina (Macoma) balthica - Jensen, 1905, pl. 1, fig. 1 a-b.

Macoma fusca - Gould, 1870, p. 94, fig. 400.

Distribution in the Canadian Arctic: Map 42.

Published records:

Tellina fusca - Sutherland, 1852, Baffin Bay; Packard, 1867, Labrador.

Macoma fragilis - Stimpson, 1861, Ungava Bay; Whiteaves, 1881, Hudson Strait; Bush, 1883, Labrador; Packard, 1891, Labrador; Richards, 1941, James Bay.

Macoma balthica - Whiteaves, 1901, Labrador; Richards, 1941, W. Hudson Bay.

New records: Canadian Eastern Arctic (Coll. FRBC and NMC). (App. I.).

M. balthica occurs in the Canadian Eastern Arctic (except in Foxe Basin), in the Frobisher Bay, and off the shores of Labrador. Its southern boundary is off Maine, U.S.A. From the Gulf of St. Lawrence it penetrates into the St. Lawrence River up to Quebec. M. balthica is a shallow water species occurring in the Canadian Arctic down to 20 meters and in James Bay down to 60 meters.

Distribution outside the Canadian Arctic:

Greenland: Southern shores of West Greenland; rare at Disco Bay. Absent from East Greenland and Iceland.

Eastern North Atlantic: From Norway to Mediterranean; abundant in Baltic Sea.

Eurasian Arctic Seas: Southern shores of Barenz Sea and in the White Sea. The eastern boundary is at Bajdaratsky Bay, south-eastern Kara Sea.

Pacific Ocean: From Bering Strait to Japan and California.

N. American Western Arctic: Recorded at Herschel Island (CAE, 1919, Dall). N. MacGinitie, 1959, states that this species does not occur off Point Barrow.

M. balthica includes many forms, some of which have distinct areas of distribution. In the Pacific Ocean M. balthica differs from that from the North Atlantic, and was regarded as a subspecies of the last. American malacologists regard it as a separate species, M. inconspicua Sowerby (Dodge, 1959, p. 52).

Some differences between populations of M. balthica from the European and the American shores of N. Atlantic have also been noticed. The European M. balthica is large, with a heavy shell, and purple stripes on white background. It is elongated, the posterior end attenuated, its lower margin

slightly arcuate. A specimen of this type is illustrated by Moebius and Mayer, 1872, vol. 1, plate opposite p. 96, figs. 14, 16, and by Segestrale, 1960, p. 4, fig. 1.

M. balthica from the American shores of N. Atlantic is whitish-gray, thin and brittle. Its anterior and posterior portions are almost symmetrical, posterior end being slightly shortened and broadened, lower margin arcuate. A specimen of this type is depicted by Gould, 1870, p. 94, fig. 400. The variability of M. balthica has been discussed by Dall, 1900, p. 299; Whiteaves, 1901, p. 142; Gould, 1870, p. 93-94; and Dodge, p. 51-5, 2. 1952.

The size of M. balthica in W. Atlantic decreases in northward direction. Near its southern boundary of distribution, off Connecticut, USA, it attains a length of 40 mm. (182010, MCZ); in the Bay of Fundy and off Nova Scotia of 20 mm., and off Labrador and Pangnirtung, of only 16 mm. In the Canadian Eastern Arctic its size decreases toward James Bay, where its largest specimens are only 10 mm. long. Specimens from this bay have been identified by Whiteaves as M. inconspicua Sowerby (Coll. NMC, Fr. Johannsen, 1921). It is probable that "M. inconspicua" from James Bay is only a dwarfed brackish water form. A similar phenomenon has been observed by Moebius and Mayer, 1872, in the Kiel Bay of the Baltic Sea.

M. balthica is a boreal species with outposts in the subarctic zone.

Macoma inconspicua (Broderik and Sowerby 1829)

Pl. 24, figs. 108-111.

Tellina inconspicua Brod. and Sow.

1829, Zool. Jour., v. 4, p. 363.

Distribution in the Canadian Arctic: Map 44.

Published records: None.

New records: Bathurst Inlet, Archipelago (Coll. Blake Jr. GSC).

M. inconspicua from the Bathurst Inlet is less than 10 mm. long, with high chalky thin shell, and gray periostracum which peels off easily. The specimens strongly resemble M. balthica from southern Hudson Bay and from James Bay, which were identified by Whiteaves as M. inconspicua. However, as the material from the Canadian Eastern Arctic accumulated, it became clear that specimens in populations occurring along the south-eastern shores of Hudson Bay, northern Hudson Bay, in Hudson Strait and in Labrador are graudally developing features peculiar to the populations of M. balthica in Labrador and southwards. It is evident that in Atlantic populations of M. balthica develop clinal changes toward the brackish water regions of high latitudes, which have led some authors to regard these marginal populations as a separate species. Differences between M. balthica and M. inconspicua are slight and the names of these two species were often used as synonyms. (see Grant and Gale,

1931; Gould, 1870; Whiteaves, 1901). The identity of the populations of these two species occurring in the Atlantic and the Pacific sectors of the Arctic has been repeatedly discussed. The material available to me is not sufficient to contribute to the discussion. In agreement with the opinion of Dodge (1952, p. 51, 52) the name of M. inconspicua Brod. and Sow. is used in the present paper to designate a species closely related to M. balthica L. from the Western North American Arctic.

Macoma loveni (Steenstrup) Jensen 1904

Pl. 24, fig. II2.

Tellina (Macoma) loveni - Jensen 1904, pIII, pl. 1, figs. 5 a-h.

Macoma loveni - Ockelmann, 1958, pl. 2, fig. 11.

Distribution in the Canadian Arctic: Map 45.

Published records:

Macoma loveni - Grieg, 1901, N. W. Baffin Bay.

New records: Canadian Eastern Arctic, Foxe Channel, Southampton Sound, Archipelago (Coll. FRBC). (App. I. .).

In the Canadian Arctic this species has been found by the 2nd Expedition of Fram in the Archipelago, Havnefjord, Jones Sound; off Southampton Island by FRBC; in the Foxe Basin by the Expedition of Belcher (labelled "Tellina inflata" Stimpson = M. loveni Steenstr.; USNM 108787).

Distribution outside the Canadian Arctic:

Greenland: In Disco Bay, West Greenland, and off the entire shore of East Greenland. Absent off Iceland.

Eurasian Arctic Seas: In all seas except the White Sea. In trenches of Kara Sea and shallows of Siberian seas.

In the N. W. Atlantic occurs a closely related species, M. inflata Verill and Bush 1898 (fide Dall 1900),

which has often been regarded as identical with M. loveni. However, they differ in the shape of the shell: M. inflata is large, elongated and less expanded than the high and short M. loveni. In the first species the apex is low and wide, in the second, small and tapering. Collections of USNM contain samples of M. inflata from Hopedale, Labrador (341376), Hebron (438925), Gulf of St. Lawrence (95638), Gaspe (108790), Nova Scotia (524427, 78318, 52426), Gulf of Maine (159769) and off Martha's Vineyard (159770).

M. inflata is a subarctic-boreal species, probably endemic in the N. W. Atlantic. The area of distribution of M. inflata probably overlaps with that of M. loveni. M. loveni is a high arctic species occurring only in the Atlantic sector of the Arctic.

Macoma moesta (Deshayes 1854)

Tellina moesta Deshayes 1854, Proc. Zool. Soc. L., p. 361.
Tellina (Macoma) moesta - Jensen, 1905, pl. 1, fig. 4 a-c.
Macoma oneili Dall, 1919, p. 20, pl. 2, fig. 1.
Macoma moesta - Ockelmann, 1958, pl. 2, fig. 13.

Distribution in the Canadian Arctic: Map 46.

Published records:

Macoma moesta - Grieg, 1909, N. W. Baffin Bay; Ellis, 1960, Baffin Land, Foxe Basin.

Macoma oneili Dall, 1919, Arctic Archipelago, 1924, Ungava Bay.

New records: Arctic Archipelago, Canadian Eastern Arctic (Coll. FRBC, NMC). (App. I.).

M. moesta is common in the Canadian Arctic. It has been taken from depths of from 5 to 70 meters in the Archipelago and Foxe Basin, but in Hudson Bay and Ungava Bay it is confined to deeper zones. It is probable that Ungava Bay is the southern boundary of this species in the N. W. Atlantic. M. moesta is abundant in the Archipelago and Foxe Basin and rare in the southern part of the Arctic, where it occurs in cold water.

M. oneilli described by Dall, 1919 from Dolphin and Union Strait is at present regarded as a synonym of M. moesta (N. MacGinitie, 1959, Ockelmann, 1958).

M. moesta has been often confused with M. calcarea and only after the taxonomy of northern macomas has been revised (Jensen 1904, 1905), it became possible to separate these two species.

Distribution outside the Canadian Arctic:

Greenland: Off Godthaab, W. Greenland, where it is probably the relic from a colder period. It is common off the northern shores of East Greenland, and is here more abundant than M. calcarea. Absent off Iceland.

Eurasian Arctic Seas: Abundant in colder region of all seas, and extends north of 75°N.

Western N. American Arctic: In the Bering Sea and Strait, and off Point Barrow.

M. moesta is a high arctic circumpolar species.

Macoma torelli (Steenstrup) Jensen 1904

Pl. 24, figs. III3.

Tellina (Macoma) torelli (Steenstrup) Jensen, 1904, pl. 1, figs. 3 a-i.

Macoma torelli - Ockelmann, 1958, pl. 2, fig. 12.

Distribution in the Canadian Arctic: Map 47.

Published records:

Macoma torelli - Grieg, 1909, Archipelago.

New records: Baffin Land (Coll. Ellis); Archipelago and Canadian Eastern Arctic (Coll. FRBC). (App. I).

The area of distribution of this rare species is little known. In the Canadian Arctic it has been taken in Jones Sound, Foxe Basin, Hudson Bay and in Ponds Inlet at depths of 20 to 200 meters.

Distribution outside the Canadian Arctic:

Greenland: In Disco Bay, West Greenland; entire coast of East Greenland, but rare in the southern part of the shores. Absent off Iceland.

Eurasian Arctic Seas: In colder regions of Kara and Barents seas and in deeper water in E. Siberian and Chukchi seas.

M. torelli is a high arctic Atlantic species.

Macoma planiuscula Grant and Gale 1931

Pl. 25, figs. II4-II8.

Macoma planiuscula Grant and Gale 1931, p. 372, pl. 14, figs. 11a, 11b; Pl. 20, figs. 8a, 8b.

Distribution in the Canadian Arctic: Map 48.

Published records: None.

New records: Amundsen Gulf, Archipelago (Coll. NMC). (App. I.).

Comparison of specimens of M. planiuscula Grant and Gale from the Amundsen Gulf with those from the Bering Sea (Bristol Bay, 48421, kindly made available to the author by the Stanford Geological Museum), has confirmed that our Macoma from the Archipelago is M. planiuscula.

This species differs from other northern Macoma by its lustrous off white periostracum tightly adherent to the shell. Its valves are thin but strong, porcellanous. The posterior part of the shell is attenuated with strong posterior flexure. Large ligament extends to the middle of the posterior upper margin of the shell, and is surrounded by two low wrinkled ridges, terminating slightly behind the apices. Sinuses are in contact with the pallial line along their entire length. In 25-30 mm. long specimens the distance between the tip of the sinus and the anterior muscle scars of the right valve is 4 mm., in the left 2 mm. This

relation, two to one, remains constant in specimens of all age groups.

Hinge: anterior cardinal tooth of the right valve is attached by a thin footing to the hinge plate; it is broadened distally and there is a thin lamella in front of it. The posterior cardinal tooth is wide, two-lobed and has a fragile footing. The anterior cardinal tooth of the left valve is robust, bipartite, with thin footing. Posterior cardinal tooth is widened; there is a thin lamella behind it.

Dimensions of the shells were as follows:

	l	h	w	h/l	w/l
Bering Sea (Staff. Geol. Mus. 48421)	23.0	17.0	8.0	0.73	0.34
Amundsen Gulf (NMC 62-215)	26.0	18.0	7.5	0.69	0.30
	21.0	15.5	7.0	0.73	0.33
	22.5	16.0	6.0	0.71	0.27
	20.0	14.5	5.5	0.70	0.25
	17.5	13.0	5.0	0.74	0.30

M. planiuscula is a subarctic Pacific species.

Suborder Asthenodontida.

Family Myidae.

Genus Mya Linne 1758

Mya truncata Linne 1758

Mya truncata Linne, 1758, Syst. Nat. ed. 10, p. 670.

Mya truncata - Foster, 1946, pl. 17, 18; fig. 1-4.

Distribution in the Canadian Arctic: Map 50.

Published records:

Mya truncata and M. truncata uddevalensis - Gray, 1824, Arctic Archipelago; Reeve, 1855, Arctic Archipelago; Sutherland, 1852, N. W. Baffin Bay; Smith, 1877, N. W. Baffin Bay; Stimpson, 1861, Ungava Bay; Pfeffer, 1882-83, Cumberland Sound; Whiteaves, 1882-84, Hudson Strait; Whiteaves, 1881, Hudson Bay; Dall, 1870, Cumberland Sound; Bush, 1883, Labrador; Packard, 1867, 1863, Labrador; Dall, 1886, Ungava Bay; Whiteaves, 1901, Hudson Bay; Grieg, 1909, N. W. Baffin Bay; Dall, 1919, Ponds Inlet; Baker, 1919, N. W. Baffin Bay; Brooks Stanley, 1935, N. Hudson Bay; Dall, 1924, W. Arctic Archipelago; Richards, 1936, James Bay; Richards, 1941, W. Hudson Bay; Ellis, 1960, Northern Baffin Land.

Mya uddevalensis Hancock, 1846, Cumberland Sound.

New records: Canadian Central and Eastern Arctic (Coll. FRBC and NMC).

Mya truncata is one of the common bivalves of the Canadian Arctic. It has been found as far north as 80°N; its southern boundary is the Bay of Massachusetts.

It occurs in the intertidal and upper sublittoral zone, but its juveniles have been taken at depths down to 100 meters.

M. truncata in its typical, elongated form is seldom taken in the Canadian Arctic. Most of the specimens belong to Mya truncata uddevalensis Forbes 1946, a shortened form with slanted posterior end of the shell.

Specimens intermediate between these two forms are numerous. The degree of slanting of the posterior end is environmentally dependent and develops with age. Mya truncata attains a length of 8 mm. in the Canadian Eastern Arctic. In southern Hudson Bay and James Bay only dwarfed specimens occur.

Distribution outside the Canadian Arctic:

Greenland and Iceland. Norway, Finmarken (Uddevala). Off France and British Islands.

Eurasian Arctic Seas: In all Arctic seas from Finmarken eastwards. Off the shores of Arctic Western America. Largest size in Greenland and Eurasian sea - 75 mm.

M. truncata is a panarctic-boreal species of circumpolar distribution.

Mya arenaria Linne, 1758

Mya arenaria Linne, 1758, Syst. Nat., ed. 10, p. 610.

Mya arenaria - Foster, 1946, p. 32-35, pl. 20, 21.

Distribution in the Canadian Arctic: Map 49.

Published records:

Mya arenaria - Packard, 1867, Labrador; Bush, 1883, Labrador.

New records: Southern Labrador (Dr. Steele Coll.). Nain and Hopedale.

This species occurs off the shores of N. W. Atlantic from Labrador to Florida.

M. arenaria has been recorded from Georges Strait (W. Hudson Strait) by Halkett, 1898; Dall stated that Mya arenaria occurs in Ungava Bay "generally" (1886). Whiteaves recorded it from Richmond Gulf (1901). However, Whiteaves specimens seen by the author in the collections of NMC are subfossil shells of Mya pseudarenaria Schlesch. (M. truncata f. ovata Jensen). M. pseudarenaria has often been misidentified as M. truncata or M. arenaria. The distribution and synonymy of M. arenaria, M. pseudarenaria, M. intermedia and M. japonica are discussed by Schlesch 1931 and N. MacGinitie 1954, 186-188. Many young specimens of M. truncata from James Bay resemble M. pseudarenaria, and can be easily confused with dwarfed adult M. truncata abundant in this

district. It is doubtful that M. pseudarenaria is living at present in the Canadian Arctic.

Distribution of Mya arenaria L. outside the Canadian Arctic:

Abundant at Finmarken, Murman and White Sea. The eastern boundary of Mya arenaria in the Eurasian Seas is off Kanin Nos.

Mya arenaria is a boreal species, penetrating into the Arctic with the Atlantic waters.

Family Hiatellidae

Genus Cyrtodaria Daudin 1799

Cyrtodaria kurriana Dunker, 1862

Cyrtodaria kurriana Dunker, 1862, Malak. Blatter., p. 38.

Cyrtodaria kurriana - Ockelmann, 1958, pl. 2, fig. 14.

Distribution in the Canadian Arctic: Map 51.

Published records:

Clycimeris kurriana - Dall, 1879, Cumberland Sound; Dall, 1919, Herschel Island, Cape Bathurst, Dolphin and Union Strait.

Clycimeris siliqua Gray, 1824, Arctic Archipelago.

New records: Canadian Archipelago and southern shores of Baffin Land.

Cyrtodaria kurriana has been found in the region of Dolphin and Union Strait and off the southern shores of Baffin Land. Its boring habits complicate the study of its distribution.

C. kurriana attains a length of 40 mm. At the southern shores of Labrador it is replaced by a closely related C. siliqua with which is has often been confused. C. siliqua is a boreal species, occurring from Labrador to Massachusetts.

Distribution outside the Canadian Arctic:

Greenland: Godthaab and in Disco Bay in Western Greenland. Whole shore of Eastern Greenland, but rare in the south. Absent from Iceland.

Eurasian Arctic Seas: Kara Sea to Bering Sea.

Western N. America: Off Alaska.

C. kurriana is a high arctic species of circumpolar distribution.

Family Hiatellidae

Genus Hiatella Daudin, in Bosc. 1801

Hiatella arctica (Linne 1767)

Mya arctica Linne, 1767, ed. 12, Syst. Nat. p. 1113.

Saxicava arctica - G. O. Sars, 1878, p. 95, pl. 20, figs. 8 a-c.

Saxicava pholadis G. O. Sars, 1878, pl. 20, figs. 7 a-c.

Distribution in the Canadian Arctic: Map 52.

Published records:

Saxicava arctica - Gray, 1824, Arctic Archipelago; Smith, 1877, N. W. Baffin Bay; Dall, 1887, Ungava Bay; Grieg, 1909, N. W. Baffin Bay; Baker, 1919, N. W. Baffin Bay; Brooks Stanley, 1935, N. Hudson Bay; Richards, 1936, James Bay; 1941, N. Hudson Bay; Johnson, 1926, Labrador; North Baffin Bay, North Hudson Bay, Laursen 1946; Ellis, 1960, N. Baffin Bay.

Saxicava pholadis - Hancock, 1846, Cumberland Sound; Dall, 1924

Saxicava rugosa - Sutherland, 1852, N. W. Baffin Bay; Reeve, 1855, Wellington Channel; Packard, 1863, Labrador; 1867, Labrador; Whiteaves, 1882-84, Hudson Strait; Whiteaves, 1901, Hudson Bay.

New records: Canadian Eastern Arctic (Coll. FRBC).
(App. I.)

Hiatella arctica is one of the commonest circumpolar species and is considered a cosmopolitan. Its larvae, however, differ in shape in the northern and in the southern parts of the area. It is possible, therefore, that within the large area there occurs more than one species, indiscernible in adult stage. Discussions on larval diversity in Hiatella arctica are in Thorson, 1936, 1946, 1950; Ockelmann, 1958; N. MacGinitie, 1959.

Subclass Anomalodesmata.

Order Eudesmodontida

Family Pandoridae

Genus Pandora Hwass, 1795

Subgenus Kennerlia Carpenter, 1864

Pandora (Kennerlia) glacialis Leach, 1819

Pandora glacialis Leach, A list of Invertebrate Animals ... in Ross, 1819, App. 2, pp. 61-62.

Pandora glacialis - G. O. Sars, 1878, pl. 1, figs. 1 a-b.

Distribution in the Canadian Arctic: Map 53.

Published records:

Pandora glacialis - Sutherland, 1852, Barrow Strait; Johnson, 1926, Labrador; Grieg, 1909, Arctic Archipelago.

Kennerlia glacialis - Packard, 1891, Labrador; Bush, 1883, Labrador; Richards, 1936, James Bay; Dall, 1924, Burwell.

New records: Foxe Basin, Hudson Bay, Northern Labrador (Coll. FRBC); Archipelago (Coll. FRBC); Hudson Bay (Coll. NMC).

P. (K.) glacialis is rare in the Canadian Arctic. It is a shallow water species occurring at depths down to 50 meters. Southward it reaches St. Lawrence Bay (Ockelmann 1958).

Distribution outside the Canadian Arctic:

Greenland: Absent in West Greenland. East Greenland:

in Scoresby Sound and in Franz Josef Fjord. Not recorded from Iceland.

Eurasian Arctic Seas: In cold regions of Barents Sea and in all Eurasian arctic seas. Not recorded from Western American Arctic.

P. (K.) glacialis is a panarctic Atlantic shallow water species.

Family Lyonsiidae

Genus Lyonsia Tourton 1822

Lysonia arenosa (Moller 1842)

Pl. 26, fig. 119.

Pandorina arenosa Moller, 1842, Index Moll. Groenl., p. 20.

Lyonsia arenosa - G.O. Sars, 1878, pl. 34, figs. 2 a-b.

Distribution in the Canadian Arctic: Map 54.

Published records:

Pandorina arenosa: Reeve, 1855, Canadian Archipelago.

Lyonsia gibbosa: Hancock, 1846, Cumberland Sound.

Lyonsia arenosa: Whiteaves, 1882-84, Ungava, Burwell; Bush, 1883, Labrador; Packard, 1891, Labrador; Grieg, 1909, Arctic Archipelago; Baker, 1911, N.W. Baffin Bay; Johnson, 1926, Labrador; Dall, 1919, Dolphin Strait.

New records: Ponds Inlet, Baffin Bay (Coll. Ellis); Eastern Canadian Arctic (Coll. FRBC); Alert, Ellesmere Land (Coll. NMC). (App. I.)

L. arenosa occurs throughout the Canadian Arctic, down to Nova Scotia. This species has often been confused with L. hyalina Conrad, which occurs from Labrador to Massachusetts; this last species has been recorded by Dall, 1924, from Burwell, North Labrador. I have had no opportunity to examine these specimens.

Distribution outside the Canadian Arctic:

Greenland: Entire shores of W. and E. Greenland. Off eastern and northern Iceland.

Eurasian Arctic Seas: In the entire Eurasian region.

Western North American Arctic: Beaufort Sea, Aleutians.

L. arenosa is a shallow water, high arctic, circumpolar species.

Family Periplomatidae

Genus Periploma Schumacher 1817

Periploma abyssorum (Verrill M.S.) Bush 1917

Pl. 27, figs. 120.

Periploma abyssorum Bush, 1893,

p. 227, Pl. 2, figs. 12, 13.

Distribution in the Canadian Arctic: Map 55.

Published records:

Periploma abyssorum - Thorson, 1951, off Lancaster Sound;

Ellis, 1960, Arctic Bay, N. Baffin Land.

New records: Hudson Bay (FRBC). (App.I)

P. abyssorum has been considered as an Atlantic deep water species occurring from Chesapeake Bay to Cape Hatteras. However, its occurrence at depths of 25-50 meters in Pond Inlet and in Hudson Bay shows that this deep water species emerges on the shelf of the Canadian Arctic.

Distribution outside the Canadian Arctic:

Greenland and Iceland: No records.

Eurasian Arctic Seas: In 1932 Soot-Ryen found this species in the shallow waters off Vrangel Is., Chukchi Sea. In discussing the bivalves of this sea and of the Polar

Ocean, Gorbunow, 1941, 1946, questioned the identity of P. abyssorum and identified the high arctic Periploma as P. fragilis Totten, 1835. This last name has been used in the Russian literature (see Filatova, 1948, 1957) and P. abyssorum regarded as its synonym. The difference in shape of the left and right valves in adult periplomas and the similarity of young specimens of both species, mentioned by Gorbunov (ibid.), also have been observed in specimens from Hudson Bay. In Eurasian Arctic seas P. abyssorum (P. fragilis of Russian authors) occurs from the Kara Sea to the Bering Sea.

The relationship of P. abyssorum with P. fragilis is in need of investigation. It is probable that P. fragilis Totten is a southern subspecies of P. abyssorum.

P. abyssorum is a panarctic Atlantic species emerging into shallow waters in high latitudes.

Periploma fragilis (Totten 1835)

Anatina fragilis Totten, 1835, Am. J. of Sc., vol. 28, p. 347.

Periploma fragilis Verill 1873, p. 673.

Periploma fragilis Dall, 1889, pl. 59, fig. 7.

Distribution in the Canadian Arctic:

Published records:

Periploma fragilis - Johnson, 1926, Labrador.

New records: None.

P. fragilis is known to occur from Labrador to New Jersey, and is peculiar to the Western North Atlantic. Records of this species in the Eurasian Arctic Seas are doubtful. The specimen of "P. fragilis" depicted by Filatova (1948, pl. CXIII, fig. 5) is P. abyssorum Verill. Until the relationship of these two species is investigated, P. fragilis should be regarded as a boreal species with outposts in the Subarctic.

Family Thraciidae

Genus Thracia Blainville 1824

Subgenus Thracia s. str. Sooth-Ryen 1941

Thracia (Thracia) devexa G.O. Sars 1878

Pl. 26, fig. 122.

Distribution in the Canadian Arctic: Map 56.

Published records from the Canadian Arctic: None.

New records:

Canadian Archipelago, Isachsen Island, Prince Patrick Island (Coll. NMC).

Ellesmere Island, Banks Island, Franklin Bay (Coll. FRBC).

South-eastern Hudson Bay (Coll. NMC). (App. I.)

This is the first record of this rare species in the Canadian Arctic. It has been found at depths of 10 to 250 feet. Dimensions: 30.5 x 22.0 x 13.8 mm.

Distribution outside the Canadian Arctic:

East Greenland: Frans Josef Fjord, Scoresby Sound and Lindenow Fjord.

East Atlantic: Norway, Spitzbergen, Novaja Zemlia.

T. devexa has been often confused with related species and therefore its eastern area of distribution should be investigated.

T. devexa is a high arctic Atlantic species.

Thracia (Thracia) myopsis (Beck) Moller 1842

Pl. 26, fig. 124.

Thracia myopsis Moller 1842, Index Moll. Groenl. p. 94.

Thracia (Thracia) myopsis - Soot-Ryen, 1941, pl. 6, fig. 3.

Distribution in the Canadian Arctic: Map 57.

Published records:

Thracia myopsis: Packard, 1867, Labrador; Bush, 1883, Labrador; Ellis, 1960, Eclipse Sound, N. Baffin Land.

New records: Ellesmere Land (Coll. NMC); Frobisher Bay, Southern Hudson Bay (Coll. FRBC).

T. myopsis has been recorded from Labrador to Massachusetts. New records extend its area of distribution into the Canadian Arctic north from Labrador, where it occurs at depths down to 30 meters.

Distribution outside the Canadian Arctic:

Greenland: Off western shores from Umanak southward; Scoresby Sound and Angmagssalik in East Greenland.

Eurasian Arctic Seas: Bering Sea.

West North America: From Point Barrow to Aleutians.

T. myopsis is a panarctic circumpolar shallow water species.

Subgenus Crassithracia Soot-Ryen, 1941.

Thracia (Crassithracia) septentrionalis Soot-Ryen, 1941. Tromsø. Mus. Arshefter, Nr. 17, pl. 1, figs. 8, 9, 10.

Distribution in the Canadian Arctic: Map 58.

Published records:

Thracia septentrionalis - Greig, 1909, Arctic Archipelago; Ellis, 1960, N. Baffin Land.

New records: Hudson Bay (Coll. FRBC). (App. I.)

T. septentrionalis is rare in the Canadian Arctic. It has been found in Smith Sound, Pond Inlet and in the mouth of Hudson Bay. It is a shallow water species, occurring at the depth of up to 50 metres. Southward from the Canadian Arctic it reaches the shores of New England.

Distribution outside the Canadian Arctic:

Greenland; Iceland.

Eurasian Arctic Seas: Filatova, 1957, recorded T. septentrionalis from the Barents, White and Kara Seas. Cockelmann (1958), however, stated that this species is absent from the Eurasian Seas.

T. septentrionalis is a panarctic species with outposts in the boreal zone. It probably occurs only in the West Atlantic sector of the Arctic.

Order Septibranchida

Family Cuspidariidae

Genus Cuspidaria Nardo 1840

Cuspidaria arctica (M. Sars 1865)

Naera arctica - G.O. Sars, 1878, pl. 6, fig. 5 a-c.

Cuspidaria arctica - Ockelmann, 1957, pl. 3, fig. 7, 8.

Distribution in the Canadian Arctic: Map 59.

Published records: None.

New records: Archipelago, Ellesmere Island (Coll, FRBC); Isachsen Island and Coronation Gulf (Coll. NMC). (App. I.)

A few specimens of this species have been collected in the Archipelago at depths of 10 to 120 meters.

Distribution outside the Canadian Arctic:

Greenland: Rare in the Northern W. and E. Greenland. In deep water of northern and eastern Greenland.

Eurasian Seas: From Barents Sea to and including East Siberian Sea and Bering Sea.

Cuspidaria arctica is a high arctic Atlantic species.

Cuspidaria glacialis (G. O. Sars 1878)

Naera glacialis G. O. Sars, 1878, pl. 6, fig. 8 a-b.

Distribution in the Canadian Arctic: Map 60.

Published records: None.

New records:

Cuspidaria glacialis: Eastern Lancaster Sound, depth 680 meters, reported as C. obesa (Loven) by Thorson, 1951 (fide Ockelmann, 1958).

This deep water species has been found only in the Archipelago.

Distribution outside the Canadian Arctic:

Greenland: Rare in W. Greenland, common in East Greenland. In deep waters off Iceland, Norway.

Eurasian Arctic Seas: From the Barents to West Siberian Sea.

N. Atlantic: In deep waters (Clarke, 1962).

C. glacialis is a panarctic Atlantic species.

Cuspidaria subtorta (G. O. Sars, 1878).

Pl. 26, fig. 121, 122.

Naera subtorta G. O. Sars, 1878, Moll. Reg. Arct. Norv., pl. 6, figs. 6 a-c.

Cuspidaria subtorta - Ockelmann 1958, pl. 3, fig. 9.

Distribution in the Canadian Arctic: Map 61.

Published records:

Naera subtorta - Jeffreys, 1877, Hall Basin, 82°33' N.

New records: Canadian Archipelago (Coll. NMC); Southern Hudson Bay (Coll. FRBC). (App. I.).

C. subtorta has been found in the Canadian Archipelago and in southern Hudson Bay. In the last district one specimen was taken at a depth of 168 meters in the cold water trench.

Dimensions of Canadian specimens from Prince Patrick Island: 8.0 x 5.3 x 3.8 mm.; from Isachsen Island: 10.0 x 6.5 x 5.5 mm.

In southern Hudson Bay this high arctic species is probably a relict.

Distribution outside the Canadian Arctic:

Greenland: Probably extinct in W. Greenland. Northern shores of E. Greenland and norther shores of Iceland.

Table 4. MARINE BIVALVIA OF THE CANADIAN ARCTIC

Subclass	Order	Superfamily	Family	Genus	Species
Prionodesmata	Protobranchida s/o Paleotaxodontina	Nuculacea	Nuculidae	Nucula	N. belloti Adams
					N. delphinodonta Migh. and Adams
					N. pernula (Müller)
					N. minuta (Fabricius)
			Nuculanidae	Nuculana	Y. hyperborea (Loven) Torell
					Y. myalis (Couthoy)
				Yoldia	Y. frigida (Torell)
					Y. lenticula (Møller)
					Y. intermedia (M. Sars)
				Yoldiella	Y. tamara Gorbunov
					P. arctica (Gray)
				Portlandia	P. sulcifera (Reeve)
	Prionodontida	Arcacea	Arcidae	Bathyarca	B. glacialis (Gray)
					B. pectunculoides (Scacchi)
Pteriomorphia	Pteroconchida	Mytilacea	Mytilidae	Mytilus	M. edulis Linne
				Dacridium	D. vitreum (Møller)
				Musculus	M. corrugatus (Stimpson)
					M. discors (Linne)
					M. niger (Gray)
				Crenella	C. decussata (Montagu)
					C. faba (Müller)
		Pectinacea	Pectinidae	Chlamys	C. islandica (Müller)
				Delectopecten	D. groenlandicus (Sowerby)
			Limidae	Lima	L. subauriculata Montagu
Teleodesmata	Heterondontida s/o Diogenodontina	Astartacea	Astartidae	Astarte	A. arctica (Gray)
					A. banksi (Leach)
					A. globosa (Møller)
					A. borealis (Schumacher)
					A. crenata (Gray)
					A. elliptica (Brown)
					A. soror Dall
					A. striata (Leach)
					A. warhami Hancock
		Carditacea	Carditidae	Venericardia	V. borealis (Conrad)
		Leptonacea	Montacutidae	Montacuta	M. substriata (Montagu)
		Cyamiacea	Turtoniidae	Turtonia	T. minuta (Fabricius)
			Thyasiridae	Axinopsida	A. orbiculata (G.O. Sars)
				Thyasira	T. dunbari sp. n.
					T. gouldi (Philippi)
	s/o Cyclodontina	Cardiacea	Cardiidae	Clinocardium	C. ciliatum (Fabricius)
				Serripes	S. groenlandicus Bruggiere
	s/o Teleodontina	Veneracea	Veneridae	Liocyma	L. fluctuosa (Gould)
		Tellinacea	Tellinidae	Macoma	M. balthica (Linne)
			s/f Macominae		M. calcarea (Gmelin)
					M. inconspicus (Brod. and Sow.)
					M. loveni (Steenstrup) Jensen
					M. moesta (Deshayes)
					M. torelli (Steenstrup) Jensen
	s/o Astenodontina	Myacea	Myidae	Mya	M. planiuscula Grant and Gale
					M. arenaria Linne
			Histellidae	Cyrtodaria	M. truncata Linne
				Hiatella	C. kurriana Dunker
Anomalodesmata	Eudesmodontida	Pandoracea	Pandoridae	Pandora	H. arctica(Linne)
			Lyonsiidae	Lyonsia	P. glacialis Leach
			Periplomatidae	Periploma	L. arenosa (Møller)
			Thraciidae	Thracia	P. abyssorum Verrill
					T. devexa (G.O. Sars)
					T. myopsis (Beck) Møller
					T. septentrionalis Jeffrey
	Septibranchida	Poromyacea	Cuspidariidae	Cuspidaria	C. arctica (G.O. Sars)
					C. glacialis (G.O. Sars)
					C. subtorta (G.O. Sars)

Eurasian Arctic Seas: Occurs from the Barenz to the Laptev Sea.

N. W. America: No records.

Arctic species of Cuspidaria are not easily identifiable; the revision of Ockelmann, 1958, is the first attempt to clear up the systematics and the distribution of some representatives of this genus.

C. subtorta is a high arctic species occurring in the Atlantic sector of the Arctic.

III. PLEISTOCENE HISTORY OF THE CANADIAN ARCTIC REGION AND OF ITS BIVALVE FAUNA..... 185

History of the Canadian Arctic marine region.

The Central and Eastern Canadian Arctic extends over the north-eastern part of the North American continent, formed by the Canadian Shield. In respect to the physiography of the land and of the marine waters this region is a well defined unit; its geological past has great bearing on the formation of the recent marine shallow water region and of its fauna.

The paleogeography of the Canadiam Arctic region has been studied intensively. The main geological features of the shield are discussed by Ruedemann et al. (1939), and the complicated geological history of the Archipelago by Clark and Stearn (1960), Thorsteinsson and Tozer (1960), Martin (1960), Blackadar and Frazer (1961), Horn (1963), Marlowe and Wilks (1963), Marlowe (1964), Pelletier (1962, 1964, 1966), Fortier and Morley (1965).

The basically simple physiography of the shield is complicated by the presence of the Archipelago and of Greenland in the north. Although now separated from the mainland, these units are geological extensions of the shield, and belong to the North American crystalline plateau. The Canadian Shield is one of the most stable regions of the northern hemisphere. Ruedemann (1939) states that it is "one of the primordial units of the earth."

The shield has not changed significantly since its origin in the Precambrian except for its stand-level: there have been periods of extensive raising and lowering of the entire land mass, caused either by orogenic processes, or by changes in the ice load in the Pleistocene. The north-eastern part of the shield remained elevated, however, for most of the time. Despite the marine transgressions in Jurassic, Trias and Cretaceous, constantly uplifted areas remained in the north with the maximum at Ellesmere Land. (Martin, 1960: 11-15, Figs. 3-8). The Ordovician and Silurian climatic zones did not exist, the Arctic sea was warm. Most paleographers agree that the polar ocean originated in Jurassic, when a great folding lifted the northern part of the shield. This was followed by the downwarping of the land on both sides of the Lomonosov Ridge (Saks, 1958). The endemic fauna of the Polar Ocean was formed in the early Tertiary, during the long period of stability when the events leading to the formation of the Archipelago and partially of the Canadian Eastern Arctic, were discussed by Fortier and Morley (1965). These authors point out that during the late Tertiary, and especially the Pliocene, the highly uplifted shield under-went erosion. Tertiary rivers cut deep into it bringing down abundant products of erosion and depositing them in the west (Beaufort formation). In their Fig. 3, these authors illustrate the inferred main elevations and the drainage system of this period. River valleys are seen in the place.

of recent channels, and the main elements of the future Archipelago are discernible. The views of these authors on the geological unity of the Archipelago and its origin are supported by Horne (1963), Marlowe and Wilkis (1963), and Pelletier (1962, 1964, 1966). According to Schuchert (1939), the Greenlandic part of the shield remained connected to the mainland until the Cretaceous. The separation began in the south with the sinking of the land in the northern Labrador Sea. The continuing uplift in the north resulted in the separation of northern Greenland (Saks, 1958). The final separation took place in the late Tertiary with the sinking of the land in the region of Davis Strait, and possibly of the whole of Baffin Bay (Teichert, 1939; Pelletier, 1964).

Pleistocene in the Canadian Arctic.

The stable conditions in the north of the American continent during the Tertiary were interrupted by the oncoming Pleistocene. The Canadian Arctic was in the centre of the ice accumulation (Bird, 1967, Figs. 28-30) and was affected by glaciation.

Marine barriers and their fauna were destroyed by grounded ice, but eventually were re-established in the interglacials. The changes caused by this succession of glacials and interglacials are not known, because of the repeated destruction of the land surface by the glacier.

Flint (1952, p.135), says: ".....our reconstruction of glacials and interglacials in the Arctic consists of broad generalizations meagerly supported at one place or other by detailed data". At present three interglacial and four glacials are recognized.

The study of the Pleistocene in the Canadian Arctic began in the mid-nineteenth century with the classical research of Lyell (1895), Tyrell (1896, 1898) and Dawson (1893). The most important papers on the Pleistocene in the Arctic are those of Flint (1947, 1957, 1960), Raasch (1961) and Ruedemann (1939). Papers concerned with the Canadian Arctic are those of Bird (1953, 1955, 1955b, 1967), Sim (1952, 1962), Mercer (1956), Lee (1960) and Farrand (1932). The investigation of the Canadian Region by the Pleistocene group of the Geological Survey of Canada resulted in the publication of papers by Andrews (1965, 1966, 1968), Blake (1962, 1966, 1970), Craig (1960, 1961, 1968), Terasmae, Webber and Andrews (1966), Falconer, Ives, Løken and Andrews (1965), Craig and Fyles (1966), Løken (1965), Pelletier (1964, 1966, 1968) and Wagner (1962, 1964 a,b 1967, 1968). These papers are concerned with the Post Wisconsin period, when the recent shallow water region with its fauna was formed. The Wisconsin glacier covered the entire Canadian Arctic (Wendorf, 1966, Figs. 3,5). Smaller caps exist in the north of the Archipelago and coalesced

during colder periods. The Innuitian glacier remained for a long time over Ellesmere Land and Melville Peninsula. Large areas of sea close to the glacier were covered by the floating ice. The Laurentian glacier was about 10,000 feet thick and depressed the shelf for about one-third of its height. (Flint, 1952; Mercer, 1956). The last glaciation reached its maximum about 35-30000 B.P. and its last stages at about 6.000-3000 B.P. The last territory to be freed from ice was the Canadian Arctic (Bird, 1967, Figs. 28-31; Falconer, Ives, Løken and Andrews, 1966).

Marine transgression followed closely the receding margin of the ice. Large amounts of water were liberated and the sea level rose. In the marine epicontinental region of the Canadian Arctic, the influx from the Arctic ocean and from the land drainage was intensive; the Atlantic waters entered from the south-east. During the marine transgression the areas of the polar and of the Atlantic waters did not remain stable: the isostatic recovery progressed and the pressure of the marine water fluctuated. Data on the land rebound in the Canadian Arctic are given by Fairbridge (1961), Farrand (1962) and by Wagner (1967). These authors show that the recovery was at a maximum at the beginning of the deglaciation and decreased thereafter to the recent rate of about three feet per century. The highest beaches of the eastern shores of Hudson Bay are now

at a height of 900 feet.

During the glaciation the marine fauna probably existed in the areas of the floating ice around the entire glacier and in the deep channels of the northern Archipelago. At the end of the glaciation, the marine transgression was extensive and the marine connections over the continent were broad. The Archipelago was inundated except for the region of the Innuitian glacier. A large epicontinental "Tyrell Sea" was formed in the south (Lee, 1960), with broad connections with the southern and the northern marine regions. This sea extended beyond the boundaries of the present Hudson Bay (Wagner, 1968, Fig,1). Its average depth was 400 metres with a maximum of 700 metres at Theulon. It attained its maximum about 8000-6000 B.P. The continuing rebound caused the gradual retreat of the epicontinental waters and decreased the depth of the Tyrell Sea to 100-200 metres, characteristic of the recent Hudson Bay. Marine connections either narrowed or disappeared. The marine shallow water region was assuming its recent configuration. At present the depth of Hudson Bay is less in the south, and the Bay continues to retreat northwards. According to Gutenberg (1941, p.766) "it has to be expected that the depth and the size of Hudson Bay will decrease rather rapidly in the future and little of the northern part, if anything, will be left of Hudson Bay when the uplift approaches its completion." It is impossible to

predict whether the shield will attain its Tertiary level: its elevation depends not only on the ice load, but also on orogenic processes. If the shield should rise considerably, almost the entire system of the inland waters would disappear and the connections between the Arctic and the Atlantic oceans would be disrupted again.

The recent shallow water region of the Canadian Arctic is a reminder of the postglacial transgression, a postglacial relic. Recent connections over the continent consist of the channels of the Archipelago and of Foxe Basin, Hudson Bay and Hudson Strait. A continuous flow of polar waters moving southwards over the continent is established. In the south they meet the Atlantic waters, and a very complicated pattern of exchange, caused by the land dissection, is produced.

Formation of the recent marine bivalve fauna of the Canadian Arctic.

The formation of any fauna is a process of long duration. When not interrupted by catastrophic geological events, the fauna develops as a continuous evolutionary sequence, resulting in the recent fauna, which in its turn becomes the foundation for the future faunas.

The continuous development of the Tertiary fauna in high latitudes was catastrophically disrupted by the onset of glaciations. The period of the uninterrupted development leading to the recent fauna begins only in the late Wisconsin

during, and after, the retreat of the last glacier.

The recent environment is not solely responsible for the systematic composition of the bivalve fauna of this region. The disruption of areas, the presence of relic areas, and the patterns of distribution in general can be understood only against the background of the Pleistocene events and particularly those of the Wisconsin glaciation.

The recent bivalve fauna of high latitudes developed from that of the Pleistocene. Grant and Gale (1931), correctly regard the Pleistocene fauna as a young one, which originated in the late Tertiary or in early Pleistocene. This fauna evolved as a result of the deterioration of climate, and of a series of migrations, caused by a succession of glacial and interglacial periods. In contrast to the Tertiary, the Pleistocene fauna was a cold water one. Grant and Gale (litt. cit., p.20), state that the Pleistocene fauna and the recent faunas of bivalves are similar. The Pleistocene fauna "has not contained species, that have not left living descendants." These authors stress also the evolutionary stability of the fauna throughout the Pleistocene: "for distinguishing the horizons from each other and from the recent, if extinction of species alone were dependent upon, only a few varieties and closely related forms of doubtful value could be used."(ibid.litt. cit., p.21).

Bartenev (1933, a,b,) divided the Pleistocene animal migrations into two groups according to their directions: 1. glacial migrations, those of animal dispersion before the advancing glacier; 2. interglacial migrations, those of animals proceeding in the opposite direction following the receding glacier. Schemes of Bartenev are based on examples of migrations of land animals, but they are also applicable to the migrations of marine annimals. The routes of dispersion of marine bivalves from the Canadian Arctic into the North Atlantic are not known. As the glacier was expanding in all directions from its centre in the Canadian Arctic and in Greenland, the fauna dispersed in all directions from its periphery, remaining, however, within the favouable environment of the periglacial marine zone. The interglacial migrations proceeded northward over the submerged shelf; the bivalves settled in the newly formed temporary embayments and epicontinental basins. The isostatic uplift often isolated these temporary basins and entrapped their fauna. In some of such basins the relic faunas still survive.

Migrating populations of bivalves closely followed the receding glacier. Wagner (1959) and Blake (1961) found bivalves settled at the end moraines. Abundant populations of bivalves with large heavy shells were often found in close proximity to the glaciers, indicating that the environment was favourable (Jensen 1905), (Warren, Gray and Naseruddin

Ahmad, in Raasch, 1961).

These migrations resulted in an outburst of speciation. The coldwater species, moving northwards, left behind populations living at present in a warmer unfavourable environment, populations which had to adapt themselves to the new conditions. The populations migrating northwards were also evolving. The latitudinal areas of many species became extended. Many populations were isolated, and evolved separately with consequent development of closely related species, subspecies, and clines. Evolution in migration and subsequent isolation explains the latitudinal succession of lower, subspecific, taxa in the recent bivalve fauna on high latitudes.

With a retreat of the glacier from the Canadian Arctic the main stage of migration was over, and readjustments followed later.

EPISODES IN MIGRATION OF THE COLDWATER FAUNA IN THE NORTH-WEST ATLANTIC AND THE CANADIAN ARCTIC

The last glaciation destroyed the shallow water fauna of the Canadian Arctic, leaving little evidence of the fauna of the last interglacial. The marine fauna was shifted both southward and northward from the centre of glaciation. The Post-Wisconsin deposits, however, provided some data on the postglacial migration of this fauna. Innes et al.(1966, p.11,

Fig.8) reconstructed the extension of the Wisconsin glacier and the marine transgression which followed its retreat.

The Atlantic episode in the migration of the northern fauna.

The southern margin of the Wisconsin glacier was grounded in Pennsylvania and in New Jersey (Richards, 1962, Clark,1906, p.147). Not only the Canadian coldwater fauna, was displaced southward, but also the Acadian. The marine fauna of Virginia at the time of glaciation was mixed, and consisted of the aboriginal warm water fauna of the Miocene, of the immigrants of the temperate Acadian fauna (Crassostrea virginica, Mya arenaria) and of the Pleistocene coldwater species (Macoma calcarea, M. balthica). The northern current moving over the submerged shelf and the embayments, supported the coldwater fauna in Maryland, Maine and in the Champlain Sea. At Cape Cod the coldwater fauna was dominant. With the retreat of the glacier, this fauna migrated northwards and established itself in the Canadian Arctic. The coldwater elements in the recent temperate fauna of Massachussets, Maine and Nova Scotia can be regarded as relics of the formerly dispersed periglacial marine fauna. The areas of Pandora glacialis, Lyonsia arenosa, Portlandia arctica, Yoldiella lenticula and Macoma calcarea are confined in the south to the colder water zone, at a depth of 50-200 metres.

The Champlain Sea episode is a most striking example of the migration of the Pleistocene fauna in the Atlantic

Ocean. The marine fauna of this sea which existed 12,000-8,000 B.P. has been well studied by Dawson (1864), Packard (1867), Goldring (1922), Elson (1959, 1960), Wagner (1967, 1970). Thirty-six species of bivalves have been found in the Champlain Sea. Its fauna was basically Arctic. It contained some Acadian shallow water species, (Mya arenaria, Volsella modiolus, Crenella glandula), a deep water species Yoldia traeciformis and a large group of Pleistocene species. The presence of such ecologically different components in the faunistic listing of bivalves was puzzling until the publication of Elson's papers (1959, 1960). He showed that the Champlain sea went through a series of stages, each characterized by a different extension of the sea, its depth, salinity, and temperature and consequently by a different fauna. Relics of the Arctic fauna of the Champlain sea still live in the Saguenay Fjord, and in the deep waters of the St. Lawrence River.

Fauna of the Saguenay Fjord.

The bivalves of the Saguenay Fjord were collected by the Biological Station at Grande Riviere, Quebec and identified by the present author. The following species are found: Nuculana pernula costigera, N. minuta, Bathyarca glacialis, Musculus discors, Crenella faba, Chlamys islandica Astarte borealis, A. elliptica, A. crenata subaequilatera, Venericardia borealis, Thyasira gouldi, Clinocardium ciliatum,

Hiatella arctica, Cuspidaria subtorta, Mytilus edulis and Macoma balthica.

The fauna of the Saguenay Fjord is mixed: besides the abundant arctic shallow water species it contains subarctic-boreal and deep water elements. This fauna is a relic of that of the Champlain Sea and probably not too different from it. The fjord is separated by a narrow threshold from the main channel of the St. Lawrence river, whose deep water fauna is Arctic, and temperate marine and brackish in its shallow water zone (Bousfield, 1955).

The bivalve fauna of the Saguenay is strikingly similar to that of the south-eastern Hudson Bay and James Bay, suggesting the existence of former connections between the Tyrell and the Champlain Seas. Connections between these basins were discussed by Potter (1932), and by LaRoque (1949). The last author suggests connections between the Champlain and Tyrell Seas via Saguenay Fjord-Lake St. John (LaRoque, 1949, Fig.104). However, the migrating coldwater bivalve fauna was almost uniform throughout the entire north-eastern region of North America. Geologically, the existence of such connections has not been proved; the early upheaval of the land in this region excludes the possibility of past connections between the Champlain and the Tyrell Seas (Craig 1968, p.64; Andrews 1968, pers. comm.).

The Canadian Arctic Bivalves.

The Pleistocene bivalve fauna of the Canadian Arctic has been studied intensively. The first papers concerning it are those of Lyell (1841, 1842, 1845), Packard (1867), Tyrell (1898) and Dawson (1883, 1893). Papers of Whiteaves (1901, 1907), Dall (1919, 1924), Richards (1936, 1940 a, b) and of Laursen (1934) contain basic data on the fauna of bivalves of this region. Pleistocene bivalves have been repeatedly discussed by the Pleistocene group of the Geological Survey of Canada: Craig (1960, 1961, 1964, 1965, 1968), Blake (1963), Andrews (1967), Løken (1965), Wagner (1967) and others. The radiocarbon data of the Geological Survey of Canada, (Vols. I-X, 1963-1970), contain lists of numerous dated Pleistocene shells. Cumulative lists of Pleistocene molluscs of North America were published by Grant and Gale (1931) and by Richards (1962). Wagner (1968 a,b, 1970) published lists of Pleistocene bivalves of the Tyrell and Champlain Seas. In the Canadian Arctic there were found twenty-eight species of Pleistocene bivalves belonging to nineteen genera and twelve families. With the exception of Mya pseudarenaria Schlesch, and Astarte laurentiana Lyell, all are still living in the Canadian Arctic.

The earliest carbon dated shells from the Canadian Arctic 40,000 to 23,000 years old, originate from the last

interglacial (Geol. Surv. Can., Radiocarbonates, Vols. I-X). Bivalve species, found in these deposits, are still present in the recent fauna. In the Archipelago were found: Hiatella arctica, Mya truncata, Serripes groenlandicus, Venericardia borealis, Portlandia arctica and Cardium ciliatum. This shows that during the last interglacial, the environment was still suitable for these species. The finding of Venericardia borealis in northern Foxe Basin indicates that there was a period when the climate there was as warm as it is now in Ungava Bay.

The formation of the Canadian Arctic fauna in the Post-Wisconsin begins at about 15,000 B.P. with the withdrawal of the glacier from the Maritime Provinces and the Gulf of St. Lawrence. It was followed by the marine transgression and the invasion of the marine fauna. Prest and Grant (1969; Geol. Surv. Can., carbonates 89, 101, 102, 312, 325, 868, 886, 882, 937, 965). Further stages of the glacial retreat have been discussed by Brooks (1969), Blake (1970), Andrews (1967, 1968), Craig (1960, 1961, 1968), Craig and Files (1961), Falconer et al (1965), Løken (1965), Wagner (1967) and by other members of the Pleistocene Group of the Geological Survey of Canada.

According to the stages of the glacial retreat, the migrations of the bivalves in the Canadian region can roughly be subdivided into three periods:

1. The Pre-Cockburn period, about 20,000-18,000 B.P., characterized by the recession of the glacier to the Cochrane moraine.

2. The Post-Cockburn period, from 10,000 or 9,000 to about 4,000 B.P., characterized by the deglaciation of the Canadian Eastern Arctic.

3. The Isortoq Fjord Period, from about 4,000 till recent. It is characterized by the retreat of ice from Foxe Basin, and from the region of Baffin Land. During this period the marine transgression subsided and the broad connections between the oceans were changed or disrupted. The recent marine region was formed and its fauna established.

Migrations of bivalves in the Pre-Cockburn period.

During the formation of the Wisconsin glacier and its subsequent growth, the marine fauna of the Canadian Arctic was divided into two areas, one at the northern and one at the south-eastern boundary of the glacier. The northern area, in the Arctic ocean, extended along the mainland and the north-eastern Archipelago; the south-eastern area in the Atlantic, along the margin of the grounded ice. The maximum extension of the glacier is illustrated by Lee (1968, Fig.3), and by Innes et al.(1968). The displaced marine fauna remained in the favourable environment of the

periglacial zone.

Migration of bivalves in the northern area.

The deglaciation of the Archipelago and the progress of marine invasion were discussed by Andrews (1967), Blake (1963, 1964, 1970), Craig (1960), Craig and Files (1960), Falconer et al (1965), Løken (1965).

Their data show that after the maximum extension to the Yukon at about 38,000 B.P., the glacier receded eastwards. The recession of ice from the Archipelago began about 12,000 B.P., freeing the Amundsen Gulf-Queen Maud region about 10,500 B.P. The bivalve fauna established itself almost immediately. Already the earlier stages of inundation had brought in Portlandia arctica, Mya truncata, M. pseudarenaria, Hiatella arctica, Macoma calcarea, M. moesta, Astarte warhami A. stræiata, A. borealis, Serripes groenlandicus, Cardium ciliatum and Bathyarca glacialis. These species were also found at Ellesmere Land, and dated 12,000 B.P. (G.S.C., carbonates 1, 16, 17, 22, 136, 230, 359, 386, 387). Mytilus edulis and Macoma balthica lived in the west Archipelago between 9,000 and 8,000 B.P. (G.S.C., 115). They were found at an elevation of 750 feet, which indicates an early immigration (Blake, 1963). Shells of Mytilus edulis of the same age were found in the Queen Maud Gulf.

The marine bivalves from Baffin Land, about 9,300

years old antedate the Cochrane moraine, formed about 7,500 - 5,300 B.P. (G.S.C. 241, 244; 1-1321). A cold-water fauna similar to that of the Archipelago was found in the deposits of Clyde, Smith, and Innuksuik Fjords. The warmwater species Mytilus edulis, Macoma balthica and Chlamys islandica lived there between 7740 and 3,200 B.P. (G.S.C. 599). The large shells, indicative of favourable conditions, were dated 3,580 B.P.

The bivalve fauna of the northern area was probably never completely destroyed. The islands were covered by the centrally located Innuitian glacier and by smaller ice caps, which coalesced from time to time (Blake, 1970; Craig and Fyles, 1962, p.2). Craig (1968) showed that the Laurentian ice sheet did not extend north of the McClure-Lancaster Sounds. Falconer et al (1965), state that at approximately 10,000 B.P., before the Cockburn stage, the sea northward of the moraine was free of ice. It is possible, however, that the connections between the faunas of the southern and northern areas were maintained around the glacier throughout the entire period of glaciation.

Migration of the bivalves in the southern area.

The northward ice recession in this area was discussed by Blake (1965, 1970), Mathew (1967), Løken (1962) and Prest and Grant (1969). The deglaciation of Hudson Strait began from the east, probably under the pressure of the Atlantic waters. Ashe's Inlet, Soper Lake and Lake Harbour were de-

glaciated between 8,500 - 8,000 B.P., and Foxe Peninsula about 6,200 B.P. The pressure of mixed waters from the east facilitated the migration of southern bivalves.

The Post-Cockburn Period of Migration.

This was the period of formation of the recent fauna of the Canadian Eastern Arctic. The complicated geological events of this period were discussed by Andrews (1968), and by Craig (1968). The maximum limits of marine transgression were illustrated by Innes et al (1968, Fig.8). The transgression extended to the north of Hudson Bay and proceeded southwards, separating the ice into three blocks of the marine transgression the Keewatin, Foxe Basin, and Labrador. The shield was still greatly depressed; a large coldwater Tyrell Sea was formed (Innes et al. 1968, Fig. 8; Lee 1962, 1968) which attained its maximum size 8,000-7,000 B.P. (Lee, 1968; Wagner, 1970). During this period broad connections between the Arctic and the Atlantic oceans were established: over the Rae Isthmus, with the Tyrell Sea; over the Melville Peninsula, with Foxe Basin; and over Baffin Land, with Baffin Bay. These connections existed from about 9,000 to 6,000 B.P., and were later disrupted by the rebound of land. Recent connections through the Fury and Hecla Strait were established over 2,000 years ago.

The Tyrell Sea receded soon after its formation.

Tyrell Sea period ended with the emergence of the Churchill area about 4,700 B.P. marking the beginning of the Hudson Bay period.

The early Tyrell Sea was a deep and cold water basin with changing salinity and temperature. It is possible that for most of the time its water was of mixed type. The Atlantic waters probably entered this sea over the lowered threshold of its bottom. After the land drainage subsided, the Atlantic influence may have increased temporarily. However, the rebound of land resulted in a decrease of the depth and of the volume of water leaving and entering the sea. The resulting stagnation and brackishness of water are conditions existing at present in Hudson Bay.

The sequence in which the species invaded the Tyrell Sea is not known. The planktonic larvae of euryhaline and eurythermal species may have been the first to appear. Mytilus edulis was found in the highest beaches of Baker Lake in Keewatin (Craig, 1968, Fig. 5, Table 2).

Chlamys islandica, indicative of mixed waters, invaded the Tyrell Sea probably during the maximum of Atlantic influences. The cold water species had an easy access to the Tyrell Sea both from the southern and the northern marine areas previously separated by the glacier. The large and heavy shells of Mytilus edulis, Mya truncata, Hiatella arctica

and Chlamys islandica indicate that at a certain period, probably the hypsithermal, the environment in the Tyrell Sea was more favourable for the bivalves, than it is now in Hudson Bay. Chlamys islandica, large and abundant in the Tyrell Sea, is rare and dwarfed in Hudson Bay. Conditions have also deteriorated for the coldwater species: in this bay Musculus, Crenella, Pandora and Lyonsia are scarce and dwarfed.

THE ISORTOQ FJORD EPISODE

This episode, which took place from about 4,000 B.P. (G.S.C. 291, 465, 533) till recent was the last in the deglaciation of the Canadian Arctic. At that time Foxe Basin was free of ice, which had receded towards Baffin Land. This basin, open previously from several sides, assumed its present shape. Despite the existence of long time connections between Foxe Basin and Baffin Bay, some species of bivalves, present in the latter, e.g. Mytilus edulis, Macoma balthica and Chlamys islandica never entered the Basin. The Pleistocene fauna of Foxe Basin was probably higharctic, as it is at present. The rare temperate water species, e.g. Crenella faba and Astarte striata immigrated into the basin possibly during the hypsithermal period.

when the temperature was higher, (Terasmae, 1961, Fig.1), and when other warm water species extended their areas northwards (Clarke et al., 1967).

The areas of the warm water species have been changing repeatedly since they first immigrated into the Canadian Arctic in the Pleistocene. Mytilus edulis and Macoma balthica, which lived in Queen Maud Gulf, Boothia Peninsula, about 10,000 (Craig, 1961) retreated to the Kent Peninsula; Mya pseudarenaria, abundant in the entire Canadian Arctic in the Post-Wisconsin, occurs at present at Point Barrow; the areas of warm water species in Baffin Bay extended to Lancaster Sound, Andrews (1967), Løken (1965); Chlamys islandica lived in the Pond Inlet region before 7,000 B.P. and as late as 5,100 B.P. (1-2549, 1-1554). The oldest shells of Mytilus edulis found at Baffin Land were dated 8,000 B.P. (Y-1554, Y-1853, G.S.C. 599). This species and Macoma balthica were living at Eastern Baffin Land as late as 3,000-2,700 B.P. (Y-831, 1-599, 555, G.S.C. 583) and Mya pseudarenaria at 5,400 and 3,500 B.P. (1-1600). At present, Chlamys islandica and Macoma balthica do not occur in Ponds Inlet.

Mytilus edulis survived in the sublittoral of Admiralty Inlet (Ellis, 1960; Craig, pers. comm.). The recent northern boundary of these three species is at Padloping Island.

Mytilus edulis, Macoma balthica and Chlamys islandica which lived in the Tyrell Sea, are still living in Hudson Bay though none of them penetrated into Foxe Basin. The presence in Lancaster Sound of Mytilus edulis and of other warm water species coincides with the hypsithermal period in the Canadian Arctic and in Greenland (Laursen, in Løken, 1965, p.196; Terasmae, 1961; Craig, 1968, Table 2).

The events of the Pleistocene determined the basic pattern of migrations and of settlements of bivalves in the Canadian Arctic. The Pre-Cockburn period was important in the formation and in the evolution of the fauna of the Archipelago; the Post-Cockburn, in the formation of the fauna of the Canadian Eastern Arctic. The migrations came to an end with the formation of Foxe Basin and of its fauna during the Isortoq period. The continuing isostatic rebound and the fluctuations of the Arctic and Atlantic influences in this region modified the early distribution areas of the bivalves, and provided the background for the development of the recent fauna.

IV. MARINE ENVIRONMENT OF THE CANADIAN ARCTIC AND DISTRIBUTION OF BIVALVE MOLLUSCS.

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THE PHYSIOGRAPHY OF THE CANADIAN MARINE ARCTIC

The Canadian marine arctic region is situated between 52° - 83°N and 52° - 125°W. It extends over the Canadian Shield and its shelf in the general direction from north-west to south-east. On the north the shield is bordered by the Arctic Ocean and the Beaufort Sea, on the east by Baffin Bay and the Labrador Sea. The Canadian marine Arctic is usually divided into the Central and Eastern regions with the boundary at Fury and Hecla Strait. From the Greenlandic region it is separated by Kennedy Strait, Kane Basin and Smith Sound. Its southern boundary is the Strait of Belle Isle.

Submarine topography and hydrography of the Canadian Arctic was studied intensively. The waters of the Archipelago have been discussed by Bailey (1957), Collin (1960, 1962, 1965), Collin and Dunbar (1964), Horne (1963), Jennes (1953), Marlowe (1964), Marlowe and Vilks (1963), Pelletier (1964), Tully (1952) and others. The hydrography of the Canadian Eastern region was discussed by Barber (1967, 1968), Campbell, Lauzier and Loucks (1964), Dunbar (1951, 1958, 1968), Hachey (1931, 1954), Pelletier (1935, 1954), Pelletier, Wagner and Grant (1968), Grainger (1959, 1961, 1962) and Nutt (1953).

The shelf of the Canadian Arctic is narrow and dissected

(Pelletier 1964, Figs. 3, 6-9) but widens towards the western mainland; in the north the land is considerably submerged. The depth of the shelf was estimated by Jennes (1953) as 300 metres, and by Pelletier (1964) at 400 to 500 metres. The unusually low position of the shelf indicates that the shield isstill lowered and the marine transgression still exists (Pelletier, 1964 p. 40). The channels of the Archipelago are shallow near the mainland and 300-400 metres deep in the north, with troughs up to 800 metres deep.

Important for the water circulation over the Canadian Arctic are: the depth threshold in the eastern Archipelago, the Barrow Strait Sill with a depth of 150 metres, and the drowned watersheds 100 to 200 metres deep in western Jones Sound and in Kane Basin (Bailey, 1957; Collin, 1962; Pelletier, 1964, figs. 6,9).

The depth threshold at Fury and Hecla Strait is 50 metres. The Labrador Shelf is situated at a normal depth of 200 metres, and is broader and less dissected at its southern part (Campbell et al, 1964; Nutt, 1953). The epicontinental waters of the Canadian Eastern Arctic are broad and shallow. The greatest part of the bottom of Foxe Basin and at Hudson Bay is situated at 200 metres and less. Foxe Channel and Hudson Bay are deep and narrow; the depth increases from 400 in the west to 800 metres and more at the Labrador Sea (Champbell, 1958, 1959; Dunbar, 1951, 1958).

At present the epicontinental marine waters of the Canadian Arctic connect the Arctic Ocean with the Atlantic Ocean, but with the progressive rise of the land, the shield will gradually become a water divider.

The bottom sediments in the Canadian Arctic were discussed by Grainger (1964), Campbell and Collin (1956), Leslie (1963, 1964), Forgeron (1960). The sediments consist of ice-rafted and water deposited materials, rougher in the tide flats and finer in places of sedimentation. Boulders deposited during the ice retreat cover large surfaces of the bottom of Hudson and Ungava Bays.

Marine waters of the Canadian epicontinental region are of the polar type - they originate from the upper layers of the Arctic Ocean. There is an admixture of the Atlantic waters in the east and the south-east, in the proximity of Baffin Bay and the Labrador Sea.

The structure of the marine waters of the Arctic Ocean and their circulation have been discussed by Bailey (1957), Coachman and Barnes (1962, 1963), Timofeyev (1960), Vowinckel and Orvig (1962). The water circulating in the Canadian Arctic is set up by the constant inflow of the polar waters from the upper layers of the Arctic Ocean and Beaufort Sea over the shelf and the continent, moving in a southern direction towards Baffin Bay and the Labrador Sea. Dunbar (1962) considers the channels of the Archipelago as

a direct extension of the Arctic Ocean and Foxe Basin, Hudson Bay and Hudson Strait as regions associated with the Arctic Ocean. According to this concept the southern boundary of the Arctic Ocean is in Davis Strait (Ibid. Litt. cit., 1962). Collin (1961) regards the crossectional area of the channels of the Archipelago as a waterway 120 km. wide, and 340 metres deep. In the south there is an influx of Atlantic waters, which on their way northwards become more and more mixed with the polar waters moving south. The admixture is at a maximum at the Labrador Sea and deceases northward in a very irregular pattern (Dunbar, 1951, 1957, 1968). The admixture contributes to the formation in this region of the waters of mixed type (Dunbar 1968, Fig. 10).

In the shallow water region of the Canadian Arctic there exists a constant, but in the long run unstable, pressure of the polar waters moving southward, and of the mixed waters moving in the opposite direction. The changing depth and the land dissection create in this region a very intricate pattern of water exchange, more complicated than in any other part of the Arctic. Schemes of the circulation are presented by Bailey (1957), Barber (1967), Collin (1962), Dunbar (1951, 1958, 1968). The main features of the circulation are as follows: the constant southward flow of the polar waters proceeds by two routes. One leads from the

Archipelago into Baffin Bay, where it passes close to the eastern shores of Baffin Land (and the Canadian current) and in the south joins the Labrador current. The second route originates in Viscount Melville Sound and through Hecla and Fury Strait enters Foxe Basin and passes through Foxe Channel and Hudson Strait into the Labrador Sea. A branch of this current enters Hudson Bay in the north-west and after circling Hudson Bay in an anticlockwise direction, joins the Hudson Strait outflow. All the northern waters join the Labrador current and become divided at the Belle Isle Strait, where some enter the Belle Isle Strait and the Gulf of St. Lawrence, others encircle the outer shelf of Newfoundland. The last outposts of northern waters enter the Bay of Massachussets.

The system of circulation in the Canadian Arctic is unstable and depends on the water pressure in the adjacent parts of the Arctic and the Atlantic Oceans (Jensen, 1932; Bailey and Hachey, 1951; Dunbar, 1951, 1954, 1955, 1960, 1962, 1968; Timofeyev, 1960). The high interdependence in circulation of marine waters in the Arctic was demonstrated by Dunbar (1960, 1968) in discussing the effects of closing of the Bering Strait on the circulation in the Canadian marine region. Elizarow and Zotov (1960) showed that the changes in the Labrador current are correlated with the changes of water temperature at the Kola Peninsula. The pressure changes are of both short and long

duration. Seasonal changes in water pressure exist, the Atlantic influence increasing in autumn and winter.

Marine waters of the Canadian Arctic have been studied intensively. Hydrography of the Archipelago was discussed by Bailey (1957), Collin (1960, 1962, 1963, 1965), Jennes (1953), Tully (1953), Campbell (1958, 1959), Dunbar (1951), Ellis (1956, 1960). Data on Foxe Basin, Hudson Bay and Strait were reported by Barber (1957, 1958), Collin and Campbell (1965), Campbell (1958, 1959), Dunbar (1951, 1958), Grainger (1959, 1960, 1963), Hachey (1951, 1954). Coastal waters of Labrador have been discussed by Bailey and Hachey (1949, 1951), Dunbar (1951), Nutt (1953), Nutt and Coachman (1956); the waters of the Labrador Sea have been studied by Campbell, Lauzier and Loucks (1964). Waters southward from the Canadian Arctic were discussed by Hachey et al (1954), Bigelow (1927), Huntsman, Bailey and Hachey (1954), Pyle (1962). Data on this region can be found also in Chamberlin (1963), Schroeder (1963). Ekmann (1953), Sverdrup et al (1946).

It was mentioned above, that marine waters of the polar type extend over the entire Canadian Arctic region and that in the east there is an admixture of Atlantic waters. The basic pattern of circulation was also discussed and it was mentioned that the platform of the Archipelago is

a barrier preventing the penetration of deeper waters of the Arctic into the shelf and limiting them to the upper layers. Bailey (1957) described in detail the thickness, temperature and salinity of these layers in the Arctic Archipelago. He showed that temperature and salinity of the surface layers changes seasonally. This layer is up to 70 metres thick and its temperature is low, although it may rise to about 5°C. Such temperatures were observed by Ellis (1960) in Pond Inlet and by Grainger (1959, 1960) in Foxe Basin. Salinity changes from 32°/oo to as low as 4°/oo. The cold water layer has a temperature below 0°C, with a minimum temperature of -2.0°C and an average salinity of 34°/oo. These two layers are present in the entire Canadian Archipelago and in the greater part of the Canadian Eastern Arctic. Layers containing slight admixtures of Atlantic water were found in deeper regions in the east, near Baffin Bay, and the northern Archipelago. This layer with a temperature of +0.5°C is situated below 250 metres and therefore may enter only at a greater depth. The polar water of the Canadian Arctic is characterized by below 0°C temperatures and salinities from 32 to 34°/oo, as indicated by Dunbar (1951; Fig. 3). However, the temperature and salinities of the upper layers are changed by insolation, winds, tides, upwelling, water from melting ice, snow and land drainage etc.

Waters of mixed origin, e.g. polar water with the

admixture of Atlantic, are present in the southern part of the Canadian Arctic, and enter in some places on the continent. In the north the temperature and salinity of mixed waters become gradually lowered by the increasing admixture of polar waters. The mixed waters enter the shallow region by two routes.

Baffin Bay Route.

The Labrador water with a temperature of 3-5°C and a salinity of 35°/oo and below, is moving in Baffin Bay northwards close to the shores of West Greenland (Dunbar, 1951, 1968). Near the Archipelago its temperature and salinity drop to 1°C and 30°/oo. This water becomes deflected toward the Archipelago and enters the south-eastern channels usually beneath the cold water layer. The Baffin Bay waters were detected in Smith and Lancaster Sounds. In the latter they were traced to the Barrow Strait Sill (Collin, 1962, Figs. 2, 3). The mixed waters extend probably along the shelf of Ellesmere Land and into the Pond's Inlet region of Northern Baffin Bay (Bailey, 1957, Fig. 29). The Baffin Bay waters ameliorate the climate of the south-eastern Archipelago. To the amelioration contributes probably also the "North[illegible] water", of a temperature +6°C and salinity of 32°/oo and found close to the entrance to Lancaster sound (Bailey, 1957, Fig. 29; Dunbar, 1951).

The Hudson Strait Route.

The mixed waters enter the continent also via Hudson Strait. The maximum admixture of Atlantic waters was found in proximity to the Labrador Sea, over the Labrador shelf and in Hudson Strait (Dunbar, 1951, Figs. 3, 4; 1968, Fig.10). Dunbar (1958, p.155) states that "the temperature-salinity correlation diagrams show the presence of Atlantic water below 100 metres, well developed in Cumberland Sound, less so in Ungava Bay and Hudson Strait (but still present), and very slight in northern Hudson Bay." Dunbar (1968, Fig.10), indicates the intrusion of mixed waters along the northern shores of Hudson Strait approximately to Big Island. Changes in temperature and salinity in the Canadian Eastern Arctic were illustrated by Dunbar (1951, Figs. 3, 4) and discussed by him in 1968. Traces of the Atlantic waters were found in the central part of Foxe Channel (Campbell, 1959). Grainger (1959), explained the presence of the southern plankton in eastern Foxe Basin as an indication of the presence of Atlantic waters in this region. Dunbar (1958, p.162) discussing possibilities of water exchange between Hudson Bay and Hudson Strait, showed that the threshold at northern Hudson Bay is not sufficiently shallow "to hinder free exchange of deep water between Hudson Bay and Hudson Strait." Barber (1967) states that there is some "spilling" of the Hudson Strait waters into northern Hudson Bay. The

penetration of the waters of Hudson Strait further into the continent is prevented by the depth threshold of the floors of Hudson Bay and of Foxe Basin. In the Canadian Eastern Arctic the depth thresholds and strong tidal currents and upwellings interfere with the regularity of exchange between the two water masses. The waters of the Labrador current, in which all outgoing waters from the north participate, are of mixed type (Dunbar, 1951, Fig. 3).

Seasonal fluctuations in temperature and salinity, though slight, were observed in the surface layer of the entire Canadian Arctic. Tides and upwellings contribute to the mixing of waters to a considerable depth. In the absence of these factors, stratification is usually established (Dunbar, 1951, Fig, 16; Grainger, 1960). The thermocline originates at a depth of 25 metres in the shallow waters, and at 50 metres in the deeper regions. The salinity may drop low in the summer. A region of brackish water exists in James Bay and extends into south-eastern Hudson Bay.

DISTRIBUTION OF THE BIVALVE MOLLUSCS IN THE CANADIAN ARCTIC

The maps of distribution of the bivalve molluscs show that their areas vary greatly from species to species. Some occur over the entire region e.g. Hiatella arctica (Map 52); others occur only in the north as Yoldiella frigida (7), or only in the south, as Chlamys islandica (21). Some areas are disrupted, as that of Liocyma fluctuosa (41), or Mytilus edulis (14). Some bivalves occur in isolated relic areas, as Astarte crenata crebricostata (28).

For the study of the patterns of distribution and of their relation to the recent environment, the data on distribution are compiled in Table 5. In this table marine regions are listed in their geographic succession over the shield from the Arctic Ocean to the Atlantic. In this direction they form a continuous system of channels, bays, etc., with a constant flow of water from the Arctic Ocean toward the Labrador Sea. Hudson Bay, though semi-isolated, is bound in its circulation to the general flow over the continent. In table 5 it is placed between Foxe Channel and Hudson Strait. The species are listed in the order of position of their areas of distribution, starting from the Archipelago. The area of each species is indicated by a line. Numbers before the specific names (Table 5) are those of the maps of distribution.

Table 5. AREAS OF BIVALVE MOLLUSCS IN THE CENTRAL AND EASTERN CANADIAN ARCTIC AND IN THE N.W. ATLANTIC

Map No.	Name of species:	Canadian Arctic Waters					N.W. Atlantic Oceanariums		
		Archipelago	Foxe Basin	Hudson Bay	Hudson Strait	Labrador	Nfld. - N. Sc.	Mass. - C. Cod	N. Carol.
13	Bathyarca pectunculoides (Scacchi)								
7	Yoldiella frigida (Torell)								
8	Yoldiella lenara (Cerbunov)								
44	Macoma inconspicua (Brod. and Sow.)								
48	Macoma planiuscula (Grant and Gale)								
60	Cuspidaria glacialis (G.O. Sars)								
59	Cuspidaria arctica (M. Sars)								
11	Portlandia sulcifera (Reeve)								
37	Thyasira dunbari sp. n.								
24	Astarte arctica (Gray)								
30	Astarte borr (Dall)								
23	Limä subauriculata (Montagu)								
34	Montacuta substriata (Montagu)								
61	Cuspidaria rubforte (G.O. Sars)								
8	Yoldiella intermedia (M. Sars)								
7	Yoldiella lenticula (Möller)								
12	Bathyarca glacialis (Gray)								
27	Astarte crenata (Gray)								
56	Thracia devexa (G.O. Sars)								
15	Dacridium vitreum (Möller)								
10	Portlandia arctica siliqua (Reeve)								
3	Nuculana pernula costigera (Leche)								
46	Macoma moesta (Deshayes)								
47	Macoma torelli (Steenstrup)								
45	Macoma loveni (Steenstrup)								
51	Cyrtodaria kurriana Dunker								
1	Nucula belloti Adams								
9	Portlandia arctica (Gray)								
22	Delectopecten groenlandicus (Sow.)								
32	Astarte warhami Hancock								
53	Pandora glacialis Leach								
3	Nuculana pernula (Müller) s. lato								
4	Nuculana minuta (Müller)								
18	Musculus niger (Gray)								
17	Musculus discors (Linné) Jensen								
16	Musculus corrugatus (Stimpson)								
39	Clinocardium ciliatum (Fabricius)								
40	Serripes groenlandicus Brugg.								
26	Astarte borealis (Schumacher)								
43	Macoma calcarea (Gmelin)								
50	Mya truncata (Linné)								
52	Hiatella arctica (Linné)								
54	Lyonsia arenosa Möller								
5	Yoldia hyperborea (Lovén) Torell								
20	Crenella faba (Muller)								
31	Astarte striata (Leach)								
38	Thyasira gouldi (Philippi)								
36	Axinopsida orbiculata (G.O. Sars)								
3	Nuculana pernula buccata(Steenstr.)								
14	Mytilus edulis Linne								
19	Crenella decussata (Montagu)								
28	Astarte crebricostata(Andr.,Forb.)								
58	Thracia septentrionalis Jeffreys								
57	Thracia myopsis (Beck) Möller								
55	Periploma abyssorum Verrill								
21	Chlamys islandica (Muller)								
42	Macoma balthica (Linne)								
33	Venericardia borealis (Conrad)								
2	Nucula delphinodonta Migh., Adams								
29	Astarte elliptica (Brown)								
25	Astarte banksi (Leach)								
6	Yoldia myalis Couthoy								
35	Turtonia minuta (Montagu)								
49	Mya arenaria Linne								
41	Liocyma fluctuosa Gould								
55	Periploma fragilis (Totten)								
	Cardium elegantulum (Beck)								
	Cardium pinnulatum Conrad								
	Cyrtodaria siliqua (Spengl.)								
	Volsella modiolus Linne								
	Pecten magellanicus Gmelin								
	Yoldia sapotilla (Gould)								
	Anomia aquamula Linne								
	Thracia conradi Couthoy								
	Crenella pectinula Gould								
	Gemma gemma (Totten)								
	Ensis directus (Conrad)								

Several groups of molluscs with distinct patterns of distribution can be distinguished:

1. Species with main areas in the north, some of them with southward outposts.

2. Species occurring over the entire region.

3. Species entering the Canadian Arctic from the south and extending outposts northwards.

4. Species with disrupted areas of distribution.

1. The first group, that of the northern bivalves (Table 5, Maps 13-32), comprises thirty species or forty-two percent of the fauna. Some occur over the entire region, but the majority are limited to the Archipelago. Only five of them have been found on the Labrador shelf. This heterogeneous group is composed of the Canadian and Canadian-Greenlandic endemics, of high arctic shallow water species and of the emerging deep water species. The Canadian endemics are restricted almost entirely to the Archipelago (Table 5, Maps 11, 37, 30, 56). Thracia devexa extends its area to western Spitzbergen. Species of this group are sedimentation feeders and probably have lecithotrophic larvae. The deep water species occur mainly in the Archipelago and only a few of them are in northern Hudson Bay (Table 5, Maps 13, 8, 60, 59, 8, 22, 55). Only Bathyarca glacialis and Delectopecten groenlandicus have a wider distribution. -

Some of the northern species occur only on the shelf, e.g. Astarte elliptica, or prefer the inland waters with increased sedimentation and avoid the shelf, e.g. Portlandia arctica and P.a. portlandica (9) and Astarte warhami (32). These species form mass settlements at river mouths, at the glaciers and in areas of intensive land drainage. They are predominantly mud engulfers and have lecithotrophic larvae. Biologically, species in the first group have much in common: they are sedimentation feeders and mud engulfers, and produce lecithotrophic larvae. Their spawning is not restricted to the warm period.

2. Species occurring over the entire region comprise a group of eighteen (Table 5, Maps 36-53) and constitute twenty-five percent of the fauna. Some of them extend their areas into the Bay of Massachussets. Some are absent, or rare, in the Archipelago; the north-western boundaries of such species are at the Barrow Strait Sill, or at Fury and Hecla Strait. Bivalves with such extensive areas are more abundant in the Canadian Eastern Arctic and attain there a larger size. Adults are sedimentation and suspension feeders most of them produce lecithotrophic larvae, a few have a larvae with a short planktonic life.

3. Seventeen species entering the Canadian Arctic from the south (Table 5, Maps 14-55) constitute 24% of the fauna. Most are restricted to southern Labrador, some enter

Hudson Strait and Hudson Bay; only a few of them are found in Foxe Basin. Several of these species occur also in an isolated area in the south-eastern Archipelago (Maps 14, 19, 2, 29, 25). To this group belong Mytilus edulis and Chlamys islandica, the largest bivalves entering the Canadian Arctic. Most species of this group are suspension feeders during their entire life cycle but some are deposition feeders with planktonic larvae, e.g. Macoma balthica. These species occur in waters of mixed origin, though some belong to the boreal Acadian fauna.

4. The group of bivalves with disrupted distribution comprise 8%, only six species (Table 5, Maps 51, 9, 58, 2, 41). Their areas are disrupted either by the entire continent, e.g. that of Liocyma fluctuosa (Map 41) or by the smaller regions, as that of Periploma abyssorum (Map 55). This group includes both plankton feeding and mud engulfing species some with planktotrophic and some with lecithotrophic larvae.

As Table 5 indicates, the general pattern within the entire fauna is that of gradual changes in the specific composition in a latitudinal direction, resulting in a maximum difference between the faunas of the Archipelago and of Labrador. It is interesting that the three main groups of species, namely those with areas in the north, in the south, and those occuring over the entire Canadian Arctic, differ also in several biological features, such as mode of reproduction and of dispersion, as well as in feeding habits.

PHYSIOGRAPHY OF THE MARINE CANADIAN ARCTIC REGION AND THE DISTRIBUTION OF BIVALVE MOLLUSCS

1. The Depth and the Distribution of Molluscs.

Discussing the distribution of bivalves with different depth requirements in the Canadian Arctic, it should be kept in mind that the vertical zonation of marine animals in the littoral and sublittoral of the Arctic does not correspond to that of the warm water regions. Here the distribution of animal communities is established within certain depth ranges. In the Arctic, the habitual depth ranges are often broadened and shifted as a result of adaptation to the changing Pleistocene environment. Gurjanova (1970, p.142), explains this phenomenon as an adaptation to the vertical migrations caused by the changing stand-levels of the continent during the glacials and interglacials. In the high latitudes, entire communities of plants and animals can change their usual zone of distribution (Zenkevitch,1963 his "Zones of Displacement"). Thus the deep water biocenoses of the Barents Sea emerge (Zenkevitch,1963, p.245, Fig. 105). The Eurasian Arctic seas are situated on a broad shelf open toward the Arctic Ocean, and the displacement of zones proceeds here on a broad scale. The narrow, dissected and abrupt shelf of the Canadian Arctic does not favour the emergence

of deep water fauna. This fauna does emerge only in the deep channels of the Archipelago, in Hudson Strait and in northern Hudson Bay. Changes in the vertical zonation occur also in the arctic littoral.

Since the publication of the first scheme of zonation in marine coastal waters by Forbes and Hanley (1853), several schemes of such zonation were proposed, including that of Stephenson and Stephenson (1949, 1954). None was universally accepted (Hedgepeth, 1957; Zenkevich, 1963). These schemes based on the vertical zonation of animals in the temperate waters, are not directly applicable to the marine distributions in high latitudes. The Arctic littoral is often devoid of animals because of the grinding action of ice, and many members of the shallow water community submerge.

There is a difference in the number of species of bivalves and their distribution in the littoral and the sub-littoral zones in the Canadian Central and Eastern Arctic. In the Archipelago and in Foxe Basin the zonation in the vertical distribution of bivalves was not observed: the littoral is almost devoid of molluscs and the main populations occur below the tidal levels almost without zonation. Close to the surface the number of juvenile forms increases. In the south-western and the south-eastern part of the Archipelago, the populations of Mytilus edulis and of Macoma balthica

occur in the sublittoral. In the southern part of the region, south of Foxe Channel and Padloping Island, with the appearance of aquatic vegetation and amelioration of climate, the vertical zonation of bivalves becomes gradually established. The large intertidal flats contain scarce specimens of Mya truncata, Macoma balthica, Cyrtodaria kurriana, and some bivalves such as Astarte borealis and Cardium ciliatum thrown out on the shores from deeper waters. Bivalves are abundant in the lower littoral and the sublittoral. In patches of mud the infaunal species appear and at the level of low tides and on the vegetation and rocks the attached forms as Mytilus edulis, Hiatella arctica, Musculus discors and Crenella faba. In the bottom live abundant infaunal species such as Nucula belotti, Nuculana pernula, Clinocardium ciliatum, and others. Beyond the zone of vegetation, the infaunal high arctic species dominate with the addition of Bathyarca glacialis and Delectopecten groenlandicus.

Species entering the Canadian Arctic from the south occur chiefly in the littoral zone, which is warmed in summer, or they enter the area of mixed waters usually at a depth of about 30 metres. In the zone of intensive mixing, as in the north-western Hudson Bay and in western Ungava Bay, Chlamys islandica was found at a depth of about 90 metres. Mytilus edulis occurs from the water level to the thermocline. Macoma balthica usually accompanies M. edulis, but occurs

also to a depth of 60 metres. Venericardia borealis was found at a depth of 30-60 metres in Hudson Strait, but not in Hudson Bay.

The shallowness of the Canadian Arctic region is relatively recent. Although the shield still stands low, especially in the north, it was more submerged during the early stages of the postglacial transgression. Even as late as ca 4,300-2,000 B.P. Foxe Basin was 9 to 30 metres deeper than it is now (Løken, 1965). Consequently, marine connections were broader. The isostatic recovery has changed both these connections and the faunistic areas: the deep water fauna retreated, and the shallow water species expanded their areas. Some areas were disrupted and relic faunas formed indicating the former distributions of bivalves and the depth of these areas in the Pleistocene.

The following features of the Canadian Arctic marine region determine the distribution of bivalves: 1. The shallowness and dissection of the entire epicontinental region. 2. The lowered position of the shield in the north. 3. The narrowness and dissection of the shelf and its abruptness toward the oceans. 4. The abundant land drainage.

The main marine zones in the Canadian Arctic are the littoral and sublittoral. The shallowest regions are the submerged northern mainland, Foxe Basin, and Hudson Bay.

The regions open to the ocean with depths from 300 metres to 700 metres, situated in the northern Archipelago and in Hudson Strait, belong to the bathyal zone (Fig. 9).

The Canadian fauna of bivalves consists predominantly of shallow water species; in second place are the deep water bivalves, and in third are species bound to the shelf.

The shallow water group contains bivalves with narrow and with broadened depth ranges. Map numbers are in brackets following species names. Abundant and widespread are Nucula belloti (1); Nuculana pernula (3); N. minuta (4); Portlandia arctica (9,10); Musculus discors (17); M. niger (18); M. corrugatus (16); Crenella faba (20); Astarte warhami (32); Astarte borealis (26); Clinocardium ciliatum (39); Serripes groenlandicus (40); Macoma calcarea (43); Mya truncata (50); Hiatella artica (52) and Thyasira gouldi (38). These species occur in large circumpolar areas, and some of them form outposts into the warmer waters. They are considered to be of arctic-boreal distribution, despite their low participation in the boreal fauna. Some of them were found at considerable depth in the Labrador Sea and Baffin Bay (Clarke, 1962). Differing in distribution from this group are the stenobathyal high arctic shallow water species, limited in the Canadian region to the littoral and sublittoral of the inland waters. They are: Macoma moesta (46); M. loveni (45); M. torelli (47); Yoldiella lenticula (7); Portlandia arctica

portlandica (9); Cyrtodaria kurriana (51); and the Canadian and Canadian-Greenlandic endemics Thyasira dunbari (37); Portlandia sulcifera (11); Astarte soror (30); and Thracia devexa (56). The main areas of the stenobathyal species are in the Archipelago, though some relic populations were found in northern Hudson Bay and northern Ungava Bay. These species belong to the Atlantic high arctic group.

The group of deep water species is small: the families Maletidae, Verticordidae, Poromyidae are absent, Cuspidariidae, Limopsidae, Arcidae are rare, though abundant at the shores of Greenland and Eurasia. Only a few specimens of the following were found in the Archipelago: Bathyarca pectunculoides (13); Cuspidaria arctica (59); C. glacialis (60); C. subtorta(61); Yoldiella intermedia (8); Lima subauriculata (23). Periploma abyssorum (55) was found at a depth of 700 metres off Lancaster Sound and at a depth of 25-50 metres in Pond's Inlet and in northern Hudson Bay. The emerging deep water species, Bathyarca glacialis (12) and Delectopecten groenlandicus (22) abound in the entire shallow water region. This group connects the fauna of the Canadian Arctic to that of the Atlantic sector of the Arctic.

The southern shallow water species, with the main areas southward from the Canadian Arctic, send outposts northwards, which, however, rarely extend beyond the

northern Labrador shelf. Venericardia borealis (33); Thracia septentrionalis (58); T. myopsis (57); Yoldia myalis (6); Crenella decussata (19); Nucula delphinodonta (2); enter the Hudson Strait; Mytilis edulis (14); Chlamys islandica (21) enter Hudson Bay. Macoma inconspicua (44) and M. planiuscula (48) enter the southern Archipelago from the Pacific sector of the Arctic.

Areas of Mytilis edulis, Chlamys islandica, Macoma balthica, Liocyma fluctuosa (41), Thracia myopsis (57) and Yoldia myalis were disrupted during the last glaciation and the northern and southern populations evolved separately. The relationship of these populations was discussed by Dall (1870, 1874, 1924), by N. MacGinnitie (1959) and by Nesis (1963).

Some arctic-boreal species of the Canadian Arctic do not penetrate northwards form Fury and Hecla Strait and the Sill of Barrow Strait. Their northward migration was probably barred by the late retreat of the Innuitian glacier; their advance in recent time was prevented by changes in the depth as well as in the water masses.

The main changes in the fauna of bivalves in the Canadian Arctic occur in the latitudinal direction and are caused not only by the changing depth, but also by changes in the water masses. Clarke (1962) lists seventeen

species of bivalves in the abyssal of the Labrador Sea found also in the shallow epicontinental waters of the Canadian Arctic. Approximately one-third of the Canadian bivalve fauna submerges, one-third broadens in depth ranges. The remaining third are high arctic shallow water species with narrow depth ranges. >

MARINE WATERS OF THE CANADIAN ARCTIC AND THE DISTRIBUTION OF BIVALVES

Maps 1-62 and Table 5 show that, whereas some of the bivalves occur exclusively in the northern areas, others enter the Arctic from the south. Still other species occur over the entire Canadian region or in isolated relic areas within it. Oceanographic data indicate that the northern bivalves are bound to the polar waters, whereas those entering from the south are bound basically to the mixed waters. There are also species seemingly not affected by the differences in the water masses; these species occur over the entire Canadian Arctic. The faunistic exchange between the northern and the southern groups of molluscs is as complicated as the exchange between these two water masses. In the zone of faunistic overlap both groups of molluscs occur in the same area, and represent populations of advancing or of retreating species, which may persist for a longer or shorter time. The distribution of molluscs in the Canadian Arctic is further complicated by postglacial events such as the rebound of land and the movements of glaciers. The isostatic rebound has changed the depths of areas of bivalves, and produced some relic areas, where these molluscs live under conditions not habitual for them. The distribution of each of these groups of bivalves will

be discussed separately.

Bivalves living in waters of polar origin

Bivalves living in polar waters of low and stable temperature and salinity are a well defined group, occurring over the entire Canadian Arctic. This group consists mainly of shallow water bivalves, living in epicontinental waters and rarely found outside the shelf. These are:

Nucula belotti (1)
Nuculana pernula costigera (3)
Portlandia arctica (9)
P.a. portlandica (9)
P. sulcifera (11)
P. siliqua (10)
Yoldiella frigida (7)
Yoldiella lenticula (7)
Dacridium vitreum (15)
Thyasira gouldi (38)
T. dunbari (37)
Axinopsida orbiculata (36)
Astarte arctica (24)
A. crenata (27)
A. warhami (32)
Macoma loveni (45)
M. moesta (46)
M. torelli (47)
Thracia devexa (56)
Cyrtodaria kurriana (51)

The above group constitutes over 35% of the Canadian bivalve fauna.

In the Archipelago, Hudson Strait and northern Hudson Bay there occurs with this group the emerging deep water species: Yoldiella tamara (8); Yoldiella intermedia (8); Bathyarca glacialis (12); B. pectunculoides (13);

Delectopecten groenlandicus (22); Cuspidaria arctica (59) C. glacialis (60); C. subtorta (61); Periploma abyssorum(55). These species occur in waters of low and stable temperature and salinity, characteristic of the cold water layer (Bailey, 1957; Dunbar, 1951), and avoid the surface layer, affected by seasonal changes of these factors. Conditions favourable for these molluscs exist in the Archipelago, in Foxe Basin and northern Hudson Bay. The annual cycle of the water temperature and salinity in this basin was described by Grainger (1959) and may be typical for the greater part of the Canadian Arctic. His data show that water temperature varies from 0^{o} to -1.9^{o}C. and salinity from 33 to 32‰ which may drop in summer to 5-10‰. However, Grainger (1959); and Ellis (1959) point out that these changes affect only the uppermost layers and only for a shorttime. The temperature and salinity at the bottom remain within the values of the cold water layer (Dunbar, 1951; Figs 3, 4; 1968 Fig. 32). The bivalves bound to polar waters occur in the region of the hydrographic sections 1 - XVII (Dunbar, 1958), in Hudson Bay, Hudson Strait and in Ungava and Frobisher Bays. They are abundant in the central and south-eastern part of Hudson Bay and in James Bay in the regions of certain hydrographic sections (Grainger, 1960, Figs 3, 6-12); Wagner, 1968). Considerable seasonal changes develop in summer in James Bay, but even here the bottom layers remain cold and the salinity low.

Seasonal changes of the magnitude observed in the Archipelago and Foxe Basin do not affect this group of bivalves; there is no vertical zonation in their distribution. However, the main populations occur at a depth of over 10 metres, probably beneath the range of action of iceflows and tides. Young specimens occur both in shallow and in deep water.

Southward from Foxe Channel and from Padloping Island the summer becomes longer and the fluctuations in temperature and salinity increase. The surface layers are affected by seasonal changes up to a depth of 25-50 metres and the thermocline becomes established, southward from this region. The first signs of vertical zonation in the distribution of bivalves appear and become progressively more pronounced. Deep water species disappear from the shallow water. The stenothermal and stenohaline polar species retreat to depths less affected by seasonal changes. The more tolerant polar water species and those of wide latitudinal distribution remain in the shallow water. Littoral species from the adjacent southern areas may enter this warmed-up zone.

Bivalve molluscs in the area of mixed waters

Nucula delphinodonta (2)
Nuculana pernula buccata (3)
Astarte striata (31)
Venericardia borealis (33)

Yoldia hyperborea hyperborea (5)
Yoldia myalis (6)
Mytilus edulis (14)
Crenella decussata (19)
Crenella faba (20)
Chlamys islandica (21)
Lima subauriculata (23)
Montacuta substriata (34)
Turtonia minuta (35)
Macoma balthica (42)
Thracia septentrionalis (58)
Thracia myopsis (57)

These species constitute about 26% of the fauna. Their distribution is more complicated than that of the polar water species. They occur chiefly within the area of mixed waters, indicated by Dunbar (1968, Fig. 10), but some form outposts into the polar water zone, especially into the warmed-up littoral. They occur in the Canadian Eastern Arctic, in the south-eastern Archipelago and in small relic areas in different parts of the Canadian Arctic.

The temperature and salinity of mixed waters in the Canadian Eastern Arctic are shown by Dunbar (1951, Fig. 3, 4), data on the waters of the south-eastern Archipelago are presented by Bailey (1957, Fig. 29) and by Collin (1962, Figs. 2, 3). In the Archipelago as well as in the Canadian Eastern Arctic, the southern species occur in regions with traces of Atlantic influence, or they enter the warmed-up littoral of polar waters e.g. that of Hudson Bay. The tides and the upwellings create favourable conditions for the penetration of these molluscs farther into the continental

waters. The temperature and salinity of the mixed waters decrease northward; at their northern boundary the number of southern species decreases. The elimination of these species in the Canadian Eastern Arctic is evident from their maps of distribution. The northern most populations of Crenella decussata (19) and of Nuculana pernula buccata (3) occur in Ungava Bay, of Yoldia myalis (6) at the north-eastern shores of Hudson Strait. Venericardia borealis (33) was found at the south-western Hudson Strait but not in Hudson Bay. Crenella faba (20) and Yoldia hyperborea (5) penetrate into Foxe Basin. Astarte striata (31) was found at the south-western shores of Foxe Channel. Chlamys islandica (21); Mytilus edulis (14); Crenella faba (20); and Macoma balthica (42) penetrate still further into Hudson Bay.

In the south-eastern Archipelago were found Astarte striata (31); Nucula delphinodonta (2); Crenella decussata (19); Thracia myopsis (57); T. septentrionalis (58); Lima subauriculata (23); Turtonia minuta (35); Yoldia hyperborea (5) and Mytilus edulis (14), the last mentioned species in the sublittoral.

Whereas some species occur both in the Canadian Eastern Arctic and in the south-eastern Archipelago, others are limited to only one of these regions. All species discussed above occur also along the shores of West Greenland,

and some of them off the southern shores of East Greenland. A faunistic exchange takes place between the Canadian and Greenlandic regions, especially noticeable in the south-eastern Archipelago. Species penetrating from the area of mixed into that of polar waters will be discussed below.

Crenella faba (20), a shallow water west Atlantic endemic, occurs in the area of mixed waters in the sub-littoral of the Canadian Eastern Arctic, and enters the warmed-up littoral of Hudson Bay. It was found also in isolated areas in northern Foxe Basin and in the south-eastern Archipelago. In polar waters it is found near the boundary of the areas of Atlantic influence, e.g. in the south- eastern Archipelago. Populations in Foxe Basin are probably relics introduced there likely during the hypsithermal period.

Chlamys islandica (21) a planktotrophic species dispersing by planktonic larvae, occurs along the entire shore of West Greenland, bathed by the warm current, but this species is restricted to the more southern area in the Canadian Eastern Arctic, south of Foxe Channel and of Cumberland Sound. Valves of this species were found in Lancaster Sound (Sabine, 1819). The northern boundary for this species is set by the currents of polar water moving southwards in Foxe Channel and along eastern Baffin

Land, i.e. the Canadian Current. In Hudson Bay young specimens of C. islandica are found in shallow water, the adults in deeper waters. In the north-western Hudson Bay adults were found at a depth of 80 metres in water of temperatures above 0°C, and salinity of 32‰ and above, brought to this depth by local circulation (Dunbar, 1958). C. islandica was found at stations close to Dunbar's Sections XII, XIII and XIV, at stations 551, 505, 553, and off the islands at the mouth of Hudson Bay. It occurs in the south-eastern part of this Bay and also in James Bay. The populations are rare everywhere, and specimens small. In Ungava Bay, C. islandica is more abundant and may attain a size of 7-8 cm., normal for this species. It was collected at a depth of 90 metres on the north-western shores of Ungava Bay, where tides are high, the temperature is above 0°C, and the salinity is above 32‰ (Dunbar, 1958, Sections II, IV, stations 126, 208, 210). It is not known from the eastern shores of Ungava Bay (Dunbar's Sections III, IV), but only from the Button Islands, where the tidal currents are strong. Almost the entire bottom of Hudson Bay and of Ungava Bay is covered by large valves of this species, indicating that in an earlier period conditions here were favourable for it. Recent populations of C. islandica in the Canadian Eastern Arctic may be considered as relics supported in some areas of polar waters by increased water exchange.

The northern boundary of Chlamys islandica is shared by Mytilus edulis and Macoma balthica (14, 42), both dispersing by planktotropic larvae. Mytilus edulis, a suspension feeder, is a large species, living in colonies and requiring large amounts of food. Macoma balthica is a sedimentation feeder and mud engulfer. Both species occur in Hudson Bay in waters affected by seasonal heating and both are tolerant to low salinity. M. edulis settles on rocks and vegetation at depths from intertidal to that of 18 metres and probably to the depth of the thermocline. Macoma balthica occurs with the previous species and settles in the intertidal zone (Green, pers, comm., 1971), but its main populations occur to a depth of 40-50 metres. The largest specimens and populations of both species occur around the Belcher Islands, where the growth rate of Mytilus edulis is high (Lubinsky, 1958, 1967).

Venericardia borealis (33), is endemic to the north-west Atlantic. It occurs within the area of mixed waters, but was also found in the Pleistocene deposits of northern Foxe Basin. It has retreated southward from the area at present occupied by polar waters. It occurs at depths of 30-60 metres along the southern shores of Hudson Strait and in deeper waters in Ungava Bay, where, according to Dunbar (1958), mixed waters are present. In Hudson Strait this species occurs in warmer but less saline waters

outgoing from Hudson Bay and moving along the southern coast of Hudson Strait. In the eastern part of the Strait, in Ungava Bay, and further southwards, the area of V. borealis is within the region of Atlantic influence (Campbell, 1958, Tables 1-4, Figs. 5-12). It was not found at the northern shore of western Hudson Strait, where the conditions are rigorous, nor at the north-eastern shore, which is under Atlantic influence.

Yoldia hyperborea hyperborea (5), occurs in the Canadian Arctic together with species associated with mixed waters and was found together with Crenella faba in Foxe Basin and in Hudson Bay. It occurs also in warmer regions of West and of East Greenland (Ockelmann, 1954). However, it lives in the coldest regions of the Eurasian seas, and is regarded by Filatova as a high arctic species. In the Canadian and Greenland ice waters, Y. hyperborea hyperborea avoids the coldest regions, as do Musculus corrugatus and Nuculana minuta.

Bivalves occurring in areas of both the polar and of the mixed waters.

Bivalves occurring over the entire region of the Canadian Arctic do not seem to depend on the type of waters. They occur together with species associated both with polar and with mixed waters, and have extensive circumpolar areas

with outposts into the northern Pacific and Atlantic. The nature of these species is not clear. Some of them, those with planktonic larvae, form clines directed toward higher latitudes; others, with lecithotrophic larvae, are chiefly subdivided into subspecies. Many of them are more abundant in the mixed waters where their growth rates here are higher than in the polar waters, as is in the case of Clinocardium ciliatum, Serripes groenlandicus, Musculus discors, M. niger, Macoma calcarea, Nuculana minuta, Musculus corrugatus.

Species occurring both in the areas of polar and of mixed waters in the Canadian Arctic are:

Nucula tenuis s. lato (1)
Nuculana pernula s. lato (3)
N. minuta (4)
Musculus discors (17)
M. corrugatus (16)
M. niger (18)
Astarte borealis (26)
Axinopsida orbiculata (36)
Clinocardium ciliatum (39)
Serripes groenlandicus (40)
Macoma calcarea (43)
Mya truncata (50)
Hiatella arctica (52)
Lyonsia arenosa (54)
Pandora glacialis (53)

They are abundant in the Canadian Eastern Arctic, but become dwarfed in James Bay as do bivalves of all other groups. While the polar water species rarely extend their

areas beyond the northern shelf, species bound to mixed waters extend their areas southwards into the Bay of Massachusetts. However, the southern outposts of these species occur in areas of water of lower temperature and salinity than those of surrounding waters, and of the mixed waters. Though the cold waters of the Gulf of St. Lawrence on the shelf, are not directly connected to the Labrador current, they still have an admixture of northern water of Arctic origin (Bigelow, 1928, p. 824-836). The temperature and salinity of the current of Nova Scotia are low enough to support some northern species. The salinity at a depth of 100 metres is 33‰ and the temperature is 5°-10°C, (Chamberlain, 1963) throughout the year, because of the increase in cold water influx from the north in summer. The isotherm of 15°C is constantly deflected from the Bay of Massachusetts to the margin of the shelf (Pyle, 1962), and intrusion of water from the Gulf stream on the shelf is prevented by the intermediate layer of water at the edge of the shelf. Bigelow (1927), discussing the sources of water in the Gulf of Maine says that "in few parts of the world is the coastal water that bathes the continental shelf as sharply demarked from the oceanic water outside the edge of the continent as it is off the east coast of North America from the Grand Banks on the north to Cape Hatteras in the south." Therefore, the pocket of the cold water on the shelf with mean annual temperatures below 15°C and salinity

below 33‰ is the last southern refuge for some northern bivalves.

Bivalves occurring over large areas of polar and of mixed waters do not remain unchanged. The suitability of the environment for these molluscs can be evaluated on the basis of their abundance and growth rates, the shape of the shell and its weight. It was mentioned above, that populations of these species in the areas of polar and of mixed waters are morphologically different. They form clines from one area to the other, or are often divided into subspecies. There exist also pairs of closely related species, associated with areas of different water masses: Crenella faba is replaced in the south by the very similar C. pectinula; Nucula belloti is replaced by N. tenuis s. str.; Thyasira gouldii by T. flexuosa; Macoma loveni by M. inflata Periploma abyssorum is replaced in shallow water by P. fragilis; in the extensive areas supposedly occupied by populations of a single species, Pecten groenlandicus, Ockelmann (1958) has found two closely related species, one occurring in the north, the other, an oceanic one, in the south. The same is true in respect to Dacridium vitreum (Ockelmann, 1958). The area of a "single species", Hiatella arctica, is in reality occupied by three closely related species, differing in the form of their larvae, each bound to an area of different waters (Thorson, 1951).

Species with disrupted areas

The disruption of areas of some species of bivalves in the Canadian Arctic is caused by several factors. On one hand, areas of species associated with mixed waters may be disrupted by intrusion of polar waters, e.g. those of Mytilus edulis, Macoma balthica and Chlamys islandica. Areas of some other species were disrupted during the last glaciation, and these were not able to join the northern and southern areas because of the shortage of time, or because of the difference in the water masses, as in the case of species of mixed waters. The northern and southern populations of species divided by the glacier remain separated for such a long period of time, that the populations in the Arctic Ocean and in the Atlantic evolved into separate, although closely related, species. Irregularities in the distribution of such species become evident when comparing their areas in the Canadian Arctic with those in other Arctic regions. For example, Liocyma fluctuosa occurs over the entire shallow water region of East Greenland and of Eurasia, the coldest in high latitudes. In the Canadian Arctic, L. fluctuosa occurs in two areas separated by the Archipelago (Map 41). The populations of this species in the Atlantic and in the western American Arctic differ in shell morphology, and were described as separate species as L. viridis and L. beckii by Dall (1879). However, N. MacGinnitie (1959)

studying the variation in these species, concluded that the difference between the Atlantic and the Arctic populations is not sufficient to regard L. beckii and L. viridis as separate populations of species. The same is true in respect to Yoldia myalis, the western Arctic differ from the Atlantic populations. This also applies to Macoma balthica whose populations from the western Arctic, closely resemble those from the Atlantic, were described as M. inconspicua and Venericardia borealis in the north-western Atlantic which differ only slightly from the western species V. granulosa. Nesis (1963) expressed the opinion, that these closely related species originated from the Pacific population which migrated into the Atlantic via the Canadian Arctic and were isolated later by glaciations while the western populations evolved separately.

Relic species in the Canadian Arctic

The relic areas in the Canadian Arctic are the results of Pleistocene events. Relic areas of two periods can be distinguished: those of the maximal extension of the postglacial marine transgression, and those which remain from the hypsmithermal period. Relic areas of the first period exist in south-eastern Hudson Bay, in the deep cold water trench between the Belcher islands and the mainland. Here occur species separated from their main areas in the Archipelago. All of them are polar water species,

some occurring in deep water, as Yoldiella intermedia (8), Periploma abyssorum (55) and some in shallow water as Dacridium vitreum (15), Yoldiella lenticula (7), Cuspidaria subtorta (61); Thracia devexa (56), Macoma moesta (46) and M. torelli (47). Most of them are abundant in the Archipelago but extremely rare in the relic areas, though they occur among rich populations of local non-relic polar species.

In this area are also present relics from the warm period, now found in mixed waters. Nucula delphinodonta (2), Crenella decussata (19), Astarte striata (31), A. crenata crebricostata (28) and Thracia myopsis (57). With the exception of A. c. crebricostata all are represented by a few specimens. They were collected in shallow water of lowered salinity, which is warmed-up in summer. Recent conditions are not favourable for these species, which soon may be extinct in this area.

The origin of this relic area is probably as follows: at the maximum extension of transgression, the cold water species extended their areas as far as this transgression allowed. Later the land rebounded, the Tyrell Sea decreased to the size of the recent Hudson Bay, and became isolated from the Archipelago. Some of the deep and shallow-water species survived in this area, supported by cold water currents passing through the trench. During the hypsmithermal period the migration of the warm water species into

Hudson Bay was facilitated. However, these species were later separated from the main areas and entrapped both in the polar water, which was warmed-up by increased isolation and by the waters of James Bay, moving northward. Chlamys islandica, a species associated with mixed waters, occurs in the warmed-up area of the Belcher Islands, and in north-western Hudson Bay. In this last region the waters of polar origin warmed up to a greater depth by local mixing. Historically it is possible to regard the entire Hudson Bay as a relic of the Tyrell Sea, where the recent polar species meet in some areas the relic populations of previous periods. This region will become warmer and less saline as the uplift continues.

The polar water species will retreat to colder, deeper and more stable areas. In the warmed up littoral there will remain the dwarfed populations of polar species.

The second area which can be considered as relic, is that of the south-eastern Archipelago, where the waters are of polar origin, with admixture of Baffin Bay waters. The fauna is basically high arctic. But in the region bound in the west by the sills at a depth of up to 150 metres there occur mixed water species. This area is outside the region of mixed waters indicated by Dunbar (1968), but the presence here of Baffin Land waters was shown by Collin (1962). In this high arctic region were

found Nucula delphinodonta, Yoldia hyperborea, Mytilus edulis (in the sublittoral), Crenella faba, Astarte banksi and A. striata. These all occur along the entire shore of West Greenland, and spread into the Canadian waters. Whether these species are at present retreating is difficult to decide. However, in the Pleistocene deposits of the raised beaches of Baffin Land were found Chlamys islandica and Macoma balthica, absent in the recent fauna of this region.

Endemic bivalves of the Canadian waters

Species endemic to the Canadian Arctic, Portlandia sulcifera Reeve (1855) and Thyasira dunbari sp. nov. (Map 37) occur in a well defined area of the Archipelago bordered in the south by the line between McClure-Lancaster Sound. They are limited to the coldest region of the polar water area, and abound at the glaciers amd muddy deposits at river mouths. They are probably mudengulfers and dispersed by lecithotrophic larvae.

Astarte soror Dall (Map 30) was found in the eastern Archipelago and in Disko Bay of West Greenland, and seems to be endemic to Baffin Bay. It was collected in polar waters, but in close proximity to the mixed waters.

The Canadian endemic species originated in the north-

western Archipelago, an area least disturbed by glaciation where the fauna probably was neither destroyed nor far displaced, as was the case in the north Atlantic. The presence of endemic species indicates a long and quiet period in the evolution of the fauna in the region bordering the Beaufort Sea.

Into the Canadian Arctic there enter also endemics from north-eastern Pacific and the north-western Atlantic. The Pacific Macoma planiuscula Grant and Gale (48) and M. inconspicua Brod. et Sow (44), and the Atlantic Crenella faba (Mull)(20) and Venericardia borealis (Conrad)(33) occur in mixed waters and in the Canadian Arctic, in areas close to them. It is probable that the Atlantic and Pacific immigrants are retreating at present from the Canadian Arctic.

The polar waters extended over almost the entire Canadian Arctic, restricting the fauna of bivalves to the polar endemics and to a smaller group of adapted immigrants. In the area of mixed waters entering from the east, the main faunistic groups are the subarctic species with the addition of a smaller group of polar species and a still smaller group of boreal species. Besides these groups we find also bivlaves little affected by the difference in the water masses, and occurring in the entire Canadian Arctic region. The number of species in each of these

groups of bivalves and their percentual relationships are presented in figs 6, 7 and 8. The changes in the specific composition in the bivalve fauna of the Canadian Arctic are summarized in Table5.

Bivalves associated with polar waters live at temperatures from -1.9 to 0.0°C, but tolerate summer increases up to +5°C. At the low temperature and salinity peculiar to the cold water layer, the polar species are numerous and abundant, and the specimens of a normal shape and size. The growth rate of immigrant species usually decreases.

In the warmer and more saline watersof mixed origin, the bivalves live mostly at temperatures varying from 0°C to about +10°C, and a salinity above that of polar waters. Under these conditions, species associated with the mixed waters become abundant and their growth rates increase. Species associated with both the polar and the mixed waters constitute about two thirds of the bivalve species of the Canadian Arctic.

It is often difficult to decide whether in the zone of contact of two water masses the limits of distribution of bivalves peculiar to these water masses are set by the simultaneous change in temperature and salinity, or by only one of these factors.

The basic changes in the fauna from the polar to the subarctic cannot be explained by the increase in temperature alone because salinity increases also in the same direction. The distribution of bivalves in the polar waters is influenced by two factors ameliorating the local environment: the summer insolation and the water mixing, caused either by tides or by some other factors.

The summer warming, though low and of short duration, occurs throughout the entire polar water region. It affects the upper layer, and in some locations produces a thermocline. South from Foxe Channel and Padloping Island, heating is intensified, summer periods prolonged and the thermocline sinks to a deeper level (Barber, 1967, Fig. 9b; Dunbar 1951, 1958; Grainger, 1962). Insolation is strongest in James Bay where the temperature may rise to 16°C but because of the stability of the water, the cold layer remains quite close to the surface. The warmed-up waters of this bay move northwards through eastern Hudson Bay and ameliorate the south-western part of Hudson Strait (Campbell, 1959; Dunbar, 1958, Fig. 24). Dunbar (1951) and Schroeder (1963) showed that in the Canadian Arctic the upper water layers change in temperature but at a depth of 100 metres the temperature remains constantly about 0°C and below.

In the Canadian Eastern Arctic, the increased

fluctuation in temperature restricts the polar species to the small deeper areas of stable temperature. In James Bay the coldwater species retreat to a depth of 25 metres (the isobath of 25 metres is illustrated by Grainger, 1962 Fig. 2). However, the specimens of the polar species are here scarce and dwarfed.

The vertical zonation in distribution of bivalves caused by temperature becomes first established in Hudson Bay: here the polar species retreat and the southern littoral species enter the warmer shallow waters, e.g. Mytilus edulis and Macoma balthica. Species of wide distribution become abundant and their specimens larger.

In Ungava Bay the separation of the arctic and subarctic species extends into deeper waters. The cold water species are restricted to the trench in which the polar waters encircling the Bay are moving on their way southwards. In the warm offshore zone occur rare specimens of the coldwater fauna, and abundant species associated with mixed waters of wide distribution.

The tides and upwellings contribute to the warming of deeper waters, and create a favourable environment for the southern species. Thus the northern-most outpost of Chlamys islandica in the Eastern Canadian Arctic is in north-western Hudson Bay, in the region of upwelling

close to Chesterfield Inlet. Here this species occurs down to the 100 metres depth of mixing (Dunbar, 1958). The tides introduce the subarctic waters into Ungava Bay. The tidal mixing ameliorates the waters at the western shore of Ungava Bay and around Akpatok Island to a depth of about 100 metres. The salinity here is above 32‰ and the temperature above 0°C (Dunbar, 1958, left-hand stations of his sections I, II and III). In this area were found the largest specimens of Chlamys islandica, Macoma balthica and Mytilus edulis in the Canadian Arctic. Specimens of Musculus and specimens of species of wide distribution are exceptionally large. The fauna of the Labrador shelf is mixed: it includes both the polar and the subarctic and species of more southern elements. The polar waters moving southwards favour the extension of polar species in this direction.

The salinity of the polar and of mixed waters is low, usually below 34‰. In the inland shallow water regions the salinity may drop to 10‰ and even below. (Dunbar, 1958; Grainger 1960; Collin, 1962). The northern part of Hudson Bay is characterized by a salinity of about 29-32‰, which decreases southward and drops to almost brackish levels in James Bay (Grainger, 1960, Figs. 4, 5). According to a scheme of Remane (1940), the salinity in James Bay is that of a marine brackish zone with marine

fauna. Classifications of brackish waters based on their salinity are discussed by Segestrale (1957) and by Zenkevich (1963, p. 344-349). However, most of these schemes were worked out using the Baltic Sea as an example, and none is applicable directly to the Canadian Arctic.

A salinity of about 10°/oo affects the well being of all bivalves; the effects are still more harmful if the temperature is simultaneously increased e.g. in James Bay. Here the growth rate of Mytilus edulis decreases. The 6-8 year old specimens toward the end of the cline attain a length of only 3-4 cm. and their shells a weight of about 20 mgms.; the valves become translucent and soft (Lubinsky, 1958, 1967). Here Macoma balthica varies in length from 0.5 to 1.0 cm., Clinocardium ciliatum from 1.0 to 1.5 cm. The extreme populations of the clines were often regarded as separate species, subspecies or "forms". Thus such populations of Mytilus edulis were identified as M. pellucidus Pennant,,of Macoma balthica as M. inconspicua, of Nuculana pernula as those of N. tenuisulcata. Specimens of these species from James Bay are illustrated in this paper by Pl. 6, Fig.30; Pl. 9 Figs.44-45; Pl. 10, Fig. 46; Pl. 11, Fig.53; Pl. 14, Fig.67. The area of the depressed fauna extends in shallow waters up to Harrison Point. The cold water fauna recovers in deep water at the mouth of James Bay.

The relations between the marine waters and the fauna of bivalves of the Canadian Arctic can be summarized as follows:

1. There exist groups of bivalves associated with either polar or with mixed waters. Specimens of each group of species are abundant and attain larger sizes in regions where the temperature and salinity are characteristic of each water type, as shown by Dunbar (1951).

2. The number of species in the mixed waters increase because of the addition of the members of new fauna to the diminishing group of polar water species.

3. Increase in temperature above that indicated by Dunbar (1951), caused the polar water species to retreat to areas of stable low temperature.

4. Salinity below 19°/oo if persisting for long periods, depresses all the bivlaves.

5. Decrease in salinity not accompanied by decrease in temperature depresses the fauna more than the simultaneous rise or fall in both these factore. Such conditions exist in areas with increased stability or water e.g. in James Bay.

6. Fluctuations in temperature and salinity influence the polar and the subarctic species differently; the rise in temperature restricts the polar water species to the waters

with more constant temperature. The fluctuations in salinity do not affect these bivalves as strongly as the changes in temperature. A rise in temperature of polar waters offers the possibility to some southern species to enter the littoral of the polar waters.

7. The sublittoral bivalves are more indicative of the water masses than species living within the fluctuating environment of the littoral.

8. In the regions recently freed from glaciation, relic populations occur quite often. They are indicative of the extension of climatic conditions in the past. The presence of such larger faunistic areas indicates a widespread retreat of the recent fauna.

THE ROUTES OF DISPERSION OF BIVALVES IN THE CANADIAN ARCTIC

The basic pattern of distribution of bivalves in the Canadian Arctic was established in the Post-Wisconsin migrations. The areas of primary distribution were later readjusted in response to the environmental changes which continued through the Post-Wisconsin and Recent period.

The retreat of the glaciers and the rebound of the land were gradually changing the depth of the Canadian Arctic Region and the areas of extension of the Polar and the Atlantic marine waters. The changing environment presented either an opportunity or a barrier to the dispersal of the bivalves with different ecological requirements.

Glacial events determined the following periods in the history of the Canadian bivalve fauna:

1. Faunistic dispersal during the late interglacial by the growing Wisconsin glacier and splitting of the Pre-Wisconsin faunistic area into the polar and the Atlantic areas joined probably by a narrow belt around Eastern Greenland.

2. The return of the fauna to the Canadian Arctic after

the retreat of the glacier during maximum submersion of land and extension of transgression: the fusion of the southern and the northern populations of bivalves; the establishment of the primary pattern of distribution.

3. The rebound of land and retreat of transgression, resulting in a readjustment of areas to these changes; the reduction of areas of deep water fauna and the separation of the southern and the northern bathyal regions; the extension of areas of shallow water species; the retreat of the Tyrell Sea and formation of Hudson Bay.

4. Late stages of marine retreat with disruption of old marine connections; formation of Foxe Basin and Fury and Hecla Strait; restriction of the Atlantic influence; retreat of the mixed waters and of their fauna after the hypsithermal period; formation of relic areas.

5. The Recent period. The readjustment of the areas, establishment of the recent pattern of distribution of bivalves; continuation of the faunistic retreat from the epicontinental region.

The routes of immigration of bivalves were determined by the bottom configuration and by the extension of areas of polar and of mixed waters. Species with planktonic larvae dispersed rapidly, but easily died out if conditions

deteriorated. This happened repeatedly as a result of the general deterioration of the climate and of the shift in the areas of marine waters. The northern boundaries of the planktotrophic species with planktonic larvae, e.g. Mytilus edulis, Chlamys islandica, Macoma balthica and also of Venericardia borealis, were repeatedly shifted in the Post-Wisconsin. The recent northern boundary of these species in the Canadian Arctic is clearly set at northern Hudson Bay by the polar current from Foxe Channel, and at Padloping Island by the Canadian current moving along the shelf of Baffin Land. The polar species, which are chiefly deposition feeders, and which disperse by lecithotrophic larvae, immigrated at a slower rate, but were not as easily exterminated as the planktotrophic species. Some of the polar species still remain in the areas disrupted by glaciation.

The retreat of the transgression and the land rebound caused a vertical displacement of the bivalves and a mixing of the littoral and the sublittoral fauna. The fauna of the raised beaches is an example of the vertical shift as is the reduction of primary areas of distribution and of the mixing of different faunistic elements, processes which still continue.

THE LAND BARRIERS AND THE DISTRIBUTION OF BIVALVES

The Canadian Shield is the most important barrier to the exchange between the Arctic and the Atlantic faunas. The bathyal elements dispersing by lecithotrophic larvae are the first victims of this barrier. The rebound of the land caused a retreat of the bathyal fauna to the northern and the southern areas (Map.64). The barrier formed by this rebound is the plateau of Foxe Basin. It is a shallow and geologically young region which the deep water species never entered. The relic deep water fauna of the Tyrell Sea still exists in the deep trench of eastern Hudson Bay. The scarcity of relic species and their specimens indicates that the present conditions are unfavouable for this fauna.

The depth of Foxe Basin did not prevent the shallow water species from joining their northern and southern areas. However, the northern and the southern populations of Liocyma fluctuosa and of Yoldia myalis still remain separated by the Canadian Shield.

A small, but well defined area in the northern Archipelago is occupied by the Canadian and Canadian-Greenlandic endemics. They are lecithotrophic high arctic shallow water species, abundant near the glaciers and rivers.

Their area is clearly limited in the south by the water barriers of the Lancaster-McClure Straits.

Most important in the distribution of bivalves in the Canadian Arctic are barriers interfering with the exchange between the polar and the subarctic waters. The combined action of these land-and-water barriers interferes with the dispersion of all bivalves independently of their modes of feeding and dispersion.

There are three such barriers in the Canadian Arctic. The first in the Western Archipelago, is formed by the narrows of Dease Strait at Kent Peninsula. The shallowness of this region, the alternating tidal currents, and the almost permanent ice-packs increases the effectiveness of this barrier. It separates the bivalve fauna of the south-western Archipelago from that of the central area, and produces the eastern boundary for the western population of Mytilus edulis, Liocyma fluctuosa, and of the Pacific species Macoma inconspicua and M. planiuscula.

The second barrier is formed by the sills of Barrow Strait and of Jones Sound, and is continuous with the land barrier of Ellesmere Land and Melville Peninsula. This region of the Archipelago was uplifted during almost the entire Tertiary and was also the area of the highest uplift

in Postglacial time. Along this elevation was situated the Innuitian glacier, which retreated only 6000-5000 B.P. (Blake, 1970, Fig.12). This barrier separated for a long time the southern and the northern areas of migrating bivalves, and produced the eastern boundary of the Canadian endemic fauna. At present this barrier prevents the penetration of Baffin Bay waters into the Central Archipelago.

A group of subarctic bivalves, probably from the fauna of West Greenland, does penetrate into the eastern Archipelago. The area of these species extends from Smith Sound to Padloping Inlet in northern Baffin Bay and to Barrow Strait sill in the Archipelago. This is probably a relic of southern fauna which penetrated into the Canadian Arctic during the period of increased Atlantic influence and is supported at present by the influx of the Baffin Bay waters. Here occur the subarctic Crenella faba C. decussata, Nucula delphinodonta, Lima subauriculata, Thracia septentrionalis and Musculus corrugatus. Here in the sublittoral was found the northern most colony of Mytilus edulis. This northern area of subarctic species is isolated from the southern area by the Canadian current moving along the shelf of Baffin Land. Yet the barrier at Barrow Strait is not an obstacle for the migration of the polar species, which occur both eastward and westward of it.

The third barrier, which is a continuation of the previous one is formed by the shallows of Foxe Basin. Its effect is similar to that of the Barrow Strait barrier. It separates the bathyal faunas (Map.64) but does not affect the polar shallow water fauna. The subarctic species are prevented from entering Foxe Basin by a polar current moving through it and Foxe Channel. In northern Foxe Basin occur only Yoldia hyperborea and Crenella faba and in the Post-Wisconsin deposits here, Venericardia borealis was found. Probably this is the relic area of the southern fauna, which invaded the Basin in the warm period. The main areas of these species are in Hudson Bay, South-eastern Hudson Strait and south from Padloping Island in Baffin Bay.

Southward from Foxe Basin, the number of the subarctic species increases. Here also begins the vertical zonation in the distribution of bivalves, a distribution which extends into the lower latitudes.

With the continuing land uplift, the action of barriers becomes enhanced. The polar species retreat to deeper areas. The mass mortality of bivalves in Hudson Bay indicates that the environment here has deteriorated since the time of the Tyrell Sea. The Canadian Eastern Arctic becomes favourable for the deposition-feeding shallow water species which prefer areas of increased land drainage.

This environment is also suitable for large plankton feeding bivalves with planktonic larvae stages. Later the faunas of Hudson Bay will probably become depressed by the lowered salinity, increased stagnation, and intensified heating.

The last composite barrier is situated at southern Labrador. It is formed by the narrows of Belle Isle and the outer shelf of Newfoundland. The Atlantic current, passing close to the shelf is a barrier for the northern species, the cold Labrador current is a barrier for the southern species. Into this region penetrate also the waters of the Gulf of St. Lawrence. With the participation of the Atlantic and Gulf waters the pattern of exchange of water masses typical for the Canadian Arctic is replaced by a more complicated one, and a new fauna replaces that of the high latitudes.

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MARINE ZOOGEOGRAPHIC ZONATION IN HIGH LATITUDES AND THE DISTRIBUTION OF MARINE BIVALVES

Since the first investigations of marine life in high latitudes, marine zoogeography has evolved from a descriptive stage to that of biogeographic synthesis, elaborated by Dunbar (1968) in his monograph on the ecological development in polar regions. The progress of our knowledge of marine distributions and of their causative factors has not changed, however, the original scheme of zoogeographic zonation. In high latitudes three zoogeographic zones have been recognized; the Arctic, the Boreal and an intermediate low-arctic or subarctic zone. The temperature of water was for a long time regarded as a master factor in animal distributions, determining the nature of the zoogeographic zonations and of the extension of zones. But the temperature ranges characteristic of the zones, as well as the basic differences in the nature of the Subarctic and the Low Arctic, have never been clearly stated and the nature of the zonation and of the boundaries between the zones has remained vague.

Although it was known that in high latitudes the salinity of marine waters varies greatly, it was seldom considered as an important zoogeographic factor. Its

importance in animal distribution was first pointed out by Appelof (1912), and the more recent data have been summarized by Kinne (1964, a,b).

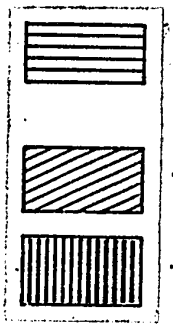
A still more precise approach to marine zoogeography was introduced with the recognition of the importance of water types in animal and plant distributions. It was shown that the chemical and physical properties of these waters are important parameters of the environment, determining the composition of the faunas and floras and the extension of their areas. Ekmann (1943, p.138) was the first to state that "the marine zoogeography must primarily be the zoogeography of the various waters, and only secondarily a zoogeography of various coastal regions." He states that the Northern Atlantic is an example of a marine region with an extensive exchange between water masses. Dunbar (1951, 1960, 1968), offered a new scheme for the subdivision of the northern marine environments based on the distribution of waters of different types. He states (1968, p.42), that in the high latitudes there exists "a broad zone in which the Arctic and the non-Arctic waters are found together in the upper layers (200-300 metres), either in closely associated streams or as mixed water." He identified the area of polar water as the Arctic zone, and the area of mixed water as the Subarctic zone. In his Fig. 10

(1968) he illustrates the area of the Subarctic zone in the Pacific and Atlantic sectors of the Arctic, and describes the oceanographic peculiarities of these zones, and their zoogeographic implications (1968, p.43-49).

This new approach was successfully applied to planktonic studies, but only a few papers discussing the distribution of benthic animals from this standpoint were published (Blacker, 1957, 1965; Galkin, 1964; Nesis, 1958, 1959, 1963, 1965; Ockelmann, 1958, 1960, 1965). Most malacologists still discuss the distribution of molluscs in relation to the ranges of temperature (Miloslavskaja, 1958; Fischer,1961; Hall 1964). Filatova (1948, 1957 a,b) studied in detail the bivalve fauna of the Arctic Eurasian seas and produced the first zoogeographic scheme for this group without emphasizing, however, the relationship between it and the water masses.

My studies on the distribution of bivalves in the shallow waters of the Canadian Central and Eastern Arctic show that the areas of the polar and subarctic waters harbour different faunas of these molluscs with the faunistic boundaries corresponding basically to the boundaries of marine waters, illustrated by Dunbar (1968, Fig. 10). The dissection of land, the depth, and the bottom relief of the Canadian Arctic determine the pattern of water

Figure 5. Distribution of Subarctic bivalves in the Canadian Arctic.

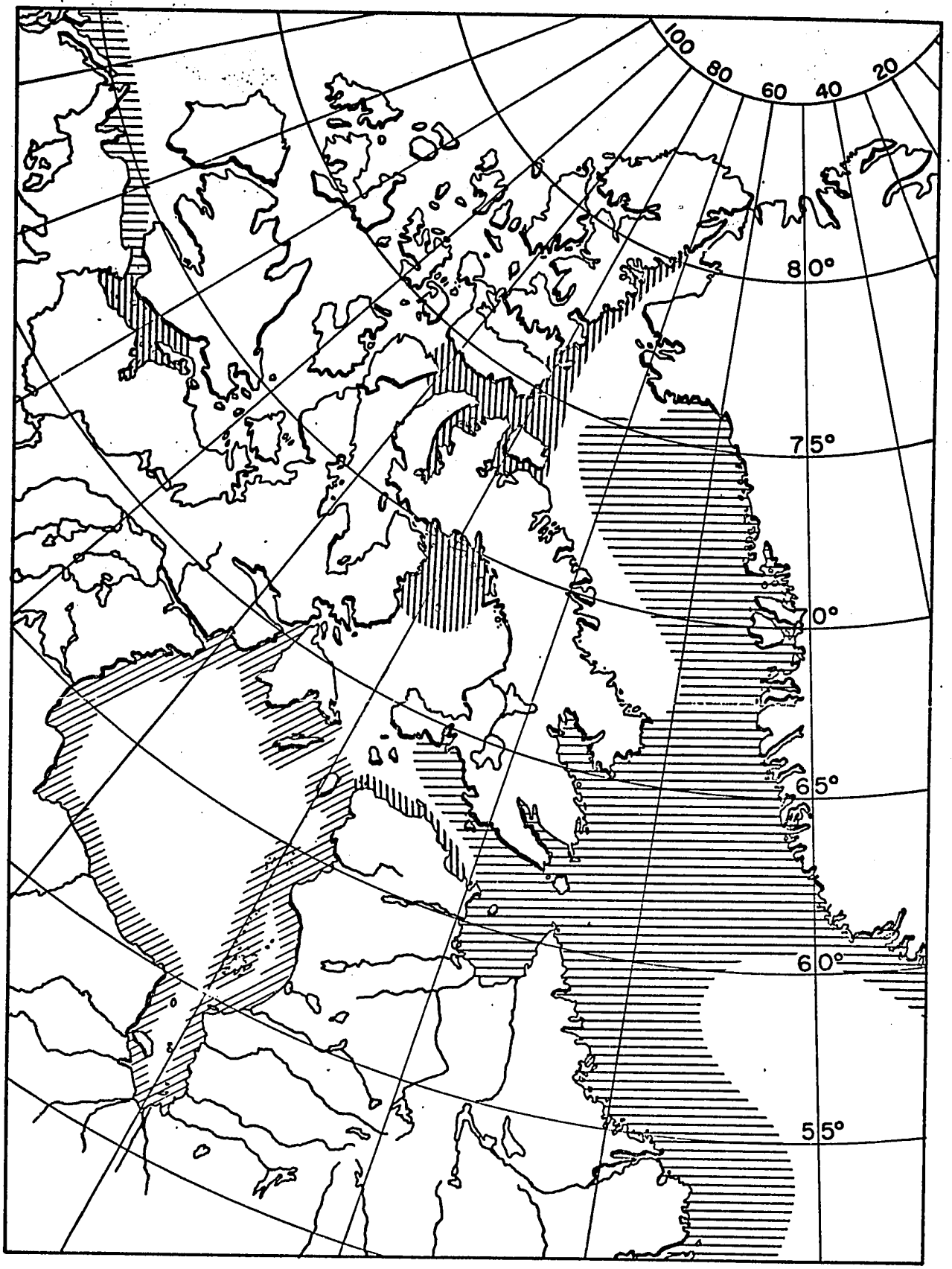


- Area of Subarctic waters (Acc. to Dunbar, 1968)

Subarctic bivalves in the Polar waters:

- in littoral

- in sublittoral



Figure

exchange and consequently, the boundaries of the Arctic and the subarctic faunas. A list of the deep water and the shallow water bivalves from the Canadian Arctic is presented in Table 7 and their areas in Figs. 9, 10; the Arctic and Subarctic species are listed in Table 6 and their areas are shown in Fig. 5.

Our data show that in some areas the Subarctic species form outposts into polar waters. These outposts extend into the areas of intensified summer heating in the littoral or into areas of increasing mixing in the sublittoral of the polar region, (Fig. 5).

Besides species indicative of the marine waters, there exist bivalves seemingly not restricted in their distribution by the changes in water masses but occurring both in the Arctic and the Subarctic zones. The number of these species is slightly lower in the Arctic and Higharctic than in the Subarctic zone and their populations less abundant. They often produce Arctic and Subarctic subspecies or form clines, and lower their growth rates toward the Arctic zone. Recent studies have shown that in these extensive areas there exists not a single species, but two or more closely related and previously unrecognized species, each occupying a separate area in a different zone, (Table 6)

The zone of contact of water masses is also a zone

Table 6. Bivalve molluscs in the Canadian Arctic fauna occurring in marine waters of different type:

Arctic bivalves:

*Bathyarca glacialis (Gray)
B. pectunculoides (Sacchi)
Yoldiella frigida (Torell)
Y. intermedia (M. Sars)
*Y. lenticula (Møller)
Y. tamara (Gorbunow)
*Yoldia hyperborea(Loven) Torell
Portlandia arctica (Gray)
P. sulcifera (Reeve)
*Nucula belloti Adams
Nuculana pernula cotigera(Leche)
*Delectopecten groenlandicus(Sow)
Astarte crenata (Gray)
*A. warhami Hancock
Thyasira dunbari sp.n.
Macoma moesta (Deshayes)
M. torelli (Steenstrup)
M. loveni (Steenstrup)
Cuspidaria glacialis (G.O. Sars)
C. arctica (M. Sars)
*C. subtorta (G.O. Sars)
Thracia devexa (G.O. Sars)
Periploma abyssorum Verill
*Cyrtodaria kurriana Dunker

Subarctic bivalves:

**Nucula delphinodonta Migh.Adams.
Nuculand pernula buccata Steen.
**Mytilus edulis L.
Crenella decussata (Montagu)
**C. faba (Müller)
Chlamys islandica (Müller)
Astarte banksi (Leach)
**A. striata (Leach)
Venericardia borealis(Conrad)
Lima subauriculata (Montagu)
Montacuta substriata(Montagu)
Turtonia minuta Fabricius
**Macoma balthica L.
M. inconspicua (Brod. et Sow.)
M. planiuscula Grabt & Gale

Panarctic-boreal bivalves:

Nucula tenuis Mont. s. lato
Nuculana pernula Muller s. lato
Musculus discors (Linne)
M. niger (Gray)
M. corrugatus (Stimpson)
Clinocardium ciliatum(Fabricius)
Serripes groenlandicus Bruggiere
Thyasira gouldi (Phill.)
Axinopsida orbiculata(G.O.Sars)
Astarte borealis (Schumacher)
Macoma calcarea (Gmelin)
Mya truncataLL.
Hiatella arctica (Linne)
Lyonsia arenosa (Møller)
Pandora glacialis Leach

* - the high arctic species with the outposts into the low arctic.

** - the subarctic species with the outposts into the low arctic and the boreal zone.

of faunistic overlap. The position of this zone is unstable and depends on the pressure of water masses or on climatic changes.

In the zone of increased insolation in the polar water area, the cold water species retreat to the depths of low and stable temperature. Some littoral Subarctic species enter the warmed-up shallow water zone. Longer and more complex food chains are usually established here. The abundance of food is favourable for the sedimentation feeding species, as well as for the suspension feeding Arctic and Subarctic species with planktonic larval stages.

Thus the seasonal increase in temperature in the polar water littoral, results in a contact between the Polar and Subarctic faunas and in the establishment of vertical zonation in the distribution of bivalves. This littoral zone ameliorated by summer insolation and containing some littoral subarctic shallow water species, can be designed as the Lowarctic Subzone of the Arctic Zone.

The following scheme of zoogeographic zonation in the Canadian Arctic based on the peculiarities of bivalve fauna can be proposed:

1. The Arctic zone: area of extension of polar waters with polar fauna.

a) The High arctic subzone: area of polar species, Canadian and Canadian-Greenlandic endemics with polar subspecies and clines of Panarctic species.

b) The Lowarctic subzone: area of polar waters with summer temperature sufficiently high to permit some subarctic littoral species to form outposts and to restrict higharctic species to the depths of constant low temperature and salinity. Establishment of vertical zonation in the distribution of bivalves.

2. The Subarctic zone: area of extension of subarctic waters with their fauna. Subarctic species both in the littoral and the sublittoral; polar species and subarctic Canadian endemics present; immigrants from the boreal zone, appear in the south; almost all polar water species restricted to polar water currents moving southwards; vertical zonation of subarctic species in the littoral and sublittoral established.

Ellis (1960, p.34), discussing the effects of oceanographic conditions in the Canadian Arctic on the infaunal benthos, arrived at similar conclusions on the role of temperature in the distribution of benthic animals in polar waters. He does not differentiate, however, the Arctic zone from the Subarctic on the basis of water masses, but

considers only the fluctuations in temperature, and speaks of the subarctic conditions in the Arctic zone and of the lowarctic conditions in the Subarctic zone. He thus recognizes a zone of temperatures intermediate between those of polar and of subarctic waters (Ibid. p.34, No.14, 15). However, he did not take into consideration the salinity gradients peculiar to polar and subarctic waters. It is obvious that the region of polar waters with temperature raised to that of the subarctic zone will still harbour a pauperized polar water fauna but not the subarctic fauna.

Figure 6. Number of species of bivalve molluscs in different regions of Canadian Arctic and N.W. Atlantic.

Regions:

Archipelago: I. Central
II. South-eastern

Canadian Eastern Arctic:
III. Foxe Basin
IV. Hudson Bay
V. Hudson Strait

Labrador Coast:
VI. Northern
VII. Southern

Acadia: VIII. Northern
IX. Southern

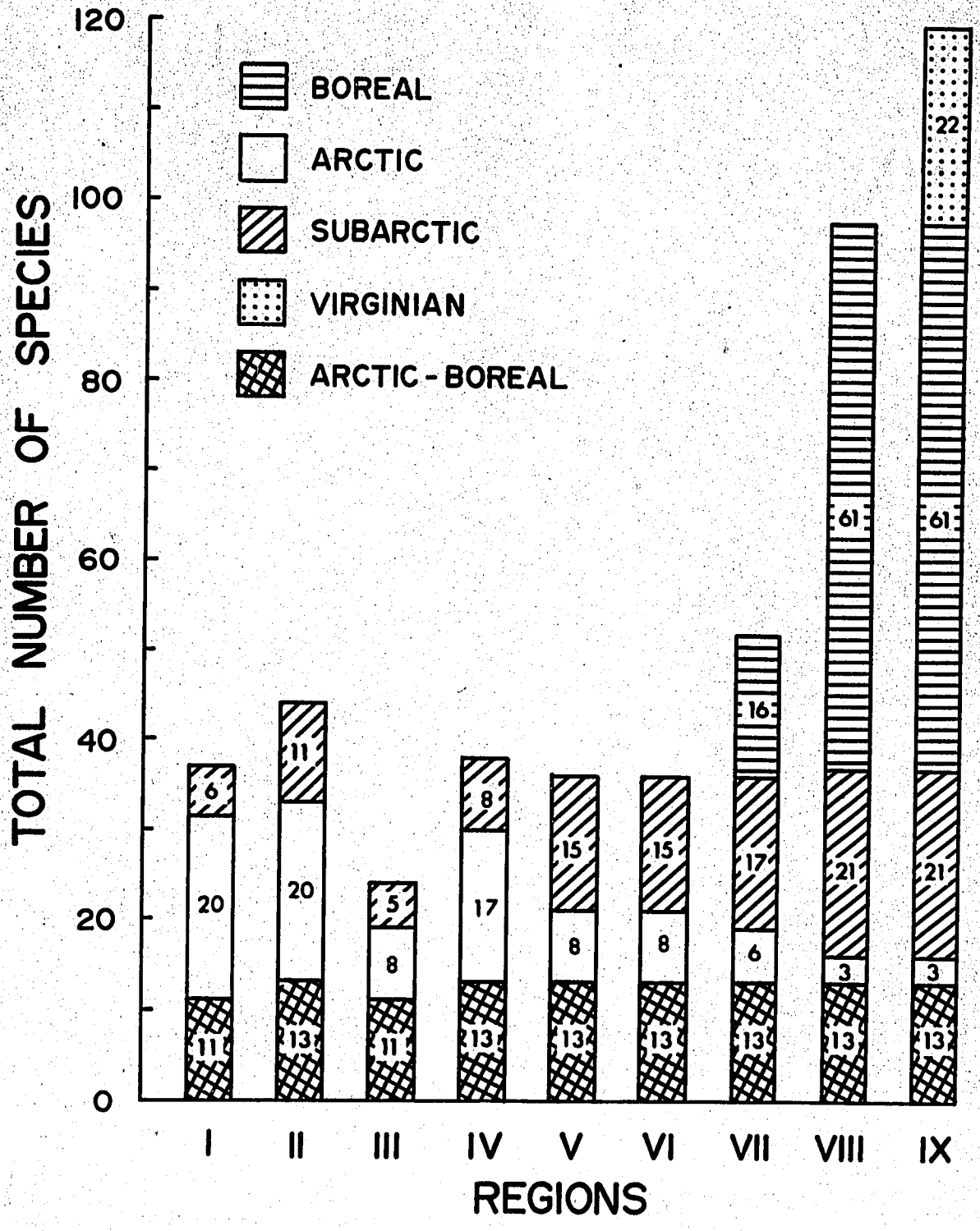

TOTAL NUMBER OF SPECIES
120
100
80
60
40
20
0
BOREAL
ARCTIC
SUBARCTIC
VIRGINIAN
ARCTIC - BOREAL
6
20
11
11
20
13
5
8
11
8
17
13
15
8
13
15
8
13
16
17
6
13
61
21
3
13
22
61
21
3
13
I
II
III
IV
V
VI
VII
VIII
IX
REGIONS

Fig. 6

Figure 7. Percentual relationship of ecological groups of bivalves in the Canadian Arctic and N.W. Atlantic.

Regions:

Archipelago: I. Central
II. South-eastern

Canadian Eastern Arctic
III. Foxe Basin
IV. Hudson Bay
V. Hudson Strait

Labrador Coast:
VI. Northern
VII. Southern

Acadia: VIII. Northern
IX. Southern

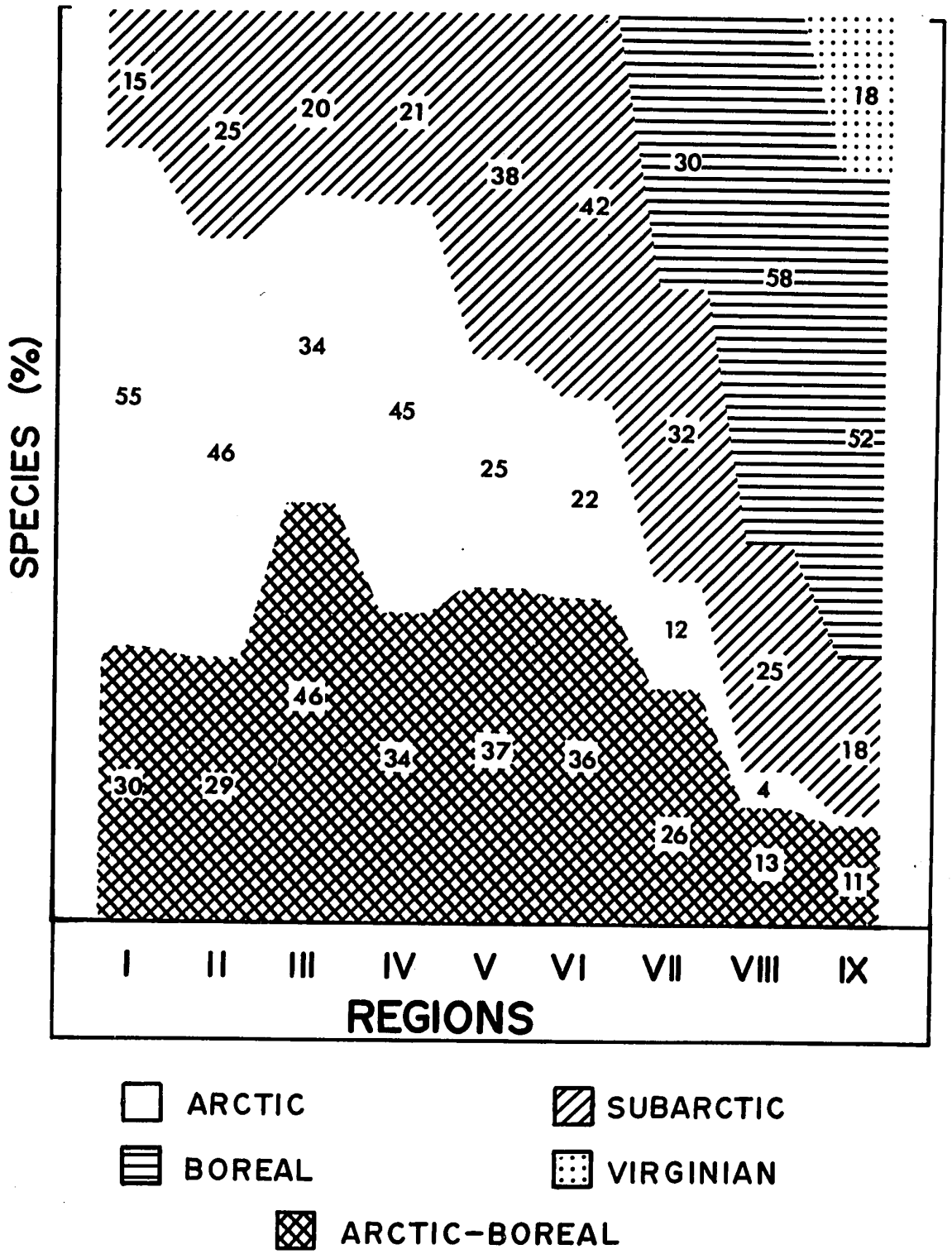

SPECIES (%)
15
25
20
21
18
38
30
42
58
34
55
45
32
52
46
25
22
12
25
46
18
34
37
36
30
29
4
26
13
11
I
II
III
IV
V
VI
VII
VIII
IX
REGIONS
ARCTIC
SUBARCTIC
BOREAL
VIRGINIAN
ARCTIC-BOREAL

Fig. 7

Figure 8. Percentual relationship of the Arctic and the Subarctic groups of bivalves and the position of Zoogeographic Zones in the Canadian Arctic.

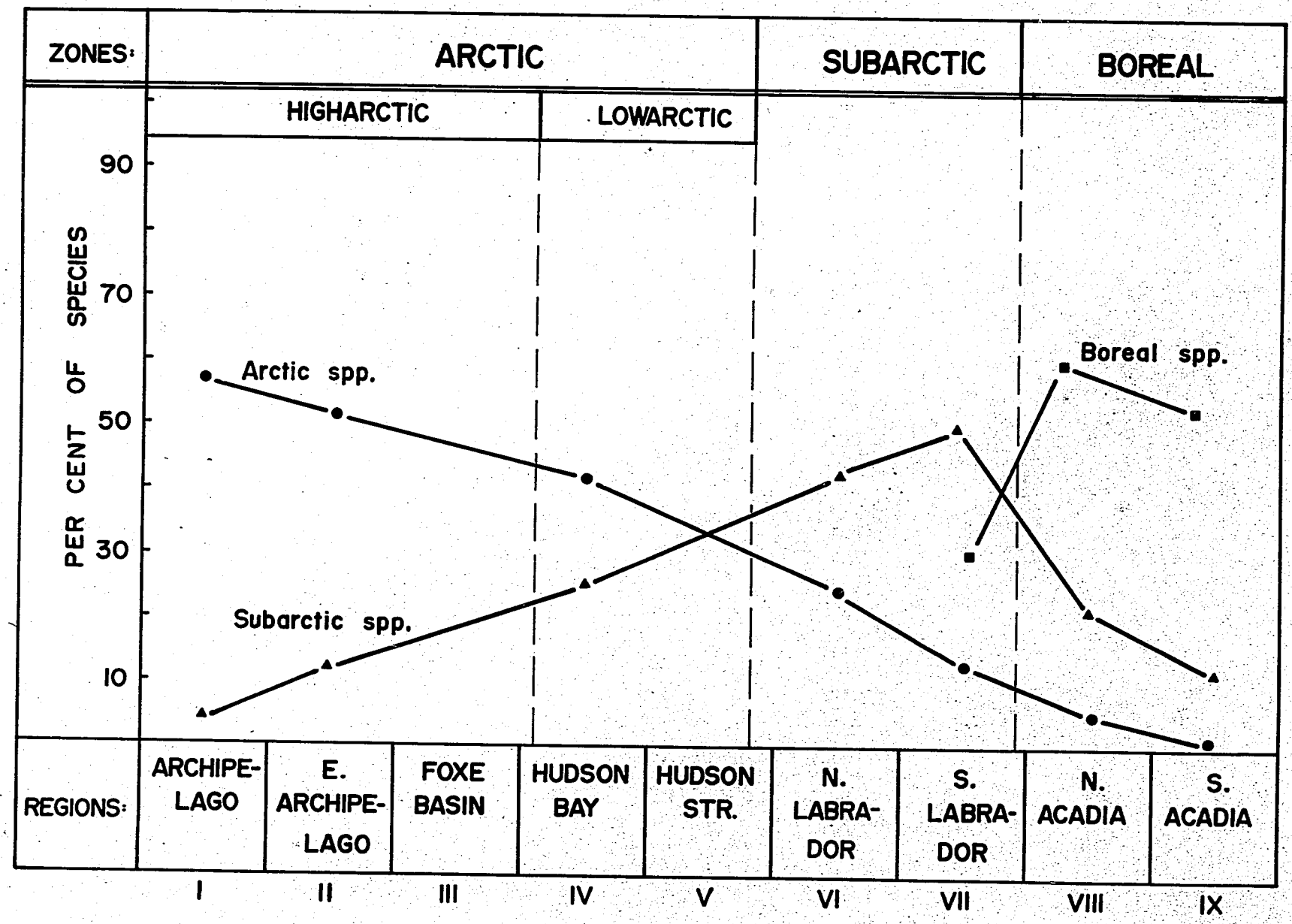

ZONES:
ARCTIC
SUBARCTIC
BOREAL
HIGHARCTIC
LOWARCTIC
PER CENT OF SPECIES
90
70
50
30
10
Arctic spp.
Subarctic spp.
Boreal spp.
REGIONS:
ARCHIPE-LAGO
E. ARCHIPE-LAGO
FOXE BASIN
HUDSON BAY
HUDSON STR.
N. LABRA-DOR
S. LABRA-DOR
N. ACADIA
S. ACADIA
I
II
III
IV
V
VI
VII
VIII
IX

Figure 8

ZOOGEOGRAPHIC ZONATION OF THE CANADIAN BIVALVE FAUNA

The faunas of adjacent zoogeographic zones are never entirely different. Usually a group of species indicative of one zone is replaced by a group indicative of the other zone, while some species extend their areas over both the neighbouring zones. Such species often produce subspecies and form clines from one zone into the other. The adjacent zones differ in their endemic species and also in ecological groups and in their percentual relationships. The number of species differing in feeding habits and in their modes of dispersion usually varies from zone to zone.

The boundary between faunistic zones is seldom clearly delimited. Usually there exists an intermediate zone, in which the contrast and interchange between the two neighbouring faunas is intense. The peculiarities of each fauna become more pronounced with increasing distance from their intermediate zone.

The numbers of bivalve species of different ecological groups and their percentual relationship in the Canadian Arctic and the Acadian faunas are shown in Figs. 6, 7, 8. The data on the Arctic fauna are by the present author, those on the Acadian fauna are compiled from

~~Tucker~~ Abbott (1954); Allen (1965); Gould (1874); Ganong (1890); Johnson (1934); LaRoque (1952); Nësis (1962, 1963); Packard (1863); Stafford (1901-1910); Verrill (1882, 1884, 1885); Whiteaves (1869, 1872, 1874, 1901).

The general trend of the faunistic changes in the above regions is the replacement of Arctic species by Subarctic, with the Panarctic group almost unchanged. The boreal species appear in the south.

The number of species (Fig. 6) changes only slightly from region 1, western and central Archipelago, to region V1, northern Labrador. There is a slight increase in this number in the south-eastern Archipelago (11) caused by the presence of some Subarctic species in this Higharctic fauna. The total number of species of bivalves decreases in Foxe Basin, and increases rapidly from Newfoundland southward where immigrants from the Boreal fauna appear. The Virginian fauna is present in southern Acadia.

The number of Arctic species decreases from the maximum of twenty in the Archipelago to six in Newfoundland, and three in the Acadian fauna. The number of Subarctic species increases from six in the western Archipelago to twenty-one at Newfoundland. The total number of species increases in a southward direction from thirty-eight in the Archipelago to one hundred and twenty in the Boreal zone.

The percentage of Arctic species decreases from fifty- five in the Archipelago to four in the Acadian fauna (Fig. 7). The number of Subarctic species increases from 15% in the eastern Archipelago to 42% in Newfoundland, and decreases in the Acadian Fauna. The Arctic and the Subarctic species comprise 29% of the Boreal fauna.

The number of the Panarctic species remains almost constant in the entire region, but their percentual participation rises from thirty in the Archipelago to forty-six in the Foxe Basin, where the number of species is low. The Panarctic species comprise 34 to 36% of the faunas of the Hudson Bay and Hudson Strait and decreases to 11% in the Acadian Fauna.

Figure 8 illustrates a scheme of exchange between the species indicative of the Arctic and the Subarctic waters in the Canadian Arctic. It also shows the boundaries of the Arctic zone, with the high Arctic and the low Arctic subzones, and of the Subarctic and the Boreal zones.

The main faunistic change is the transition from the dominance of the Arctic fauna in the Higharctic subzone to the dominance of the Subarctic species in the Subarctic zone. The intermediate Lowarctic zone contains Western and Eastern Hudson Strait, and includes Hudson Bay. The Arctic zone extends thus to the central portion of Hudson Strait, where the influx of mixed waters changes the fauna from Arctic to Subarctic.

The second faunistic change occurs off southern Newfoundland, where the replacement of the Arctic fauna by the Subarctic is almost complete. Here the number of both Arctic and Subarctic species is low, and the Boreal fauna predominates.

THE BOUNDARIES OF THE ARCTIC AND THE SUBARCTIC ZONE

The maps by Dunbar (1968, Fig. 10) of the Subarctic zone in the Canadian Arctic shows that this zone extends far north along the west coast of Greenland. At the Melville Peninsula it extends slightly westwards, but does not reach the Canadian shores, where the strong Canadian Polar current passes. The Subarctic zone approaches southern Baffin Land at Padloping Island and extends into Hudson Strait. At the northern shores of the Strait, this

zone extends to Cape Dorset of Foxe Peninsula; at the southern shores it ends at the north-western promontory of Ungava Bay, east of Cape Wakeham. In the Canadian western Arctic, the Subarctic waters are close to the mainland and the zone ends in the narrow passage between the Amundsen and the Coronation Gulfs.

There are three areas in the Canadian Arctic not included in Dunbar's map (1968), where the Subarctic bivalves occur further inland (Fig. 5):

1. In the south-western Archipelago, sublittoral populations of Mytilus edulis, Macoma planiuscula and Musculus corrugatus occur up to the Narrows of Dease Strait eastward from the Coronation Gulf. In the central Archipelago Subarctic species are absent.

2. In the sublittoral of the south-eastern Archipelago occur Mytilus edulis, Nucula delphinodonta, Crenella faba, Yoldia hyperborea and Musculus corrugatus. The presence of these Subarctic species indicates an amelioration of the sublittoral, caused by intrusion of Baffin Bay waters (Collin, 1962), increased summer heating (Ellis, 1956), and the close proximity of the relatively warm "Northern water" in northern Baffin Bay (Dunbar, 1951; Bailey, 1957). The group of species occurring in the sublittoral, enters

the Canadian Arctic probably from the fauna of West Greenland and survives as a relic in the present Higharctic conditions of the Archipelago.

3. The third region of penetration of the Subarctic waters on the continent is in Hudson Strait. The Subarctic sublittoral bivalves occur here as far as the Markam-Big Island area on the northern shores of the Strait, but as far as Nuvuk on the south-western shores. The extreme poverty of bivalve fauna on the north-western shores of Hudson Strait contrasts with its richness on the southern shores of Hudson Strait. Here in the littoral occur Mytilus edulis and Macoma balthica, and in the sublittoral many Subarctic species, including Venericardia borealis. Some of these species enter the littoral of Hudson Bay, but only two, Yoldia hyperborea and Crenella faba enter Foxe Basin. They occur here in the north of this basin and are probably relics of the Hypsithermal or of a still earlier warm period, when Foxe Basin was not isolated from Baffin Bay. In the Wisconsin deposits of this area was found Venericardia borealis, which is now extinct in Foxe Basin. The sublittoral Subarctic species survive in southern Hudson Strait supported by the warm waters outgoing from Hudson Bay, or by the last traces of Subarctic waters.

The presence of Subarctic species in southern Hudson

Strait does not necessarily indicate a change in the entire fauna of the eastern Hudson Bay from Polar to Subarctic, but rather the existence of some faunistic overlap. In deeper waters of Hudson Strait there occurs an abundant fauna of Arctic bivalves, while in the littoral and sublittoral occur Venericardia borealis and Nuculana pernula buccata; the growth rates of Panarctic bivalves are here increased. Such outposts of the Subarctic fauna in the sublittoral extend westward as far as Nuvuk.

These outposts of the Subarctic fauna in the Polar zone are unstable. During the Hypsithermal period the areas of the Subarctic planktotrophic species extended far northward: they occurred along the entire shelf of Baffin Land in 6000-3000 B.P. Among them was Chlamys islandica, a fossil shell of which was found in Lancaster Sound by the J. Ross expedition and recently by students of Manitoba University in Jones Sound. Mytilus edulis, Macoma balthica and Chlamys islandica were not found in the deposits of Foxe Basin. These species dispersing by planktonic larvae, were probably prevented from entering the Bay by the Polar waters discharged through Hudson Strait. However, these species were not prevented from settling at the eastern shores of Baffin Land.

The Southern Boundaries of the Canadian Arctic Fauna

The southern boundary of the Canadian Arctic fauna in its unchanged form is at the Strait of Belle Isle. The intrusion of the waters of the Gulf of St. Lawrence and of the northern branch of the Gulf Stream sets limits to the northern waters with their fauna. Here the zone of displacement ends and the first Boreal species appear.

It is difficult to determine exactly the position of the southern boundary of the northern fauna. Within the Acadian fauna there are relics of both the northern and the southern, Virginian faunas, (Bousfield, 1967; Clark, 1906; Ganong, 1890). This complicated faunistic pattern is caused by the events of the Post-Wisconsin period, when extensive currents of Polar waters supported a northward migrating postglacial fauna, which has left behind several relic areas. The recent pattern of water exchange in the Newfoundland-Nova Scotia region is complicated. In the shelf zone there are at least three types of waters, the mixed northern waters, those from the Gulf of St. Lawrence and the Atlantic waters, Nesis (1965), indicates the presence of five water types here, almost all of them mixed.

Marine conditions south of Newfoundland were discussed by Chamberlain (1963), Ekmann (1953), Lauzier and Trites

(1958), Lauzier and Hall (1962), Nesis (1965), Parr (1935), Pyle (1962) and Schroeder (1963).

Ekmann (1953, p. 135-141), discussed the water exchange and the marine fauna south of Newfoundland. He showed that the offshore region is under the influence of a cold current which extends the northern fauna southward. However, the temperature ranges and fluctuations are higher here than in the north, and depress the northern fauna. Parr (1933) discussed the seasonal variation in the temperature of the Bay of Massachusetts, the southern most area of northern waters. He found four patterns of seasonal fluctuations of temperature, all of which differ from those in the north, as described by Collin (1960), Dunbar (1958), and Grainger (1959, 1960). The data of Parr, Pyle, Schroeder and Chamberlain show that at a depth of 200 metres the temperature is low but still positive. The temperature range of water on the shelf is from +5°C in winter to about 15°C in summer. The bottom temperature is about +5°C. These temperature conditions as well as those of salinity, contrast with the low and even temperatures and salinity in the Arctic zone of Canada where the temperatures in winter are below 0°C, with a summer maximum of +5°C in the north and +13°C in the south; in this zone the salinity in summer may drop almost to brackish levels.

Ekmann (1953), did not regard the area of the Bay of Massachusetts as Subarctic-Boreal, because of the presence of pockets of the northern fauna within the well established Boreal fauna of this Bay. Our data support the opinion of Ekkmann: among the ninety-eight species of bivalves of the northern Acadian fauna and one hundred and twenty of the southern, only three species are Arctic and twenty-three Subarctic. The presence of 52% of Boreal species in the northern Acadian and of 70% Boreal plus Virginian species in the fauna of the southern Acadian, leaves no doubt as to the Boreal nature of the Acadian fauna. The northern species, because of their low participation in this fauna and of their peculiar distribution, may be regarded as relics of northern fauna, which have migrated northwards, following the retreating favourable environment of the periglacial marine zone.

Woodward (1851, 1856), Hall (1964), and Dunbar (1968) place the southern boundary of the Subarctic zone at the southern shores of Newfoundland. The southern boundary of the Subarctic bivalve fauna coincides basically with the boundary established by these authors. An attempt to map the zone of faunal exchange in this region will be made after a study of the bivalve fauna of the shelf of Newfoundland, Grand Banks and of the eastern part of the Gulf of St. Lawrence.

ZOOGEOGRAPHY OF THE CANADIAN ARCTIC BASED ON THE FAUNA OF BIVALVE MOLLUSCS

My studies show that the composition of the Canadian marine bivalve fauna and the distribution of its species depend on the following factors:

1. The proximity to the North Atlantic, Arctic and North Pacific Oceans.

2. Physiography of the marine region: its extension over the shelf and continent; connections with the Arctic and the Atlantic Oceans; dissection of the Archipelago and of the shelf; depth, bottom relief of the region, and bottom sediments.

3. The extension and patterns of exchange of the Arctic and Subarctic waters.

4. History of the region in the Wisconsin period; growth and retreat of glaciers and of marine transgression.

5. Biological features of bivalves: feeding habits, modes and time of dispersal.

The basic zoogeographical subdivisions of the Canadian Arctic bivalve fauna obviously depend on the ecological differences between the Arctic and Subarctic waters, and thus on the zones of distribution of these waters (Figs. 5 and 8).

Each faunistic zone is further subdivided into regions of the deep and of the shallow water fauna (Fig. 9, I, II, III).

Figure 9. Regions of deep and shallow water bivalve fauna in the Canadian Arctic.

Deep water regions: I - Northern

II - Southern

IIa - of relic deep water fauna.

Shallow water regions:

III - Southern Archipelago

IIIa - Foxe Basin

IIIb - Hudson Bay

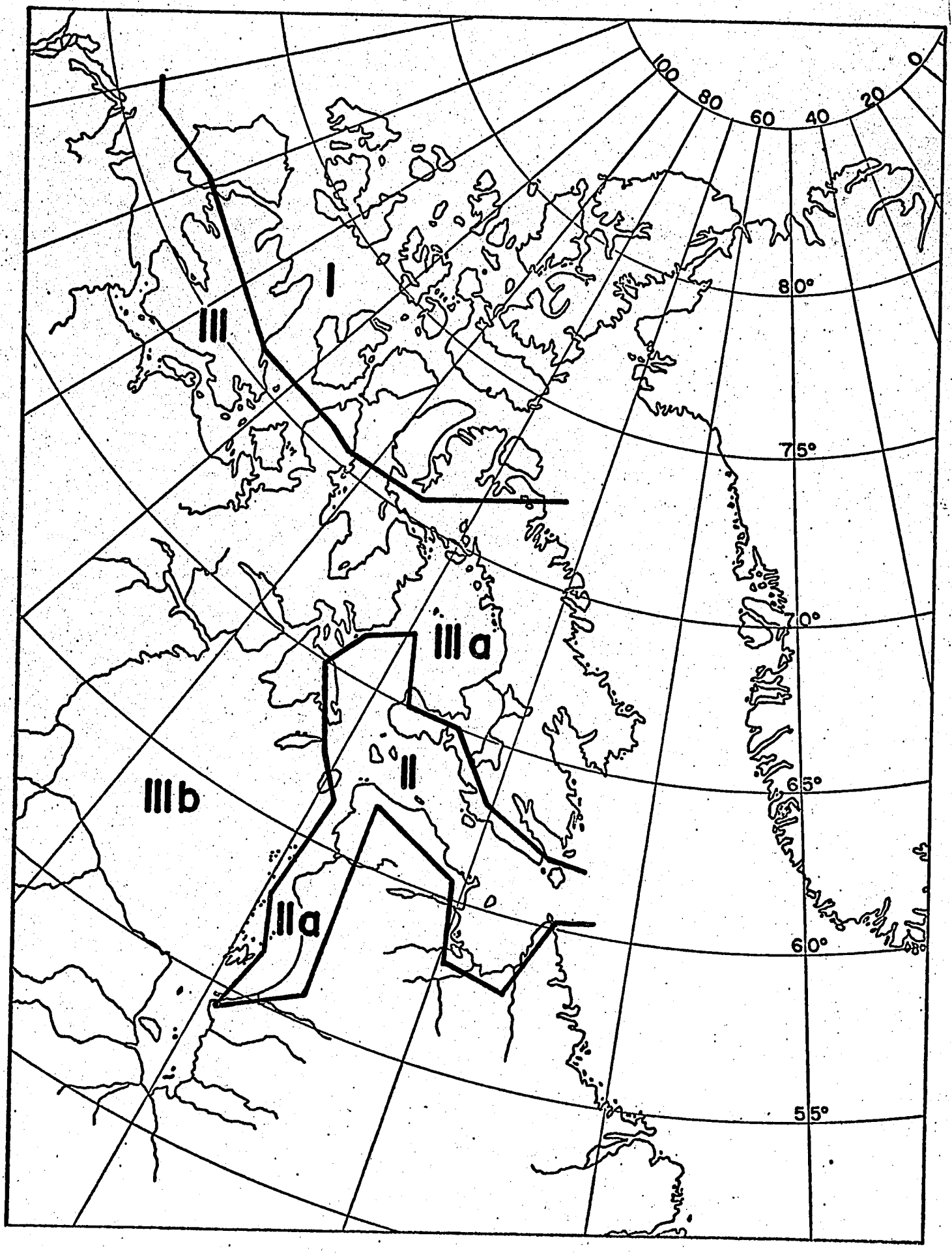


Figure 9

Figure 10. Provinces of the Canadian Arctic bivalve fauna

High Arctic provinces:

I. Endemic province of Queen Elizabeth Islands.
II. Central high arctic provinces:
  a. of central Archipelago.
  b. of Foxe Basin.
  c. of the shelf of Baffin Land.
III. South-western Archipelago.
IV. South-eastern Archipelago.

Low Arctic provinces:

V. Canadian Eastern Arctic provinces:
  a. Hudson Bay.
  b. James Bay.
  c. Central Eastern Arctic.

Subarctic provinces:

VI. Northern Subarctic provinces:
  a. Eastern Hudson Strait & southern Inlets of Baffin Bay.
  b. Northern Labrador.
VII. Southern Labrador and Newfoundland.

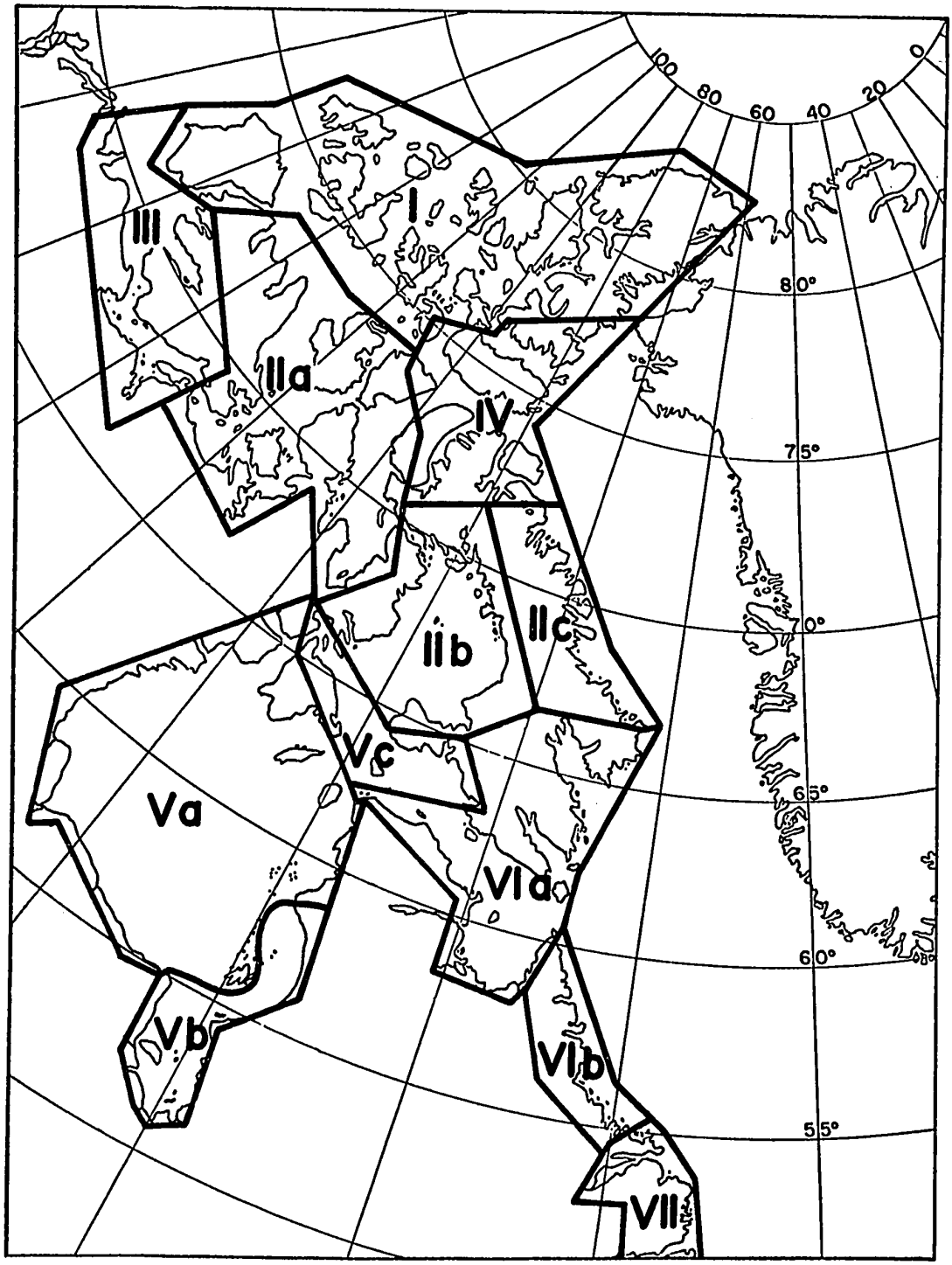

100
80
60
40
20
0
80°
75°
70°
65°
60°
55°
I
III
IIa
IV
IIb
IIc
Vc
Va
VIa
Vb
VIb
VII

Fig.10

There are two such deep water regions, one in the Central, and one in the Eastern Canadian Arctic, in the Higharctic subzone and in the Subarctic zone respectively (Fig. 9, I, II). The area of the relic deep water fauna of Hudson Bay was included in the southern deep water region.

The shallow water region was subdivided into three subregions; (1) the Central Canadian Arctic embracing the shallow waters of the mainland and in the Archipelago (Fig. 9, I, III); (2) Foxe Basin (IIIa); and (3) Hudson Bay and James Bay. The shallow water zone of Hudson Strait is included in Subregion IIIb.

The fauna of the deep water region is more or less uniform and was not subdivided into smaller zoogeographic units. The shallow water fauna, however, is zoogeographically diverse and was subdivided into twelve provinces (Fig. 10).

<u>The Higharctic provinces</u>:

1. Province of the endemic fauna of the Northern Archipelago (I).
2. Central Higharctic province (IIa).
3. Higharctic province of Foxe Basin (IIb).
4. Higharctic province of the Baffin Land shelf (IIc).
5. Province of the mixed fauna of the south-eastern Archipelago (IV).

<u>The Lowarctic provinces</u>:

7. Province of Hudson Bay (Va).
8. Brackish water province of James Bay (Vb).

9. Central Lowarctic province (Vc).

The Subarctic provinces:

10. Central Subarctic province (VIa).
11. Province of northern Labrador (VIb).
12. Province of southern Labrador (VII).

The Arctic fauna is characterized by the predominance of sedimentation feeding and mud engulfing bivalves which disperse by lecithotrophic larvae and are independent of the summer season in their breeding. The suspension feeding species which in this zone are neither numerous nor abundant, are mostly of Panarctic distribution.

The Subarctic fauna consists of Arctic and Subarctic sedimentation feeding and mud engulfing species with lecithotrophic larvae, and of a considerable group of suspension feeding bivalves with planktotrophic larvae. These last depend greatly on the seasonal food supply and therefore breed in summer.

The Lowarctic fauna is mixed, and consists basically of the following groups: (1) Arctic sedimentation and Subarctic sedimentation feeders; (2) Panarctic species, heterogeneous in respect to their feeding and reproduction; and (3) a few Subarctic suspension feeders with planktotrophic larvae, occurring mainly in the warmed-up littoral.

An important feature in the distribution of bivalves is their vertical zonation. It begins in the Lowarctic zone, where

some Arctic species retreat from the warmed-up littoral and are replaced by a few Subarctic species. In the Subarctic zone the vertical zonation is well developed in both the littoral and the sublittoral, where the Subarctic species predominate, whereas in the lower sublittoral and bathyal the Arctic species still occur. Therefore, in many Subarctic provinces the fauna changes with increasing depth from Subarctic to Arctic.

ZOOGEOGRAPHIC AREAS OF THE CANADIAN ARCTIC BIVALVE FAUNA

Fauna of the Arctic Zone (Figs. 9 and 10).

The fauna of this zone extends over the Archipelago, Foxe Basin, Foxe Channel, Hudson Bay, western Hudson Strait, and the shelf of Baffin Land to Padloping Island (Fig. 10, I - V). The Arctic group of species, however, submerges in the eastern Hudson Strait and extends thus over the entire Canadian region, including Labrador.

The following groups of species are characteristic:

1. Arctic shallow water species, which are dominant.
2. Panarctic shallow water species, which are not abundant in the northernmost areas, and some of which are restricted in distribution.

3. Deep water Arctic species which are not abundant, with the exception of emerging Bathyarca glacialis and Delectopecten groenlandicus.

4. A few Subarctic species which occur in the sublittoral of the southeastern and southwestern Archipelago and in the littoral of the Lowarctic zone.

5. Endemic Canadian and Canadian-Greenlandic Higharctic shallow water species, abundant but restricted to the northern Archipelago. The Arctic species are listed in Table 6, their percentual relationship to other groups of species is shown in Fig. 7.

In the Arctic fauna abound Bathyarca glacialis, Delectopecten groenlandicus, Portlandia arctica arctica, P.a. portlandica, P.a. siliqua, Nucula belloti, Nuculana pernula costigera, Yoldiella lenticula, Macoma moesta, Astarte crenata crenata, A. warhami. Rare are: Yoldiella frigida, Y. intermedia, Macoma loveni, M. torelli, Cuspidaria subtorta, C. arctica, C. glacialis. In isolated areas occur Periploma abyssorum, Cyrtodaria kurriana; in the north abound the endemics Thyasira dunbari sp. n., Portlandia sulcifera and Thracia devexa. Restricted to the southeastern Archipelago are Mytilus edulis, Nucula delphinodonta, Crenella faba and Astarte striata. In the sublittoral of the southwestern Archipelago occur Mytilus edulis, Macoma inconspicua and M. planiuscula.

Fauna of the Higharctic Subzone (Fig. 9, I, III, IIIa; Fig. 10, I - IV).

This subzone extends over the Archipelago, Foxe Basin, Foxe Channel and the entire northern shelf from Cape Bathurst to Padloping Island. Here the Higharctic fauna dominates and the vertical zonation in the distribution of bivalves is absent.

The Subzone is subdivided into regions of the deep and shallow water faunas.

Fauna of the Higharctic Deep Water Region (Fig. 9, I).

The region of this fauna extends over the bathyal of the northern Archipelago including McClure Strait, Lancaster Sound, McClintock Channel and Gulf of Boothia. Characteristic of this region are Bathyarca pectunculoides, B. glacialis, Yoldiella tamara, Y. intermedia, Delectopecten groenlandicus, Cuspidaria arctica, C. glacialis, C. subtorta, Astarte crenata, Periploma abyssorum and Lima subauriculata.

Fauna of the Higharctic Shallow Water Region (Fig. 9, I, III, IIIa).

The region extends along the northern mainland from Cape Bathurst to Baffin Bay. Characteristic of it are abundant groups of Higharctic species. Rare are Panarctic Macoma calcarea, Nuculana minuta and Musculus corrugatus.

The region is subdivided into six provinces (Fig. 10, I - IV):

a. Higharctic shallow water province of Canadian endemic fauna (Fig. 10, I). Extension: north-western shelf, littoral and sublittoral of the Queen Elizabeth Islands to Ellesmere Land and Barrow Strait Sill in the east; an outpost over the northern shore of Amundsen Gulf. Characteristic of this province are abundant Canadian endemics: Portlandia sulcifera and Thyasira dunbari, and north-Atlantic Thracia devexa. Dominant are Higharctic shallow water species and emerging Bathyarca glacialis and Delectopecten groenlandicus. Panarctic species are rare. Pandora glacialis was not found. The western part of this province probably served in the Wisconsin period as a glacial refuge for the bivalve fauna.

b. Central Higharctic shallow water province (Fig. 10, IIa). Extension: from Kent Peninsula in the west to Hecla-Fury Strait in the east. Fauna exclusively Higharctic. Abundant are Astarte crenata, A. borealis placenta, A. warhami, Yoldiella lenticula, Nuculana pernula costigera, Nucula belloti, Portlandia arctica portlandica, Macoma moesta, M. torelli, M. loveni. Extremely abundant are Bathyarca glacialis and Delectopecten groenlandicus, which probably compete in abundance with the shallow water species.

c. Higharctic shallow water province of Foxe Basin (Fig. 10, IIb). The fauna of this province is peculiar in many respects: (1) it

contains only a small number of species, (2) deep water species are absent, (3) absent are also species indicative of the Low-arctic zone (Mytilus edulis, Macoma balthica, Chlamys islandica and Venericardia borealis, (4) the sole representative of Portlandia is P. arctica siliqua, (5) in northern Foxe Basin were found Thyasira gouldi, Crenella faba and Yoldia hyperborea, which occur also in the Archipelago east of the Barrow Strait Sill, (6) Higharctic shallow water species are abundant.

The fauna of Foxe Basin is a typical shallow water High-arctic one; it has Crenella faba and Yoldia hyperborea in common with the fauna at Baffin Bay, and Nuculana pernula costigera, Macoma calcarea f. obliqua, and Portlandia arctica siliqua in common with that of the Archipelago.

d. Higharctic province of the Baffin Bay Shelf (Fig. 10, IIc). Extension: eastern shores of Baffin Land from Pond's Inlet to Padloping Island. Its Higharctic fauna is continuous with that of the Archipelago; it is peculiar in the absence of Subarctic species, which occur, however, to the north and south of this province.

e. Higharctic province of the south-western Archipelago (Fig. 10, III). Extension: Amundsen and Coronation Gulfs to Kent Peninsula. Higharctic shallow water species predominate. In the sublittoral occur Mytilus edulis, Macoma inconspicua and M. planiuscula. Here occurs Macoma calcarea f. obliqua,

described from the East Siberian Sea and found also in Foxe Basin.

f. Higharctic province of the south-eastern Archipelago (Fig. 10, IV). Extension: Shelf of Ellesmere Land from Smith Sound to, and including, Pond's Inlet, Jones Sound and Lancaster Sound as far as Barrow Strait Sill. In deep water was found the Higharctic Periploma abyssorum and the subarctic Lima subauriculata. In the sublittoral are present bivalves occurring in the shallow water of oceanic shores, Astarte arctica, A. elliptica. Portlandia is represented only by P.a. siliqua. The number of species in this province is increased by Subarctic sublittoral species: Nucula delphinodonta, Yoldia hyperborea, Crenella faba, Astarte striata, Thracia septentrionalis, T. myopsis and Mytilus edulis. Here occur also the Panarctic Nuculana minuta, and Musculus corrugatus, which avoid Higharctic conditions. The fauna of this province is similar to that of north-western Greenland.

The Fauna of the Lowarctic Subzone of the Arctic Zone (Fig. 10, Va, b, c).

This subzone extends over Foxe Channel, Hudson Bay and the western part of Hudson Strait, approximately to Big Island-Wakeham Bay Narrows. The basically polar waters of this subzone have an admixture of subarctic water in the east. The shallow water region is ameliorated by intensive insolation.

The area of brackish waters of James Bay extends into south-eastern Hudson Bay.

Dominant is the Higharctic shallow water fauna, in which Bathyarca glacialis and Delectopecten groenlandicus abound. In eastern Hudson Bay occur rare specimens of bathyal species. In the shallow water off Belcher Islands a few Subarctic species are found. In the littoral and the offshore sublittoral the fauna is mixed and consists of remaining Higharctic species, of a large group of Panarctic species, and of few Subarctic species. The vertical zonation of the bivalve fauna is established.

a. Central Lowarctic province (Fig. 10, Vc). Extension: junction of Foxe Channel, northern Hudson Bay and western Hudson Strait. Higharctic fauna predominates in the bathyal and sublittoral. In the shallow water, besides Higharctic species occur Crenella faba and Astarte striata, but these species are scarce. This province is remarkable for the poverty of bivalve fauna in the shallow water zone, which is caused by the abrasive action of ice moving from Foxe Channel into Hudson Strait. Here were found Nucula belloti, Nuculana pernula costigera, Yoldiella lenticula, Astarte warhami and Macoma loveni.

b. Lowarctic province of Hudson Bay (Fig. 10, Va). Extension: plateau of the Bay including James Bay. The waters

are polar, but the vertical zonation in distribution of bivalves is established. Abundant are both Higharctic shallow water species and Panarctic species, whose growth rates are high. A rich epifauna lives on numerous boulders left by the glacier.

Besides many sedimentation-feeding species with lecithotrophic larvae, in the Bay occur also suspension-feeding Panarctic and Subarctic species with planktotrophic larvae, e.g. Mytilus edulis (in the littoral and sublittoral) and Chlamys islandica (in the sublittoral). The number of species in Hudson Bay is high in contrast to that in Foxe Basin.

The fauna of the entire floor of Hudson Bay consists of Higharctic and of Panarctic species, both epifaunal and infaunal. The littoral is populated by Higharctic and Subarctic species. Abundant are Mytilus edulis, Hiatella arctica, Musculus discors, M. niger, M. corrugatus, Macoma balthica and, at a depth of 30-70 metres Chlamys islandica settles.

In the trench of the south-eastern Hudson Bay occur species found also in the Archipelago: Thracia devexa, Yoldiella lenticula, Y. intermedia, and Periploma abyssorum. This trench is a relic area of the Higharctic fauna surviving here since the time of the maximum extension of the Tyrell Sea. In the shallow water off Belcher Islands were found shells of Nucula delphinodonta, live Crenella decussata and abundant Astarte crenata crebricostata. These species occur usually in the shallow open seas. Their presence shows that at some period in

the history of the Tyrell Sea this area was under Arctic influence. Here in the shallow water are found masses of large shells but no live specimens of Mya pseudarenaria Schlesch.

c. Brackish water province of James Bay (Fig. 10, Vb). Extension: over James Bay with outposts into the shallow water of Hudson Bay. The water is polar, but less saline and much warmer in summer than in any other region of the Canadian Arctic. The increased land drainage and high stability of the water contribute to its brackishness and the current from James Bay carries the brackish water into Hudson Bay, where it mixes with polar waters of this Bay.

The fauna of James Bay does not differ from that of Hudson Bay, but is dwarfed and depressed. Living specimens are scattered amidst masses of shells covered by clayey deposits. The vertical zonation is almost nonexistent because the zones are displaced and mixed. The fauna recovers towards Hudson Bay. Here appear Yoldiella lenticula, Astarte warhami, and the entire group of Higharctic species. The vertical zonation becomes established.

The brackish waters affect the littoral fauna of the southern Belcher Islands and off the mainland almost to Fort Harrison.

Bivalve fauna of the Subarctic Zone (Fig. 10, VIa, b).

The Subarctic Zone extends in Baffin Bay southward from

Padloping Island into the eastern Hudson Strait. Here the shallow water of the northern shores of Hudson Strait extends to Big Island and to Nuvuk on its southern shores. The waters are Subarctic and the vertical zonation is well established.

The contact between Polar and Subarctic waters and the openness of the region towards the Atlantic Ocean influence the fauna of this zone. Polar waters moving to the Labrador Sea in the deep channel of Hudson Strait extend the Higharctic fauna southwards. In the littoral and sublittoral occur both Polar and Subarctic bivalves, but the number of Subarctic species increases in the shallow water while the Polar species gradually submerge.

Abundant are Yoldia hyperborea, Crenella faba, C. decussata, Astarte striata, Venericardia borealis, Thracia myopsis, Mytilus edulis, Macoma balthica and Chlamys islandica. Panarctic species prosper.

The boundary between the Arctic and Subarctic zone is not sharp and the fauna changes gradually. The Subarctic zone begins with the presence of Subarctic species in the littoral and sublittoral. The boundary of the Subarctic fauna is less distinct at the northern shores of Hudson Strait because of the scarcity of bivalves. At Ashe's Island only Yoldia myalis, Crenella faba and Astarte borealis were found, but not Mytilus edulis.

More distinct is the boundary of the Subarctic fauna at the southern shores of Hudson Strait, where the Subarctic species abound and where Venericardia borealis was found as far west as Nuvuk. Bathyarca glacialis, Delectopecten groenlandicus, Periploma abyssorum and Portlandia arctica disappear from the shallow waters. Nuculana pernula costigera is replaced by N.p. buccata, and Astarte elliptica, Nucula delphinodonta, and Liocyma fluctuosa appear again.

a. The Central Subarctic province (Fig. 10, IVa). Extension: from Padloping Island in Baffin Bay along the northern shores of Hudson Strait to Ashe's Island; along the southern shores of the Strait from Nuvuk to the Labrador shelf. In this province both the tidal mixing and the insolation are intense and the vegetation rich, but the environment is less favourable for the Polar fauna and Subarctic species dominate.

The boundary of the Central Subarctic province is marked in Baffin Bay by the last littoral colonies of Mytilus edulis at Padloping Island, and in Hudson Strait by the most westerly findings of Venericardia borealis at Nuvuk and of Yoldia myalis at Ashe's Island.

b. The Subarctic province of northern Labrador (Fig. 10, VIb). Extension: northern shelf of Labrador from Hudson Strait to Hopedale. The fauna is mixed Arctic and Subarctic. The Polar species remain within the polar current and enter bays, inlets, etc.

c. The Subarctic province of southern Labrador (Fig. 10, VIII). Extension: from Hopedale to the Strait of Belle Isle. The fauna of this province is very similar to that of the shelf of Newfoundland and therefore both these coastal regions can be united into one, the southern Subarctic Province.

This is a province of typical Subarctic fauna with the admixture of some boreal species in the south, such as Modiolus modiolus, Mya arenaria, Pecten magellanicus, Anomia squamula, and Spisula polynyma. Mytilus edulis occurs at Newfoundland not only in the littoral but in the sublittoral down to a depth of 50 metres (Nesis, 1965).

A few Arctic and Subarctic species occur southward from Newfoundland in pockets of cold water and a few specimens of Subarctic species were even found off Cape Hatteras. But south of Newfoundland the northern waters disappear and with them the northern bivalve fauna.

The mosaic pattern of the zoogeographic distribution of bivalves is produced by the complicated dissection of the land, the presence of several types of water masses, and above all by the glacial events of the Wisconsin and Post-Wisconsin periods. The Laurentian glacier separated for a long period the bivalve fauna of the north-western area from that of the south-eastern, and the bivalves of each area evolved independently. In the north-western area, which was least glaciated and probably served

as a glacial refuge for bivalves, the fauna developed locally, without extensive migrations. Here originated the Canadian endemics and into this area the north Pacific species extended their outposts.

Whereas the northern fauna in the western region remained stationary for a long time, the fauna of the Atlantic area went through a period of extensive migrations and, geologically speaking, returned to the Canadian Arctic recently.

The boundaries of many zoogeographic provinces of the Canadian Arctic are determined by glacial movements, water barriers, and land-rebound. The endemic Higharctic shallow water species, dispersing by lecithotrophic larvae were unable to cross the southern barrier of McClure Strait-Lancaster Sound. They were prevented from expanding eastward by the raised land and the glacier in the Innuitian region (Blake, 1970, pp. 569, 658, Fig. 12.

The exchange between the faunas of West Greenland and the Archipelago was probably limited for a shorter period, because of the proximity of the warm west Greenland current. The bivalves did migrate from Greenland into the south-eastern Archipelago, but only to the Barrow Strait Sill. Panarctic bivalves were stopped by the same barrier. The presence of these land and water barriers explains the differences in the faunas of the I, IIa and IV provinces (Fig. 10).

The rise of the land in the south-western Archipelago produced a barrier for the northern Pacific fauna in the Narrows of Dease Strait at Kent Peninsula (Fig. 10, III). In the sublittoral of this province occur a few subarctic bivalves.

The formation of the fauna of the eastern Canadian Arctic was also influenced by the land rebound and the retreat of the Laurentian glacier. The rise of the land disrupted the broad marine connections of Foxe Basin with Baffin Bay and the Archipelago. The Fury and Hecla Strait originated later, probably as a result of pressure of water from the north. The isolation of Foxe Basin has interrupted the connections between the faunas of the Canadian Central and Eastern Arctic. The deep water and the Subarctic species occurring in Hudson Strait and in Baffin Bay (Mytilus edulis, Macoma balthica, Chlamys islandica) never entered Foxe Basin. The barrier for Subarctic species with planktonic larvae was probably formed by the Polar current from Foxe Channel.

The Tyrell Sea supported a Higharctic fauna at the time when the ice over the Keewatin and Labrador was melting, and the connections with the Arctic Ocean were broad. However, the Subarctic Mytilus edulis lived in the Tyrell Sea at an early stage of transgression.

In Hudson Bay the deep water species, restricted at present to the trench, are in the process of extinction. During the Hypsithermal period some Subarctic sublittoral species,

which still occur around the Belcher Islands, migrated into Hudson Bay. Mya pseudarenaria, the extremely large and abundant shells of which are found at the Belcher Islands, died out, probably at the end of the Hypsithermal period.

The brackish water province of James Bay originated as a result of the latest period in land rebound and is probably the youngest province in the Canadian Arctic.

The mosaic pattern of the zoogeography of bivalves in the Canadian Arctic contrasts with the relative simplicity of their zoogeography in the Eurasian Arctic as worked out by Filatova (1957, b, Fig. 1). The simple physiography of the Eurasian shelf, its width, and considerable longitudinal extension, resulted in a zonal distribution extending parallel to the shore. Filatova's zones IIIa, b, and V follow each other in long parallel strips toward the abyssal zone, IV. The openness of the shelf toward the Arctic Ocean explains the high participation in its shelf fauna of the emerging bathyal, and even of some abyssal, bivalves. Filatova does not discuss the influence of the water masses and of the Pleistocene events on the recent fauna of the Eurasian marine bivalves.

THE ZOOGEOGRAPHIC RELATION OF THE CANADIAN MARINE BIVALVE FAUNA TO THAT OF THE NEIGHBOURING COASTAL REGIONS AND TO THE ENTIRE CIRCUMARCTIC BIVALVE FAUNA

The Canadian fauna of bivalves contains species restricted to different depth zones (bathyal, sublittoral and littoral), to different water masses (Arctic, Subarctic), and to different geographic areas (Atlantic, Pacific and Circumpolar), (Tables 6, 7, 8).

The bathyal species constitute 15% of the fauna, the 39 littoral and sublittoral species of the epicontinental marine waters 64%, and the 13 shallow water species of oceanic shores, 15%.

The participation of the Atlantic, N. Pacific and Circumpolar species in the Canadian Arctic fauna is as follows:

N. Atlantic		Circumpolar		N. Pacific	
Sp. No.	%	Sp. No.	%	Sp. No.	%
25	45	29	52	2	3

The number of Arctic, Subarctic and Panarctic species in these groups in the Canadian marine fauna is as follows:

Table 7. List of bivalves with different depth requirements in the Canadian Arctic.

Shallow water bivalves of the shelf:

Nucula belloti Adams
Nuculana pernula (Müller)
Nuculana minuta (Fabricius)
Yoldia hyperborea (Torell)
Yoldiella lenticula (Møller)
Portlandia arctica (Gray)
P. sulcifera (Reeve)
Chlamys islandica (Müller)
Mytilus edulis L.
Crenella faba (Müller)
Musculus discors (L.)
M. niger (Gray)
M. corrugatus (Stimpson)
Thyasira gouldi Phil.
T. dunbari sp. n.
Astarte warhami Hancock
A. crenata crenata (Gray)
A. borealis (Schum.)
Clinocardium ciliatum (Fabr.)
Serripes groenlandicus Brigg.
Axinopsida orbiculata (G.O.Sars)
Venericardia borealis (Conrad)
Macoma balthica L.
M. calcarea (Gmelin)
M. moesta (Deshayes)
M. torelli (Steenstrup)
M. loveni (Steenstrup)
M. inconspicua Brod. Sow.
M. planiuscula Grant & Gale
Cyrtodaria kuttiana Dunker
Mya truncata L.
Hiatella arctica (L.)
Pandora glacialis Leach
Lyonsia arenosa Müller

Shallow water fauna of the shores of the open sea:

Nucula delphinodonta Migh.et Ad.
Crenella decussata (Mont)
Dacridium vitreum (Møller)
Turtonia minuta (Mont)
Montacuta substriata (Mont)
Lima subauriculata (Mont)
Liocyma fluctuosa (Gould)
Astarte banksi (Leach)
A. arctica (Gray)
A. crebricostata (Forbes)
A. elliptica Brown
A. striata (Leach)

Deep water species emerging:

Yoldiella intermedia (M. Sars)
Y. frigida (Torell)
Y. tamara (Gorbunov)
Bathyarca pectunculoides(Scacc)
B. glacialis (Gray)
Cuspidaria glacialis (G.O. Sars)
C. arctica (M. Sars)
C. subtorta (G.O. Sars)
Delectopecten groenlandicus(Sow)
Periploma abyssorum Verill et Bush.

Table 8. List of bivalves of Atlantic, Pacific and circum-arctic distribution in the fauna of the Canadian Arctic.

Atlantic species:	Pacific species:
Portlandia lenticula (Møller)	Macoma planiuscula Grant and Gale
P. frigida (Torell)	M. inconspicua Brod. et Sow.
P. sulcifera (Reeve)	
Bathyarca glacialis (Gray)	
B. pectunculoides (Scacchi)	
Dacridium vitreum (Møller)	
Pecten groenlandicus (Sowerby)	
Astarte crenata (Gray)	
A. soror Dall	
Thyasira dunbari sp. n.	
Macoma loveni (Stimpson)	
M. torelli (Stimpson)	
Thracia septentrionalis Jeffreys	
T. devexa G.O. Sars	
Cuspidaria subtorta (G.O. Sars)	
C. arctica (M. Sars)	
C. glacialis (G.O. Sars)	
Periploma abyssorum Ver. and Bush.	
Lima subauriculata Montagu	

Species of circumpolar distribution:

Nucula belloti Adams	Axinopsida orbiculata (G.O. Sars)
Nuculana pernula (Müller)	Cardium ciliatum Fabr.
Portlandia arctica (Gray)	Serripes groenlandicus Brugg.
Yoldiella intermedia (M. Sars)	Macoma calcarea (Gmelin)
Musculus discors (L.)	M. moesta (Deshayes)
M. niger (Gray)	Hiatella arctica (L.)
Astarte borealis (Schum.)	Mya truncata L.
A. warhami Hancock	Lyonsia arenosa (Møller)
Thyasira gouldi Philippi	Pandora glacialis Leach

Species with circumpolar distribution interrupted in high latitudes:

Crenella decussata (Montagu)	Liocyma fluctuosa (Gould)
Musculus corrugatus (Stimps)	Cyrtodaria kurriana Dunker
Nuculana minuta (Fabricius)	Macoma balthica L.
Mytilus edulis L.	Nucula delphinodonta Migh. et Adams
Chlamys islandica (Müller)	Turtonia minuta (Mont.)
Astarte striata (Leach)	Montacuta substriata Mont.
Venericardia borealis (Conrad)	Yoldia myalis Couthoy

Species	N. Atlantic		Circumpolar		N. Pacific	
	Sp. No.	%	Sp. No.	%	Sp. No.	%
Arctic	19	76	6	20	-	-
Subarctic	6	24	8	30	2	3
Panarctic	-	-	15	50	-	-
Total	25	100	29	100	2	100

The circumpolar species, because of their wide longitudinal and latitudinal distribution, are less important in the determination of zoogeographic affinities of the fauna than any other group. Half of these species (50%) are Panarctic, the other half being composed of Arctic and Subarctic species, 20 and 30% respectively. The zoogeographically important North Pacific species constitute only 3% of the Canadian Arctic fauna.

The group of North Atlantic species, constituting 45% of the Canadian fauna, seems to be characteristic of this fauna. This group contains 76% of Arctic and 24% of Subarctic species. The nineteen North Atlantic Arctic species constitute the largest sub-group of species in the Canadian Arctic fauna and identify this fauna as Atlantic-Arctic.

The Canadian fauna is connected to the Atlantic fauna by endemic Thracia devexa and the subarctic endemic Crenella faba. The Canadian Arctic fauna has more species in common with the Atlantic fauna than with the Pacific because the areas of many

Panarctic species considered as circumpolar are disruputed on the Pacific sector of the Arctic.

BIVALVE FAUNA OF THE CANADIAN AND GREENLANDIC SHALLOW WATER REGIONS

The Greenlandic Shield is an extension of the Canadian Shield. The shores of Greenland are exposed both to the Arctic and to the Atlantic waters. The shelf is narrow and greatly dissected, and in East Greenland is under the influence of the Polar current. A current of mixed waters is formed by a branch of the Polar East Greenlandic current which passes for a short distance close to the southern part of the Greenland shore, joining the waters of the warm Irminger current and flowing north as the West Greenland current. Thus, south of Greenland, the polar waters mix with the underlying Atlantic layer, ameliorating the severe Arctic conditions. The bivalve faunas of west and east Greenland differ considerably. The Atlantic Subarctic species occur off the entire West Greenland coast. The Arctic species occur in the north in Disco Bay, and in some isolated areas at the southernmost part of the coast. In contrast, the fauna of East Greenland is Higharctic, the Subarctic species occurring only in the south. The entire fauna of Greenland is Atlantic-Arctic, with an admixture of Atlantic Subarctic and Panarctic species.

Lists of Greenlandic bivalves were compiled by Thorson (1951, Table I, p.105) and by Ockelmann (1958, Table 2, p. 194). The similarity of the Greenlandic and the Canadian faunas was expressed by Ockelmann in percentages of species common to both regions (1958, p. 192, Fig. 27). This percentage is 65 in the fauna of West Greenland and 69 in that of East Greenland. My data show a higher percentage of identical species, 75 in the fauna of Canada and West Greenland, and 84 in the fauna of Canada and East Greenland. The similarity of both faunas was increased by the recent finding in the Canadian waters of Yoldiella intermedia (M. Sars), Yoldiella lenticula (Moller), Yoldiella frigida (Torell), Thracia devexa (G.O. Sars), Thracia septentrionalis (Jeffreys), Bathyarca pectunculoides (Scacchi), Cuspidaria subtorta (G.O. Sars), C. arctica (G.O. Sars) and of C. glacialis (G.O. Sars). The presence of Astarte soror (Dall), Crenella faba (O.F. Muller), Macoma balthica L., Musculus corrugatus (Stimps), Nucula dephinodonta (Migh. Ad.), Turtonia minuta (Fabr.) in the Canadian Arctic increases the similarity of its fauna to that of West Greenland. Two species, Thracia devexa (G.O. Sars) and Pandora glacialis (Leach) absent in West Greenland increase the similarity of Canadian and East Greenlandic fauna.

The number of common higher taxa in both fauna is also high: of 21 families of bivalves of the Canadian Arctic, 17 were found also in Greenland; of 32 Canadian genera, 25 and 26 respectively were found in West and East Greenland. Of 57 shallow water species, 46 were found in West Greenland, and 43

in East Greenland. Dissimilarities in the faunas are the poverty of the bathyal fauna of Canada, and the absence of Peroplomatidae and Carditidae in Greenland. Most similar (90% of common species) are the faunas of the Archipelago and of East Greenland. The similarity between the faunas of the Canadian Eastern Arctic and West Greenland is only slightly lower.

BIVALVE FAUNA OF THE CANADIAN ARCTIC AND OF THE EURASIAN SHORES

The Eurasian shelf extends over 160° in longitudinal direction. In some regions the Eurasian shore is over 1000 miles wide and slants gradually towards the Arctic Ocean. It is subdivided into a chain of open shallow seas and dissected by deep trenches in the west. The entire region is basically that of polar waters, though the Nordcap and the Chuckchi currents introduce some mixed waters into the western and eastern part of this region. Timofeyev (1960), and Coachman and Barnes (1961, 1963), state that the Atlantic contributes much more to the waters of the Eurasian shelf than does the Pacific.

Along the western Eurasian shelf the fauna of bivalves gradually changes from Atlantic boreal and Subarctic to High-arctic in the center of the coastal region. The Pacific species appear in the eastern seas (Filatova, 1948, 1957, a, b).

Filatova (1957a) gives a list of 119 species from the Eurasian Arctic seas. Her data show that the temperate species of both the Atlantic and the Pacific origin decline toward the centre of the shelf and are at a minimum at the East Siberian shallows. Here the areas of many "circumarctic" species are disrupted. Filatova (1957 b, p. 197) showed that in the Eurasian Arctic bivalve fauna, 92 species (77%) are of Atlantic origin and 43 species (36%) of Pacific origin. The 30 species of Atlantic boreal immigrants constitute 25% of the bivalve fauna of the Eurasian region and occur here over a wide area. The Pacific boreal immigrants are represented by only 10 species (5%) and occupy a small area in the east. The dominance of the Atlantic fauna at the northern Eurasian shores was stressed also by Gurjanova (1970, p.30).

In the Eurasian seas, many southern immigrants extend their area much further north than in the Canadian waters. Subarctic species enter even the Kara Sea, while in Canada they are mostly restricted to southern Labrador. These differences in the latitudinal distribution of bivalves obviously depend on the differences in the extension of marine waters: at the Canadian shores, the polar Canadian and Labrador currents extend the areas of polar species far southwards. On the northern shores of Europe the northern branch of the Gulf Stream extends the areas of southern species far into high latitudes. There are 68 species common to the Eurasian and Canadian northern fauna. However, a generalized comparison of the Eurasian and the Canadian

fauna would be misleading. The fauna of the Barents Sea and that of the Eastern Canadian Arctic have almost 90% of species in common. The similarity of the faunas of Foxe Basin and of the Kara Sea is also considerable. However, the fauna of the Laptev Sea contains less than 60% of species occurring in the Canadian Arctic.

The Subarctic, Arctic and Panarctic species are represented in Canada and in Eurasia by different subspecies.

THE FAUNA OF THE CANADIAN AND OF THE WESTERN AMERICAN ARCTIC REGIONS

The bivalve fauna of the Canadian Arctic and of the Western North American Arctic have in common 16 Panarctic circumpolar species such as Hiatella arctica, Mya truncata, Nucula belloti, Macoma moesta, M. calcarea, Astarte warhami and others. But the fauna of the shelf of Alaska and of the Beaufort Sea harbours a group of north Pacific endemics. According to Dall (1919), N. MacGinnitie (1959) and Filatova (1957a), the following Pacific species are peculiar to the western American Arctic:

Nuculana radiata (Krause)
N. collinsoni (Dall)
Yoldia scissurata (Dall)
Cardita crebricostata (Krause)
C. crassidens (Brod. Sow.)
Diplodonta aleutica (Dall)

Astarte alaskensis (Dall)
A. polaris (Dall)

A. esquimaulti (Baird)
Cardium californiense (Deshayes)
C. Corbis (Martin)

Pseudophytia compressa (Dall)
Macoma planiuscula (Grant and Gale)
M. inconspicua (Brod. Sow.)

The number of Pacific species decreases towards the Canadian Arctic region. Their populations of the circumpolar species west of the Mackenzie River differ slightly from those in the Canadian and in other sectors of the Arctic shelf. These were described by Dall (1919) as separate species: Liocyma viridis, L. becki, Macoma onelii, Pecten andersoni, Nucula quirica. However, Schlesch (1932), Grau (1934) and N. MacGinnitie (1955), who studied these forms, feel that their populations are not sufficiently different to regard them as separate species. They indicate, however, the presence in this region of an independent evolutionary trend caused probably by Pleistocene isolation.

The important zoogeographic feature of the Canadian Arctic fauna distinguishing it from that of Western North America is the almost complete absence of Arctic species of Pacific origin in Canada and of Atlantic Arctic species in the western Arctic. The sharp boundary between these two zoogeographic regions is at the mouth of the Mackenzie River. The western Archipelago is the most important barrier separating the waters and the fauna of the west Atlantic from those of the west Pacific sector of the Arctic.

The areas of endemic Higharctic and of Subarctic Atlantic and Pacific species conform well with the usual zoogeographic subdivision of the circumpolar fauna into the Atlantic and the Pacific sectors. The western shelf of the Canadian Archipelago is an important zoogeographic boundary between the faunas of the Atlantic and the Pacific sectors of the American Arctic. The narrow, abrupt shelf of the Archipelago and the zone of brackish waters at the mouth of the Mackenzie River are barriers to the faunistic interchange between these sectors. The three species of bivalves entering the western Archipelago from the east are Mytilus edulis L, Macoma inconspicua Brod. Sow. and M. planiuscula Grant and Gale which tolerate well the brackishness of the water of the Mackenzie River.

The western boundary between the Pacific and Atlantic bivalve fauna is the New Siberian Islands and their shallows. Gurjanova (1970, p. 144) stresses the importance of this region as a zoogeographic barrier. She suggests that at the New Siberian Islands there existed for a long period of time a land barrier which disappeared only recently.

The similarity of the bivalve faunas of the Canadian and of the Greenlandic regions and the great dissimilarity of these faunas with the fauna west of the Archipelago is sufficent to separate the bivalve fauna at the Arctic shores of North America into two faunistic regions: The Canadian-Greenlandic and the western North American. The Canadian-Greenlandic Region can be

subdivided into the Canadian and the Greenlandic subregions, differing mainly in the distribution of the Higharctic and the Subarctic species.

CONCLUSIONS: MARINE BIVALVE FAUNA OF THE CANADIAN ARCTIC IN THE NORTHERN ENVIRONMENT

The ecological situation in high latitudes was discussed by Dunbar in 1960, 1963 and 1968. He regards the marine life in northern latitudes as an evolving ecosystem. He points out that the stress of the Arctic environment requires from the marine organisms the use of all adaptive powers available both in the adult and the larval stages (1968, p.56). Therefore, the study of life in high latitudes should be concerned with the investigation of the "manner in which the communities of organisms responded to the changes to give the situation we find in the high latitudes today".

Dunbar states that one of the features of adaptation to the Arctic environment is the change in life production on all trophic levels and a simplification of food chains and of the entire ecosystem. These changes result in a greater stability of biological processes within this ecosystem.

The succession of the bivalve faunas in the marine Arctic, Subarctic and Boreal zones of the Canadian Arctic has presented an opportunity to discuss some of the evolutionary trends within this group of animals, leading to the formation of this Arctic fauna.

There are three main trends in the faunistic changes from the Boreal to the Arctic zones:

VI. CONCLUSIONS: CANADIAN ARCTIC BIVALVE FAUNA IN THE NORTHERN ECOSYSTEM 309

1. A change in the systematic composition from zone to zone with complete separation of the areas of the Boreal and the Arctic species.

2. A gradual decrease in diversity toward high latitudes.

3. An increase in the participation of infaunal species bound to the bottom sediments in all life stages, and a decrease in species depending on marine water for their dispersal and nutrition.

Changes in the composition of the fauna of the Canadian region from one zone to the other are illustrated in Fig. 5, and those in the percentual relationship of the Boreal, Subarctic and Arctic species in Fig. 6.

The bivalve fauna in each zone, Arctic, Subarctic, and Boreal, consists of the following elements:

1. Species endemic and indicative for each zone.

2. Panarctic species, represented usually in each zone by lower taxa or by clines.

3. Adapted immigrants occurring in outposts.

4. Relic species occurring in isolated areas.

The boundaries between zones are not sharply delimited, and the changes in the fauna from zone to zone are gradual, but involve all the above faunistic elements and affect both the higher and the lower taxa.

In the present paper many examples have been given of changes in the species populations of bivalves from one zone to another. The number of species with areas extending over parts of two neighbouring zones, and remaining unchanged, is low, and will probably further decrease as our knowledge progresses.

The evolutionary involvement of the lower taxa in the process of expansion of bivalves into the neighbouring zones is intensive, as it was in similar situations in the previous geological periods.

Chavan (1955, p. 508) states that the adaption of bivalves to the changing climate was acquired usually on lower taxonomic levels: "le caractère climatique se transmet plus souvent à l'echelon sous-generique ou sectionelle qu'à celui de genre même". Using as an example Astarte and Venericardia, he (Ibid., p. 507) states that the genera do not change their basic ecological type but, if the environment changes, they produce populations adapted to the environment of the new zone.

The competition for a new niche is usually highest between closely related species and therefore only one or two congeneric species enter the new zone. The competition within the zone further restricts the number of related species. The successful populations become abundant and widely spread.

As a result of these phenomena the Canadian Arctic bivalve fauna contains 53% of endemic Higharctic species, 20% of Arctic populations of Panarctic species, and 27% of Subarctic species occurring in outposts.

Figure 11. Scheme of systematic structure of the Canadian Arctic bivalve fauna.

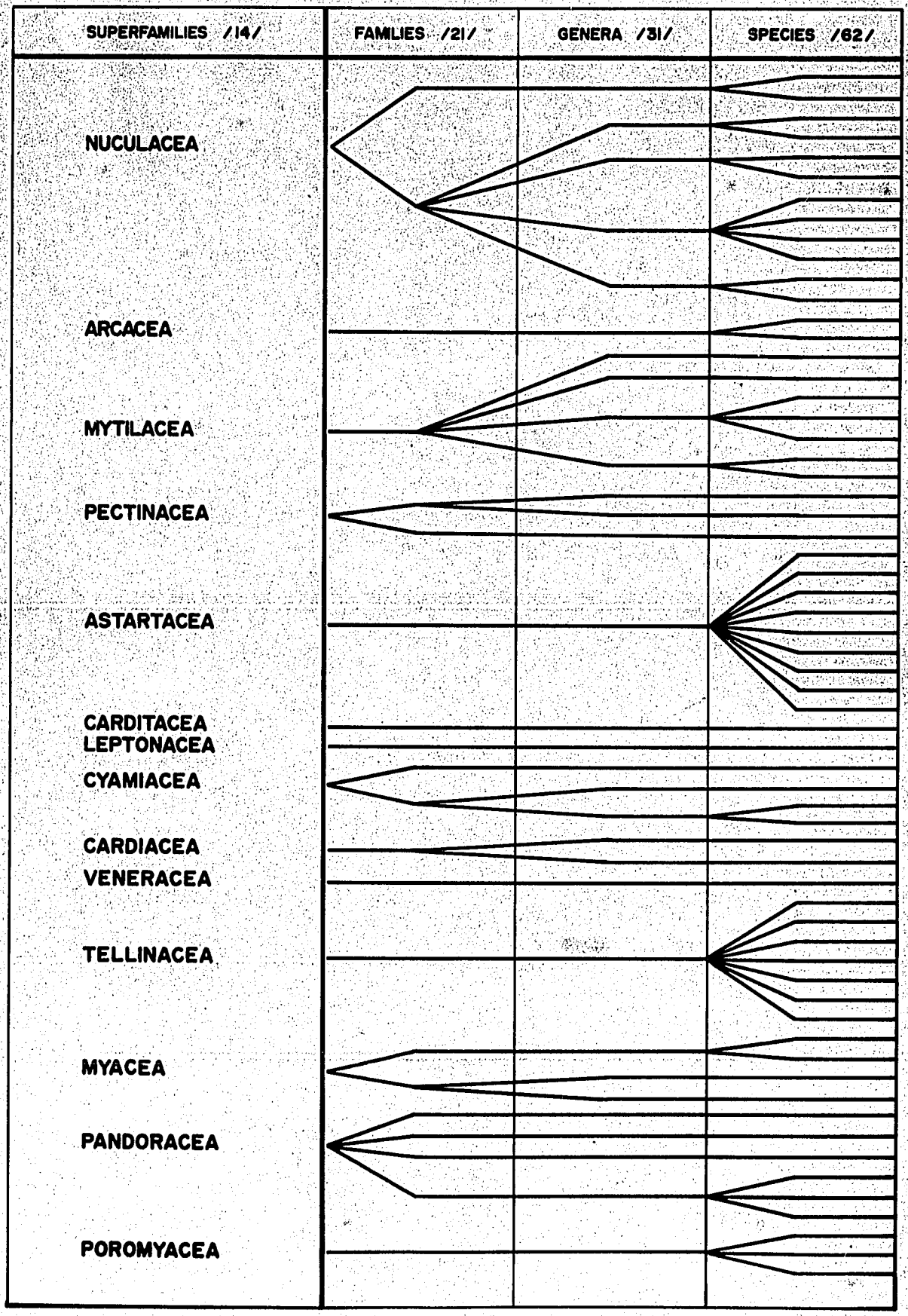

SUPERFAMILIES /14/
FAMLIES /21/
GENERA /31/
SPECIES /62/
NUCULACEA
ARCACEA
MYTILACEA
PECTINACEA
ASTARTACEA
CARDITACEA
LEPTONACEA
CYAMIACEA
CARDIACEA
VENERACEA
TELLINACEA
MYACEA
PANDORACEA
POROMYACEA

Fig. 11

The diversity of the fauna of the Canadian region decreases from the boreal to the Higharctic. Subzone lists of taxa of the Canadian bivalve fauna are presented in Table 4 and its taxonomic structure in Fig. 11.

The seventeen genera represented in the Arctic by only one species constitute more than half (55%) of the number of genera. Those with two species each, a total eight, constitute 26%. The remaining six genera (19%) are each represented by three or more species, among them Macoma with seven species and Astarte with nine.

The eight families with a single genus and a single species comprise 38% of the number of families. The superfamilies with only one family, one genus and one to three species constitute 50% of the number of superfamilies.

The structure of the Canadian Arctic bivalve fauna is peculiar in the following:

1. The group of bivalves with linear succession of taxa is large. Some sequences begin with a single superfamily and end in a single species, e.g. Carditacea, Veneracea and Leptonacea, or in two or three species as in Arcacea and Poromyacea.

2. Linear successions of higher taxa ending in more than three species are found in Astartacea and Tellinacea (Macominae). However, the taxonomy of Astarte is in need of further studies. At present, this genus is divided into "Sections" (Dall, 1903); Thiele, 1935).

3. The fan-like pattern is present in Nuculacea, which have two families and several genera. A fan-like structure on the specific level is found in Astartidae and Macominae.

4. Pandoracea are subdivided into four families, each with one genus, but only one genus has three species, and the remaining only one each.

Often only one species from each genus becomes fully adapted to the Arctic environment, the other becomes restricted to the Subarctic.

The Canadian and the Eurasian bivalve Arctic faunas are similar in their basic taxonomic structure.

The biological features of bivalves often set limits to their expansion into the Arctic zone. The shortened period of the planktonic bloom affects unfavourably the plankton feeding species with planktotrophic larval stages of long duration, but not the deposition feeding species with lecithotrophic larvae.

According to Thorson (1936, 1946, 1950, 1952, 1956 and 1957), Ockelmann (1958), and a review by Mileikowsky (1961), the following changes in the ecology of bivalves are observed when comparing the faunas of the southern and northern latitudes:

1. In the mode of dispersion: the disappearance of species with planktonic larvae or shortening of the planktonic stage, possibly by increase in larval growth rates.

2. In the time of spawning: from that of only in summer to that of almost the year round.

3. In the mode of reproduction: an increase in the number of hermaphroditic species or specimens.

Affected by the changes in the environment were suspension feeders in general and especially those with protracted planktotrophic larval stages, which lost contact with bottom sediments (the Polysyringia of Purchon, 1970, p. 106, p.115, Fig. 47).

A broad access to the Arctic had the species which found their niches similar to those they occupied in the zone of their origin, namely the sedimentation feeding and mud-engulfing infaunal species with lecithotrophic larvae. They did not depend on the periodical abundance of suspended food and extended their breeding time from the summer to the autumn and winter.

Areas free from glaciation were especially favourable for the Arctic sedimentation feeders, because of the voluminous glacial deposits left by the glaciers and transported by land drainage. This probably explains why deposition feeders with lecithotrophic larvae and suspension feeders with shortened planktotrophic larval stages abound in the north.

Thus the evolutionary trend of bivalves directed toward the utilization of food suspended in water, which produced so many specialized suspension feeders in the temperate zone (Purchon, 1970), was not of much survival value in high latitudes. Sedimentation feeders constitute 86% of the Canadian Arctic bivalve fauna, and 85% of the fauna of East Greenland (Ockelmann, 1958).

Eight species of specialized suspension feeders are restricted to the Canadian Eastern Arctic and to the southern shores of East Greenland. A similar process of elimination of suspension feeders takes place in the Eurasian Arctic.

The intraspecific variation of bivalves is connected to their mode of dispersion. Species with lecithotrophic larvae disperse slowly, and their populations are easily separated even by minor barriers, and become incipient subspecies. Species dispersing by planktonic larvae usually form clines. However, their larvae are unprotected and the areas of such species are unstable.

Nicol (1955, p.119), discussing the composition of the bivalve fauna in high latitudes in respect to the age of the taxa, concluded that this fauna consists basically of species of older, primitive families, such as Nuculidae, Nuculanidae, Mytilidae and Astartidae, originating in the Pennsylvanian period. Representatives of other families occur in the Arctic only sporadically, "and are only striving."

On the basis of the data of Soot-Ryen (1932, 1939), N. MacGinnitie (1955), Thorson (1951), Ockelmann (1958), Filatova (1948, 1957), as well as my own, it can be concluded that in the Arctic there are represented five Paleozoic families, fourteen Mesozoic (chiefly late Mesozoic ones), and four Cenozoic families: Myacidae, Periplomatidae, Lyonsiidae and Leptonidae.

Each family independently from its age, is represented in the Arctic only by one or two genera and by an equal number of species. The genera Macoma, Astarte, Musculus, and some of the Anomalodesmata, which originated chiefly in the Tertiary, have produced more than three Arctic species each (Grant and Gale, 1931; Soot-Ryen, 1932; Sorgenfrei, 1956; Schenk, 1939; Moore, 1952; Zittel, 1936). Many older families have produced only one Arctic species, and one or more Subarctic species. Thus it becomes evident, that to the colonization of the Arctic zone by certain species contributed not the "vigour of old families" but the biological features of these species, such as their food habits and peculiarities of life cycle, independently of their geological age or that of their higher taxa.

Changes in the diversity of bivalves toward the high latitudes has been usually regarded as a result of lowering of the water temperature, e.g. Fischer (1961); Hall (1964). Similar results can be obtained, however, by plotting the diversity gradient against any other factor changing toward high latitudes, e.g. the salinity of water. On the basis of these data (C. Hall, 1964, p. 229, Fig. 4; Fischer, 1961, p. 60, Fig. 13; review by Pianka, 1966), one can surmise that the reduction in the number of species toward the Arctic zone is caused by only one factor, and that this reduction ends in a fauna consisting of only fourteen species of bivalves of circumpolar distribution. The figure by Fischer shows the numerical changes only in the faunas of Carolina, Virginia and Acadia, and omits the Arctic fauna. The

principle of gradual replacement of one fauna by another in areas of different water masses along the eastern shore of North America is not shown by the present data. It seemed desirable to study the changes in the diversity of the bivalve fauna in its dependence on the types of marine waters along the shores of the North-western Atlantic. Such a study would simultaneously produce data on a complex of factors peculiar to these water masses, which could be analysed separately later.

Oceanographic data from the Canadian Central and Eastern Arctic were available for this research. Marine waters of the polar and of mixed types were accepted as a base for the zoogeographic zonation of the bivalve fauna. Seasonal changes in the temperature and salinity of these waters were taken into consideration in the subdivision of the main zoogeographic zones, as was the vertical distribution of the water masses.

The physiography of the marine region resulting in local differences in the bivalve fauna was also considered.

In the polar waters there exists a vigorous endemic Arctic fauna of bivalves, which is less diverse than that of the Subarctic, and especially of the Boreal, zones. It is well adapted to its Arctic environment, and is rapidly increasing its diversity, especially on the subspecific level.

The polar communities suffered a major stress at the beginning of the Pleistocene. Climatic oscillations caused extensive migrations and even partial extinctions of the bivalve

fauna and thus lowered its diversity. Oscillations of Pleistocene faunas are schematically illustrated by Fischer (1961, Fig. 19).

On the basis of its number of species and the duration of its evolution in the Pleistocene, the Arctic bivalve fauna has to be regarded as a young fauna. In Fischer's diagram (Ibid., Fig. 17) it must be placed near the beginning of the curve, where the increase in diversity is steep.

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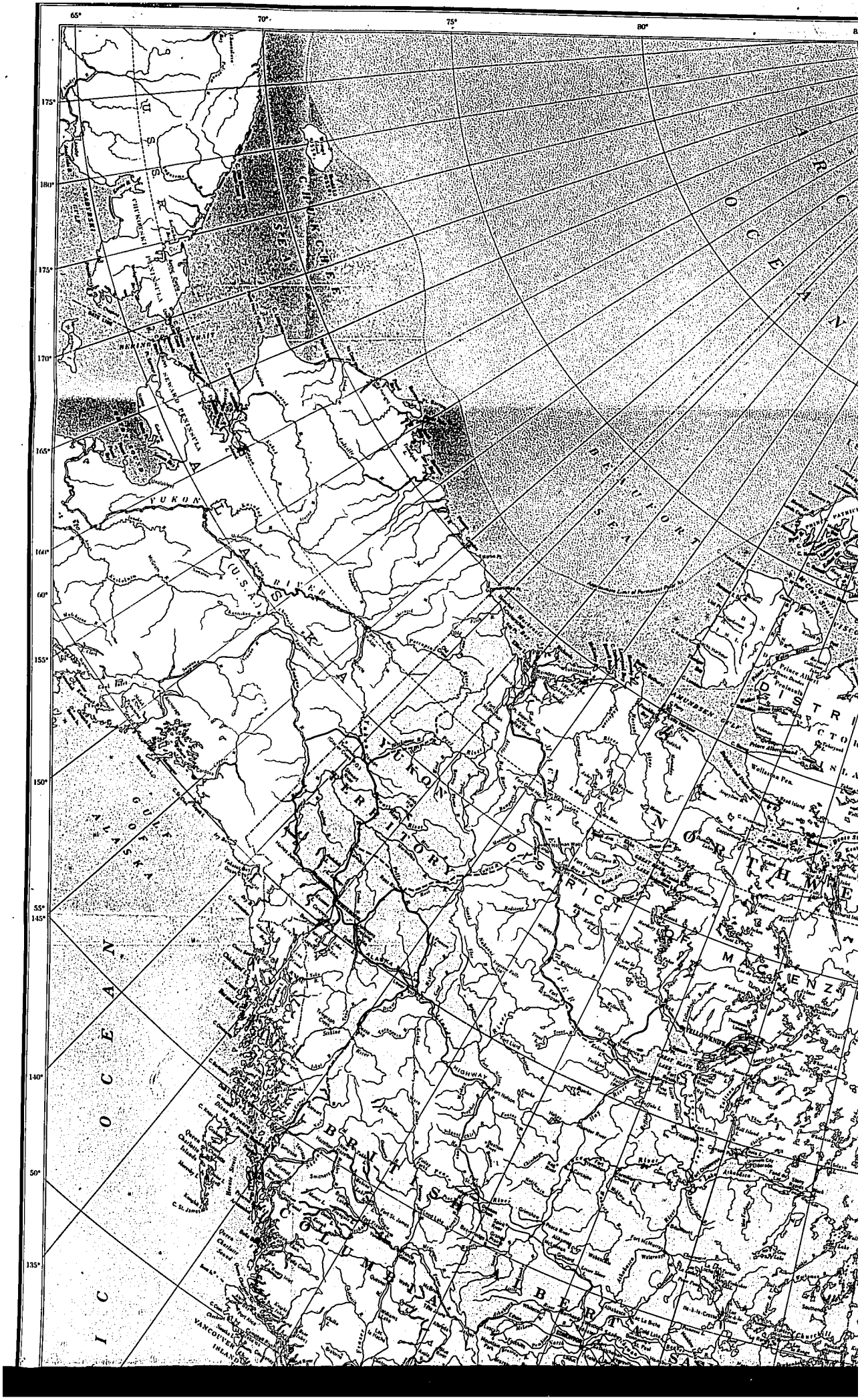
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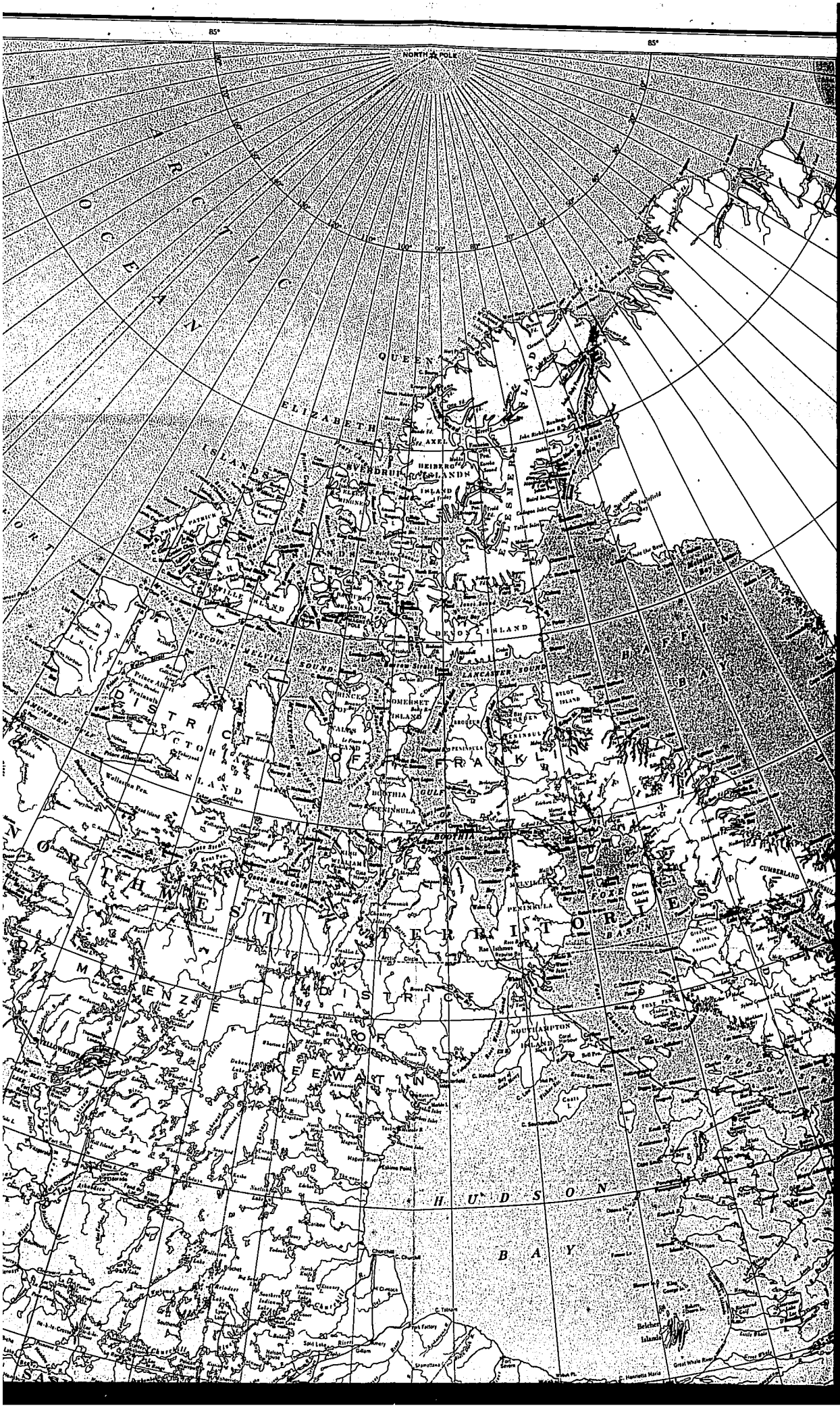
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PRINCE OF WALES ISLAND
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BYLOT ISLAND
AXEL HEIBERG ISLAND
EVERARD ISLANDS
ELLESMERE ISLAND
DEVON ISLAND
CUMBERLAND PENINSULA
Belcher Islands
Great Whale River
Churchill
Fort Severn
Winisk
Attawapiskat
Moosonee
Fort George
Great Whale R.
Port Harrison
Povungnetuk
Wakeham Bay
Lake Harbour
Cape Dorset
Frobisher Bay
Pangnirtung
Clyde River
Pond Inlet
Arctic Bay
Resolute
Grise Fiord
Eureka
Craig Harbour
Dundas Harbour
Port Leopold
Fort Ross
Spence Bay
Gjoa Haven
Cambridge Bay
Coppermine
Tuktoyaktuk
Aklavik
Fort McPherson
Arctic Red River
Fort Norman
Fort Simpson
Fort Wrigley
Fort Providence
Fort Resolution
Hay River
Fort Smith
Fort Chipewyan
Fort Vermilion
Fort Liard
Fort Nelson
Fort St. John
Dawson Creek
Peace River
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Athabasca
Lac La Biche
Edmonton
Calgary
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Lethbridge
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Wainwright
Vermilion
Camrose
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Ponoka
Rocky Mountain House
Drumheller
Hanna
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Taber
Cardston
Pincher Creek
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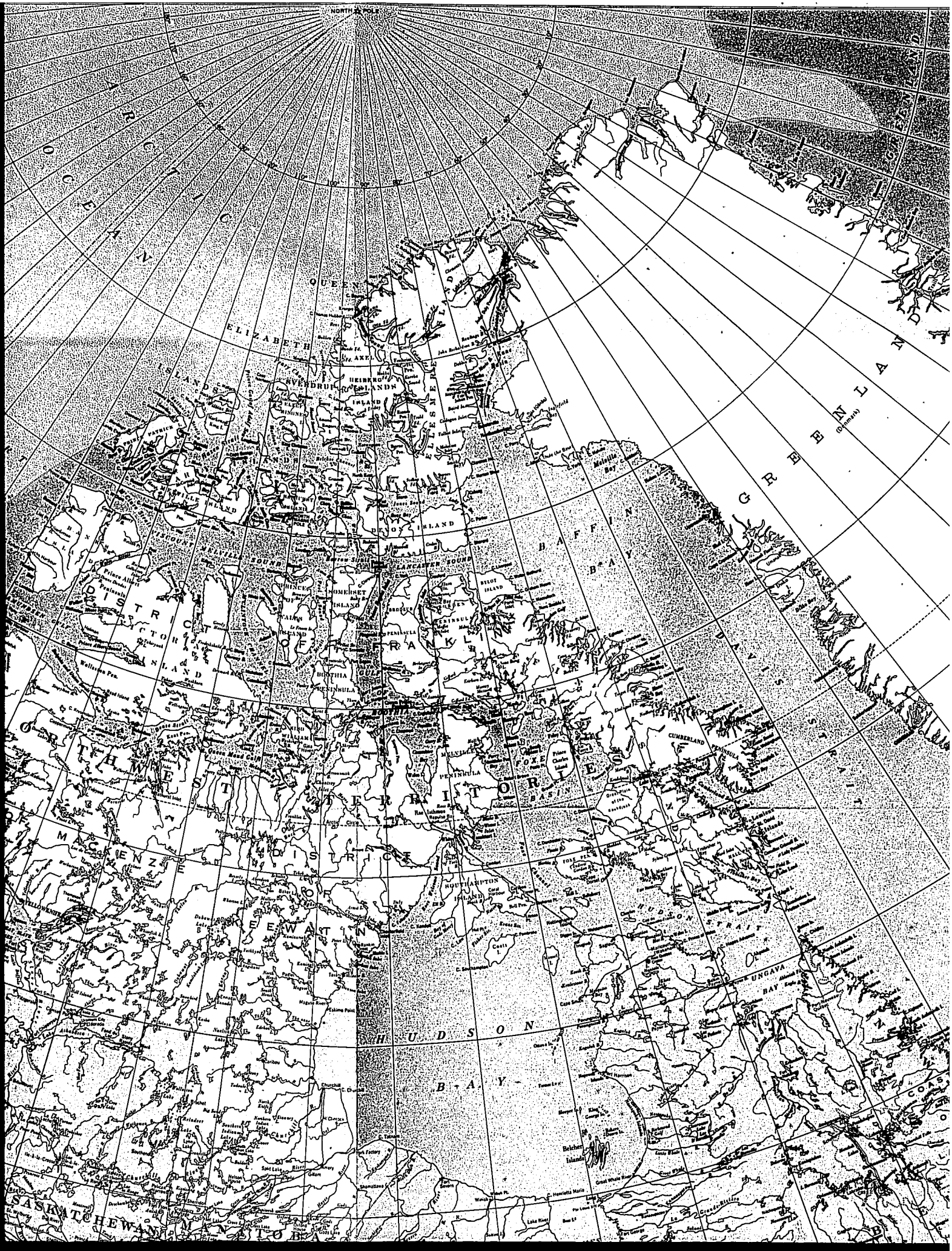
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PRINCE PATRICK ISLAND
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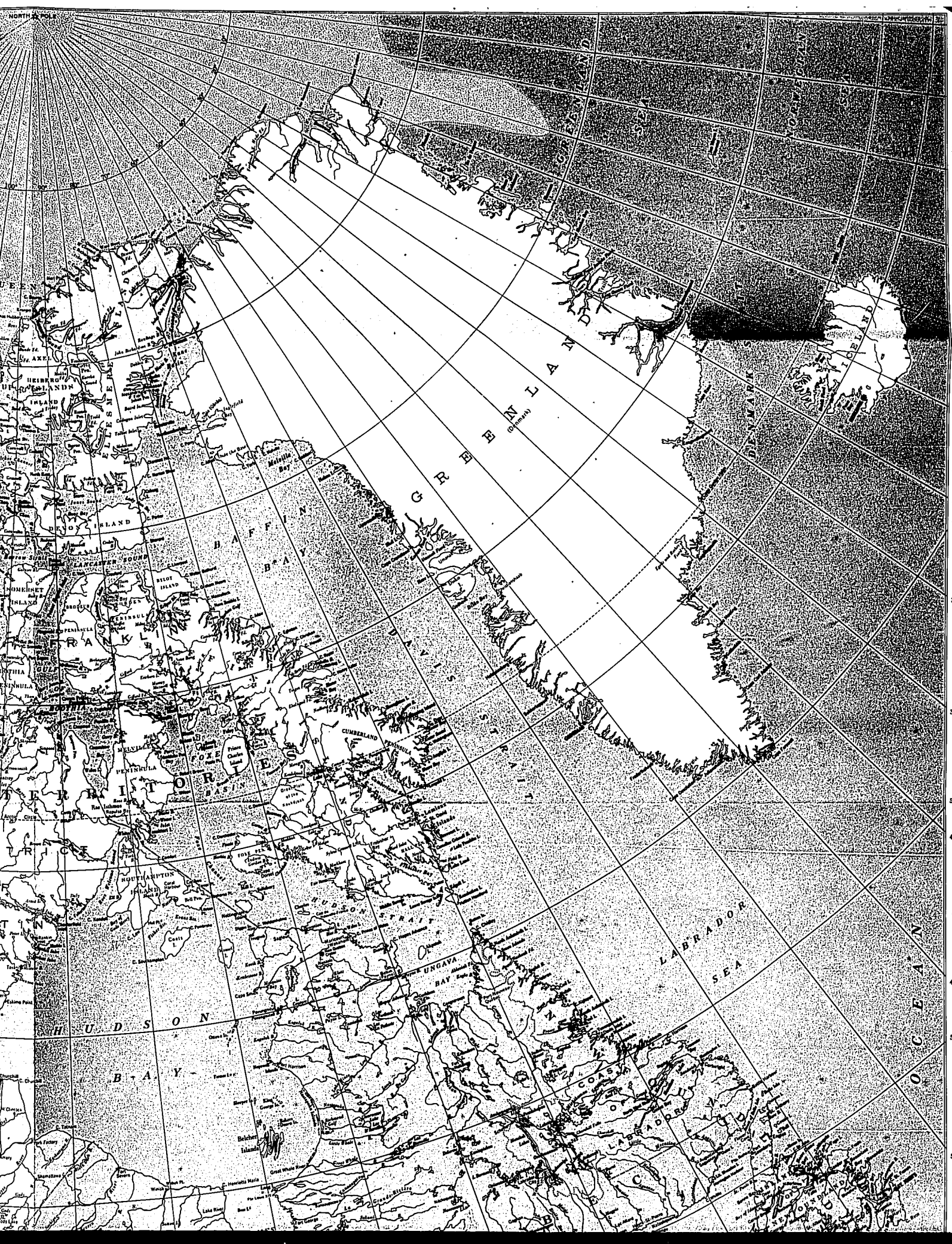
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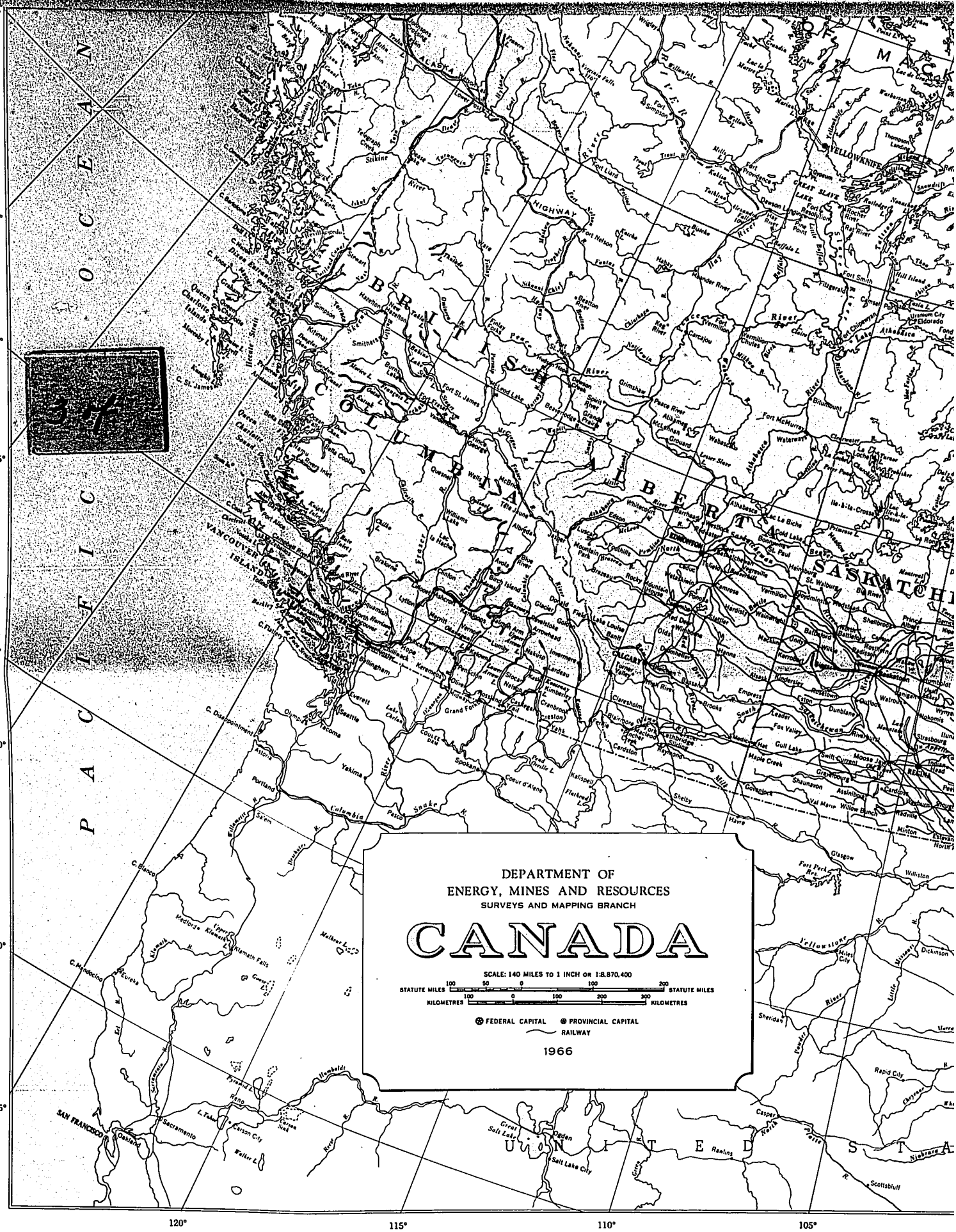

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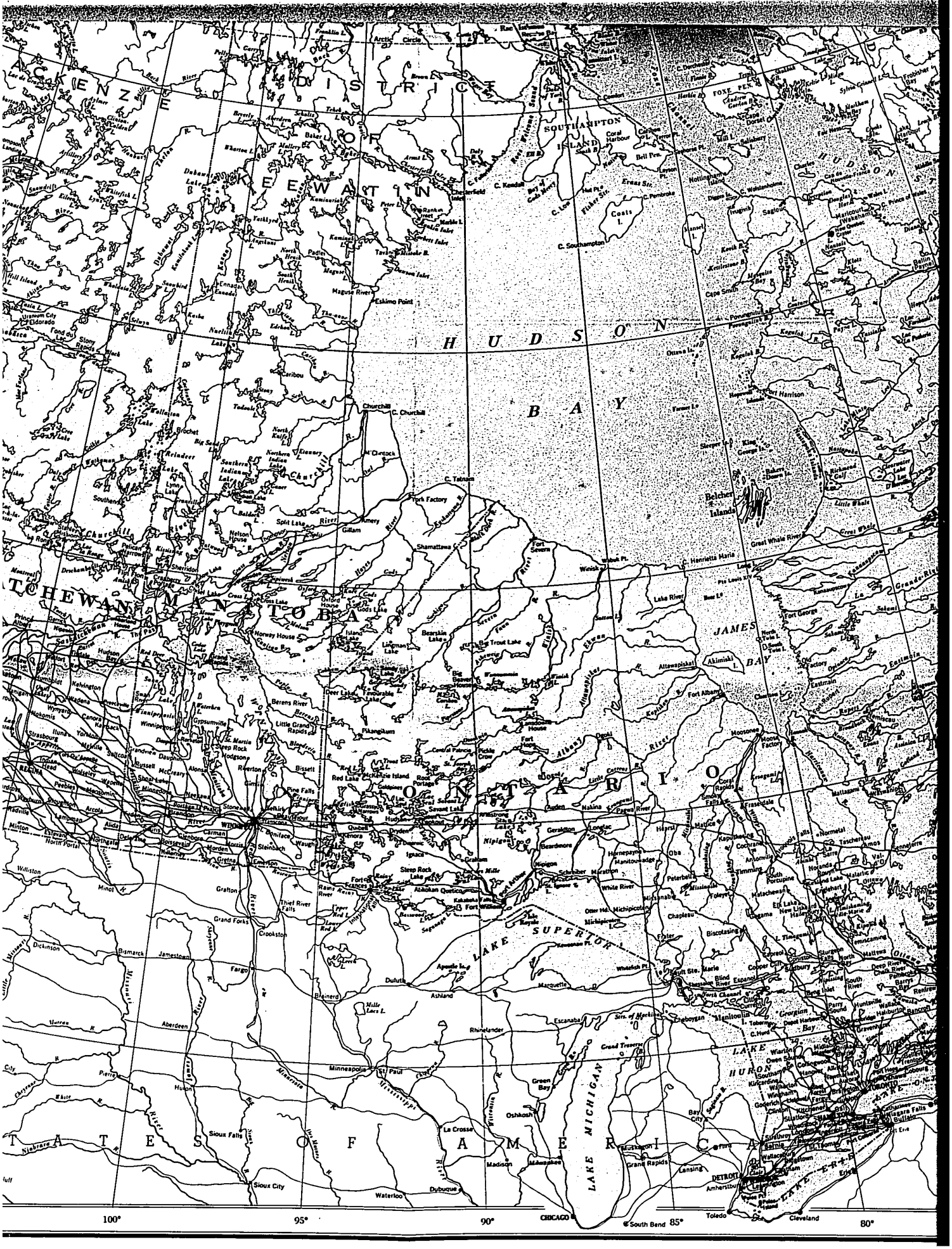
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LAKE HURON
LAKE ERIE
LAKE MICHIGAN
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C. Tatnam
York Factory
Fort Severn
C. Henrietta Maria
Belcher Islands
Great Whale River
Eskimo Point
Maguse River
C. Southampton
C. Kendall
C. Low
C. Pembroke
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Nottingham Island
C. Wolstenholme
Cape Smith
Fort Harrison
Ottawa Is.
Kegaska
Pointe au Pic
Tadoussac
Bonaventure
Gaspé
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Matane
Rivière du Loup
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Charlottetown
Sydney
Halifax
Yarmouth
Prince Edward Island
Cape Breton Island
Newfoundland
Labrador
Ungava Bay
Port Burwell
Port Stanley
Windsor
Detroit
Toledo
Cleveland
Buffalo
Niagara Falls
Hamilton
Toronto
Kingston
Ottawa
Montreal
Quebec
Trois-Rivières
Sherbrooke
Lake Erie
Lake Ontario
Lake St. Clair
Georgian Bay
Manitoulin Island
Sault Ste. Marie
Thunder Bay
Fort William
Port Arthur
Kenora
Dryden
Sioux Lookout
Red Lake
Pickle Crow
Fort Hope
Moosonee
Moose Factory
Cochrane
Kapuskasing
Timmins
Sudbury
North Bay
Barrie
Orillia
Owen Sound
Collingwood
Midland
Parry Sound
Huntsville
Gravenhurst
Bracebridge
Muskoka Lakes
Haliburton
Peterborough
Lindsay
Belleville
Brockville
Cornwall
Hawkesbury
Pembroke
Renfrew
Arnprior
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Trenton
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Ajax
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Scarborough
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St. Thomas
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Sarnia
Wallaceburg
Leamington
Kingsville
Amherstburg
Windsor
Niagara-on-the-Lake
St. Catharines
Welland
Port Colborne
Fort Erie
Grand Bend
Goderich
Clinton
Wingham
Listowel
Palmerston
Mount Forest
Owen Sound
Meaford
Collingwood
Wasaga Beach
Midland
Penetanguishene
Orillia
Barrie
Bradford
Newmarket
Aurora
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Markham
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Whitchurch-Stouffville
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Burlington
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Ancaster
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Paris
Woodstock
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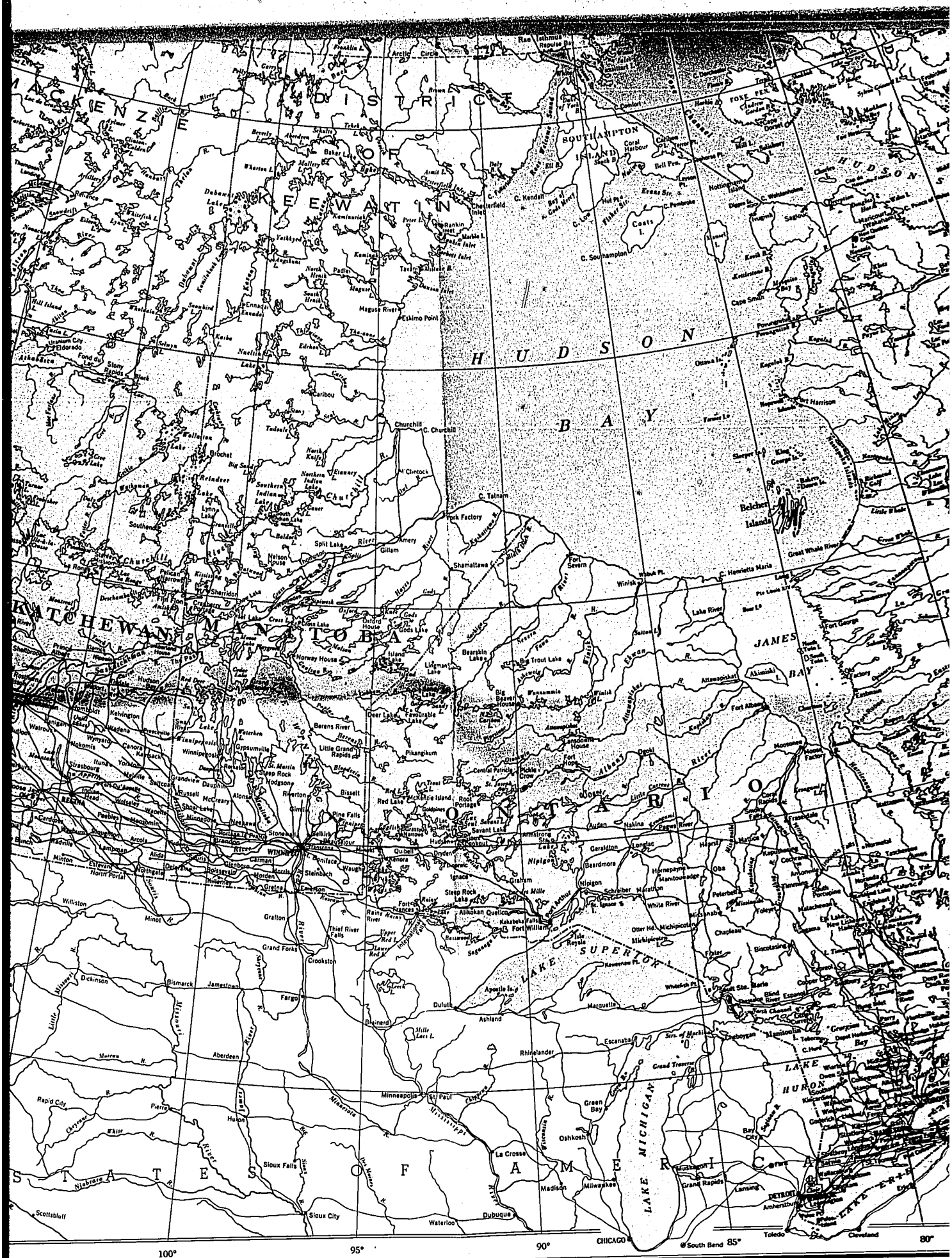
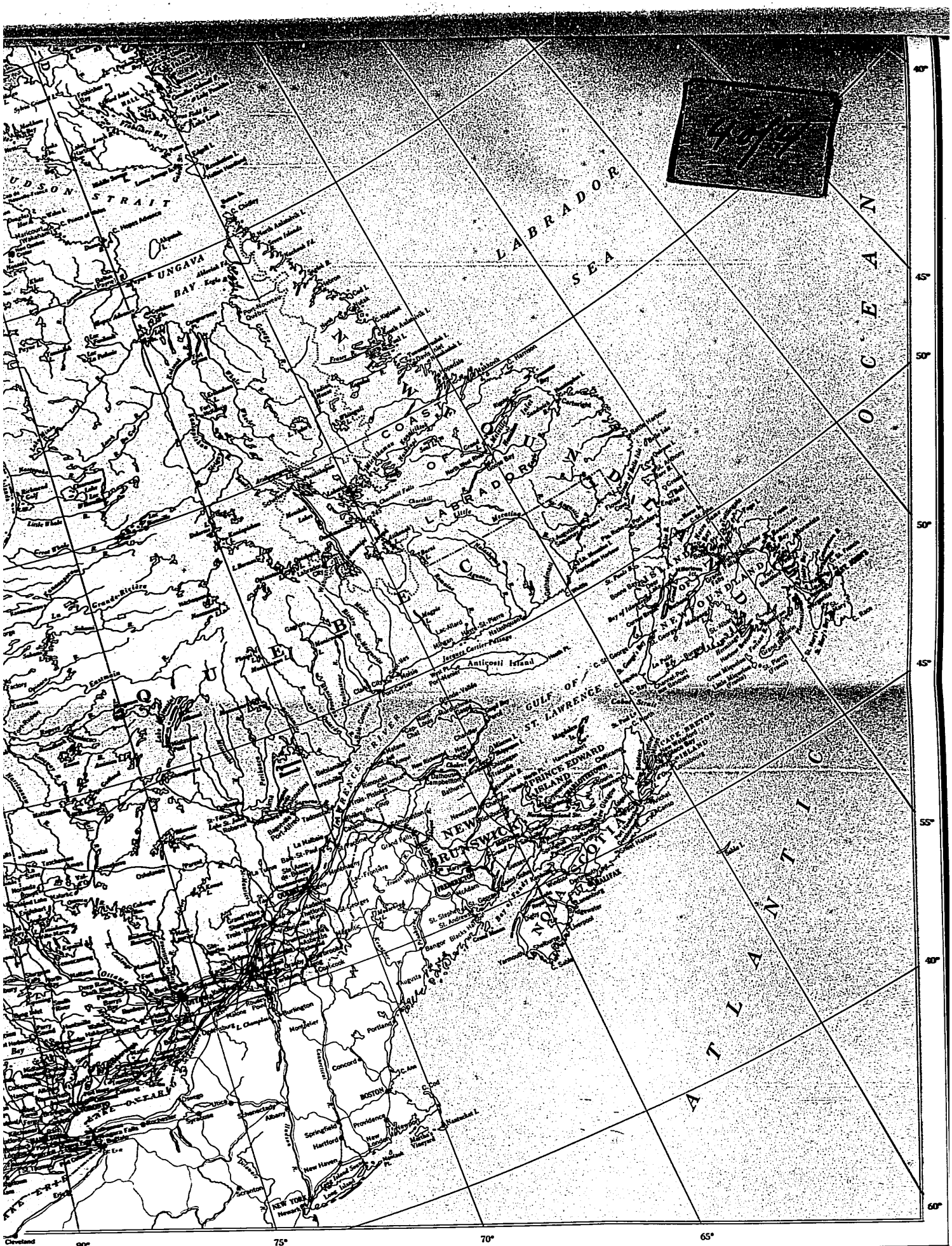

MACKENZIE DISTRICT OF KEEWATIN
HUDSON BAY
SOUTHAMPTON ISLAND
FOXE PEN.
HUDSON STRAIT
SASKATCHEWAN MANITOBA
ONTARIO
JAMES BAY
LAKE SUPERIOR
LAKE HURON
LAKE MICHIGAN
STATES OF AMERICA
Arctic Circle
Churchill
C. Churchill
York Factory
Fort Severn
Winisk
Pt. Henrietta Maria
Belcher Islands
C. Southampton
C. Tatnam
Eskimo Point
Caribou
Reindeer
Southend
Nelson House
Split Lake
Gillam
Shamattawa
Norway House
Island Lake
Lingman Lake
Bearskin Lakes
Big Trout Lake
Winisk
Fort Albany
Attawapiskat
Lansdowne House
Fort Hope
Pickle Crow
Central Patricia
Pikangikum
Little Grand Rapids
Berens River
Red Lake
McKenzie Island
Root Portage
Savant Lake
Armstrong
Auden
Nakina
Pagwa River
Geraldton
Longlac
Beardmore
Nipigon
Schreiber
Marathon
White River
Hornepayne
Manitouwadge
Oba
Peterbell
Missanabie
Foleyet
Chapleau
Biscotasing
Sturgeon Falls
Sudbury
Timmins
Matheson
Kapuskasing
Cochrane
Iroquois Falls
Englehart
New Liskeard
Haileybury
Temiskaming
Sesekinika
Opasatika
Gogama
Mattice
Hearst
Manitouwadge
Steep Rock Lake
Graham
Ignace
Dryden
Quibell
Kenora
Waugh
Minaki
Sioux Lookout
Lac Seul
Savant Lake
Hudson
Ear Falls
Pickle Lake
Fort Frances
Rainy River
Rainy Lake
Atikokan
Quetico
Kakabeka Falls
Fort William
Thunder Bay
Port Arthur
Nipigon
Jackfish
Otter Hd.
Michipicoten
Michipicoten I.
Whitefish Pt.
Sault Ste. Marie
Blind River
Espanola
Little Current
Manitoulin I.
Killarney
Parry Sound
Sturgeon Bay
Tobermory
Owen Sound
Southampton
Kincardine
Goderich
Port Elgin
Bruce Pen.
Wiarton
Meaford
Collingwood
Midland
Penetanguishene
Orillia
Barrie
Georgian Bay
Lake Simcoe
Lake Couchiching
Lake Nipissing
North Bay
Temagami
Lake Temiskaming
Cobalt
Kirkland Lake



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Appendix I. List of bivalves from the Canadian Arctic identified by the present writer.

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Appendix I - Part 1

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62-2005, B. 8, 31, 32, 38

62-2003, B. 7, 10, 23

62-2008, B. 14, 15, 16, 18

62-2007, B. 12

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62-2012, B. 27, 28

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62-4007, B. 24

62-4009, B. 30

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62-4300, B. 19

62-4302, B. 20

62-4303, B. 21

62-4305, B. 22

62-4307, B. -

62-7004, B. 4, 5, 2

62-7003, B. -

62-7008, B. -, 3

62-7011, B. 2

62-7012, B. 6

62-7015, B. 4, 5, 6, 66

62-7032, B. 45

62-7300, B. 1, 2

62-7301, B. 3

62-7302, B. 4

62-7305, B. 5

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64-004, B. 110

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1. List of species of marine bivalve molluscs collected by the Arctic Biological Unit of the Fisheries Research Board of Canada in the Central Canadian Arctic, 1962-1964.

Bathyarca glacialis (Gray 1824)

Nucula belloti Adams 1856

Nuculana pernula (Muller) costigera Leche 1883

Nuculana minuta (Muller 1776)

Portlandia arctica (Gray 1824)

Portlandia arctica (Gray 1824) var. portlandica Hitchcock 1834

Portlandia sulcifera (Reeve 1855)

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Yoldiella intermedia (M. Sars 1865)

Yoldiella lenticula (Möller 1842)

Yoldiella frigida (Torell 1859)

Mytilus edulis L. 1758

Musculus niger (Gray 1824)

Musculus discors laevigatus (Gray) Jensen 1912

Musculus discors substriatus (Gray) Jensen 1912

Musculus corrugatus (Stimpson 1851)

Dacridium vitreum (Möller 1842)

Delectopecten groenlandicus (Sowerby 1842)

Astarte borealis (Schumacher) var. placenta Mörch 1869

Astarte crenata (Gray 1824)

Astarte crenata crebricostata (Andr. et Forbes 1847)

Astarte striata (Leach 1819)

Astarte warhami Hancock 1846

Thyasira gouldi Philippi 1845

Thyasira dunbari sp. n.

Axinopsida orbiculata (G. O. Sars 1887)

Serripes groenlandicus Bruggiere 1789

Clinocardium ciliatum (Fabr. 1780)

Liocyma fluctuosa (Gould 1870)

Macoma calcarea (Gmelin 1792)

Macoma moesta (Deshayes 1854)

Macoma loveni (Steenstrup) Jensen 1905

Macoma torelli (Steenstrup) Jensen 1905

Hiatella arctica (L. 1767)

Cyrtodaria kurriana Dunker 1862

Mya truncata L. 1758

Lyonsia arenosa (Möller 1842)

Pandora glacialis Leach 1819

Thracia (Thracia) devexa G. O. Sars 1878

Cuspidaria arctica (M. Sars 1865)

Cuspidaria subtorta (G. O. Sars 1878)

Bathyarca glacialis (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3002/13	11-7-62	Ax. Heiberg Is.	M	29	8
62-3002/12	4-7-62	"	M	29	2
62-3003/50	5-8-62	Ellesmere Is.	M,S,G	2-30	1
62-2002/4	26-6-62	Creswell	M,C	33	6
62-2002/34	4-8-62	"	M,C	33	3+1 v.
62-2012/27	25-7-62	"	M,C	36	6
62-2013/26	25-7-62	"	S	15-20	5
62-2014/30	25-7-62	"	C	35	4
62-2031/44	11-8-62	"	M,C	40	2
62-2002/20	14-7-62	"	M,C	33	5
62-2032/45	11-8-62	"	C,M	59-62	2
62-2003/10	30-9-62	"	-	-	1
62-2002/17	7-7-62	"	M,C	33	2
62-2012/27	25-7-62	"	M,C	36	1
62-2002/43	11-8-62	"	M,C	33	2
62-2032/45	11-8-62	"	C,M	59-62	2
62-2002/43	11-8-62	"	C,M	33	2
62-2002/11	30-6-62	"	C,M	33	3
62-7300/2	23-8-62	Wellington Bay	S,M	30	1
62-7307/4	23-8-62	"	-	-	85
64-004/110	6-9-64	Cambridge Bay	R,S	38	7
62-2081/3	10-9-62	"	-	-	3
62-7302/4	23-8-62	"	M	50-60	2
62-3001/35	27-7-62	Eureka	M	2-70	1 v.
62-3001/35	27-7-62	"	M	2-70	1 v.

Nucula belloti Adams 1856

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/4	26-6-62	Creswell	M,C	33	2
62-2002/34	4-8-62	"	M,C	33	6
62-2014/30	25-8-62	"	C	35	3
62-2030/40	9-8-62	"	C	24-27	16
62-2031/44	11-8-62	"	M,C	40	19
62-2002/20	14-7-62	"	M,C	33	5
62-2032/45	11-8-62	"	C,M	59-62	1
62-2001/2	25-6-62	"	M,C	10	1
62-2002/9	30-6-62	"	M,C	33	1
62-2005/8	29-6-62	"	M,C	10	2
62-2002/17	7-7-62	"	M,C	33	2
62-2002/22	21-7-62	"	M,C	33	1
62-2013/26	25-7-62	"	S	15-20	9
62-2012/27	25-7-62	"	M,C	36	1
62-2032/45	11-8-62	"	M,C	59-62	1
62-7015/66	9-8-62	Wellington Bay	M,C	25	1
62-1103/4	24-7-62	Banks Is.	S,G	2	2
62-77	11-4-62	J. A. MacDonald	-	-	2
62-85	15-9-62	"	-	-	1
62-2081/3	10-9-62	Cambridge Bay	-	-	1

Nuculana pernula (Muller) costigera Leche 1883

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/26	22-7-62	Ellesmere Is.	M	2-70	1
62-3001/30	25-7-62	"	M	2-70	1
62-3001/35	27-7-62	"	M	2-70	3
62-3001/36	27-7-62	"	M	2-70	3
62-3001/55	9-8-62	"	M	2-70	8
62-3001/58	12-8-62	"	M	2-70	12
62-3003/19	17-7-62	"	M,S,G	2-30	4
62-3003/20	17-7-62	"	M,S,G	2-30	4
62-3003/49	5-8-62	"	M,S,G	2-30	2
62-3005/31	25-7-62	"	M	20-40	1
62-3005/32	25-7-62	"	M	20-40	1
62-2002/4	26-6-62	Creswell	M,C	33	3
62-2002/34	4-8-62	"	M,C	33	16
62-2005/8	29-6-62	"	M,C	10	1
62-2012/27	25-7-62	"	M,C	36	4
62-2013/26	25-7-62	"	S	15-20	16
62-2014/30	25-7-62	"	C	35	51
62-2030/40	9-8-62	"	C	24-27	5
62-2031/44	11-8-62	"	M,C	40	25
62-2002/20	14-7-62	"	M,C	33	2
62-2032/45	11-8-62	"	C,M	59-62	1
62-2002/9	30-6-62	"	M,C	33	2
62-2002/17	7-7-62	"	M,C	33	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/22	21-7-62	Creswell	M,C	33	2
62-2013/26	25-7-62	"	S	15-20	7
62-2012/27	25-7-62	"	M,C	36	1
62-2005/3	29-6-62	"	M,C	10	2
62-2002/42	11-8-62	"	M,C	33	2
62-2032/45	11-8-62	"	M,C	59-62	2
62-1103/4	24-7-62	Banks Is.	S,G	2	9
62-1108/11	26-7-62	"	-	50	1
62-7305/5	24-8-62	Cambridge Bay	R,G	20-30	2
62-7015/6a	9-8-62	"	M,C	25	1
62-7300/1	23-8-62	"	S,M	30	2

Nuculana minuta (Muller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/26	22-7-62	Ellesmere Is.	M	2-70	1 v.
62-3003/19	17-7-62	"	M,S,G	2-30	1
62-4003/10	9-7-62	Cornwallis Is.	S,R	10-30	1
62-2002/34	4-8-62	Creswell	M,C	33	1
62-2014/30	25-7-62	"	C	35	1
62-2012/27	25-7-62	"	M,C	36	1
62-1103/4	24-7-62	Banks Is.	S,G	2	1

Portlandia arctica (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/30	25-7-62	Ellesmere Is.	M	2-70	10
62-3001/55	9-8-62	"	M	2-70	1
62-3004/22	18-7-62	Ax. Heiberg Is.		2-57	54
62-2002/4	26-6-62	Creswell	M,C	33	1
62-2002/34	4-8-62	"	M,C	33	22
62-2011/24	23-7-62	"	M,S,C	40	12
62-2012/27	25-7-62	"	M,C	36	6
62-2013/26	25-7-62	"	S	15-20	18
62-2014/30	25-7-62	"	C	35	48-44j.
62-2030/40	9-8-62	"	C	24-27	40-30j.
62-2031/44	11-8-62	"	M,C		17
62-2032/45	11-8-62	"	C,M	59-62	2
62-2008/16	5-7-62	"	S,M	20-45	2
62-2002/22	21-7-62	"	M,C	33	3
62-2012/27	25-7-62	"	M,C	36	1
62- /28	25-7-62	"	-	-	1
62-2016/33	30-7-62	"	S	15	1
62-2005 38	29-6-62	"	M,C	10	4
62-2032/45	11-8-62	"	M,C	59-62	3
62-7004/2	1-7-62	Wellington Bay	M,S	0-3	11
62-7015/66	9-8-62	"	M,C	25	1
62-7300/2	23-8-62	"	S,M	30	32
62-1103 4	24-7-62	Banks Is.	S,G	2	5

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/15	14-7-62	Eureka	M	2-70	2
62-2082/5	10-9-62	Cambridge	-	-	3
62-2081/5	10-9-62	"	-	-	28 j.
62-7300/1	23-8-62	"	S,M	30	fragm.
61-43/29	28-8-61	Frozen Strait	-	55-92	1
60-3 2	11-8-60	Richmond Gulf	-	-	1
	29-8-55	Husky Lakes	-	-	4

Portlandia arctica (Gray) portlandica (Hitchcock 1834)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/24	22-7-62	Ellesmere Is.	M	2-70	29
62-3001/25	22-7-62	"	M	2-70	19
62-3001/26	22-7-62	"	M	2-70	16
62-3001/36	27-7-62	"	M	2-70	1
62-3001/42	1-8-62	"	M	2-70	1
62-3001/58	12-8-62	"	M	2-70	2
62-3008/48	5-8-62	"	M,S,G	2-30	30
62-3004/21	18-7-62 11-7-62	"	-	2-57	43
62-3002/12	4-7-62	Ax. Heiberg Is.	M	29	84
62-2004/16	5-7-62	Creswell	S,M	20-45	10
62-2005/8	29-6-62	"	M,C	10	2
62-2013/26	25-7-62	"	S	15-20	20
62-2012/27	25-7-62	"	M,C	36	12
62-2005 38	29-6-62	"	M,C	10	1
62-2011/25	24-7-62	"	M,C	-	2
62-7015/5	9-8-62	Wellington Bay	M,C	25	8
62-7015/4	25-7-62	"	M,C	25	10
62-1017/12	5-8-62	Banks Is.	-	50+	11
62-1100/2	24-7-62	"	M,C	50+	3
62-1107/9	26-7-62	"	M	16	5
62-1101/2	24-7-62	"	M	4	3
62-7015/4	25-7-62	"	M,C	25	22
62-2081/3	10-9-62	Cambridge Bay	-	-	48
62-7300/1	23-8-62	"	S,M	30	8

Portlandia sulcifera (Reeve 1855)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	34
62-3002/13	11-7-62	"	M	29	58
62-3004/23	18-7-62	Ax. Heiberg Is.	M,S,G	2-57	91
62-3011/56	10-8-62	Eureka Sd.	M	30-42	24
62-3001/57	12-8-62	"	M	2-70	11

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/34	4-8-62	Creswell	M,C	33	2 v.
62-2031/41	11-8-62	"	M,C	40	1-1 v.
62-2002/42	11-8-62	"	M,C	33	2
62-2002/11	30-6-62	"	M,C	33	1

Yoldiella intermedia (M. Sars 1865)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3003/49	5-8-62	Ellesmere Is.	M,S,G	2-30	2

Yoldiella frigida (Torell 1859)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2082/5	10-9-62	Cambridge Bay	-	-	1

Yoldiella lenticula (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/34	4-8-62	Creswell	M,C	33	51
62-2011/24	23-7-62	"	M,C	-	
			S	40	1
62-2014/30	25-7-62	"	C	35	129
62-2030/40	9-8-62	"	C	24-27	4
62-2031/44	11-9-62	"	M,C	40	86
62-2002/17	7-7-62	"	M,C	33	1
62-2002/20	7-7-62	"	M,C	33	1
62-2002/22	21-7-62	"	M,C	33	1
62-2013/26	25-7-62	"	S	15-20	6
62-2011/25	24-7-62	"	M,C	-	1
62-2012/27	25-7-62	"	M,C	36	14
62-2032/45	11-8-62	"	M,C	59-62	2
62-2008/5	26-2-62	"	M,C	33	1
61-43/29	28-8-61	Frozen Strait	-	85-92	1

Mytilus edulis L. 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-7003	29-6-62	Ferguson River	-	-	fragm.
	29-8-55	Husky Lakes	-	-	3

Musculus discors (L.) *var. laevigatus* Jensen 1912

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/25	22-7-62	Ellesmere Is.	M	2-70	2
62-4305/22	16-7-62	Devon Is.	-	40	2
62-4300/19	14-7-62	"	-	5	3
62-4302/20	15-7-62	"	R	5	2
62-4303/21	15-7-62	"	R	5	1
62-4001/46	6-8-62	Cornwallis Is.	-	35-62	1
62-4003/10	9-7-62	"	S,R	10-30	2
62-4012/33	25-7-62	"	-	24	2
62-4003/10	9-7-62	"	S,R	10-30	1
62-2012/27	25-7-62	Creswell	M,C	36	3
62-2013/26	25-7-62	"	S	15-20	2
62-2014/30	25-7-62	"	C	35	6
62-2031/44	11-8-62	"	M,C	40	5
62-2004/6	29-6-62	"	M,C	9	1
62-2008/14	3-7-62	"	S,M	20-45	1
62-2003/23	23-7-62	"	G	34	
			C	43	1
62-2012/27	25-7-62	"	M,C	36	1
62-2017/41	9-8-62	"	S	11	
			C,S	24	1
62-2032/45	11-8-62	"	M,C	59-62	2
62-2008/18	2-7-62	"	S,M	20-45	1
62-7004/2	1-7-62	W'ton Bay Cambr.	M,S	0-3	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-7015/5	9-8-62	W'ton Bay Cambr.	M,C	25	7
62-7015/66	9-8-62	"	M,C	25	1
62-7300/2	23-8-62	"	S,M	30	1
64-004 110	6-9-64	Cambridge Bay	R,S	38	2
62-2081/3	10-9-62	"	-	-	1
62-7300/1	23-8-62	"	S,M	30	1
62-7302/4	23-8-62	"	M	50-60	1
62-1106 6	26-7-62	Banks Is.	S,G	70	3
62-1107 9	26-7-62	"	M	16	3
62-1101 2	24-7-62	"	M	4	3
62-1107 10	26-7-62	"	M	16	1
62-7015/4	25-7-62	"	M,C	25	1
58-1003	17-8-58	Frobisher Bay	-	70	1
61-43/29	28-8-61	Frozen Strait	-	85-92	19
	7-9-62	Cape Parry	-	-	1
62-4003/10	9-7-62	Cornwallis Is.	S,R	10-30	1

Musculus discors (L.) *var. substriatus* Jensen 1912

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	2
62-3001/29	25-7-62	"	M	2-70	1-1 v.
62-3001/30	25-7-62	"	M	2-70	2
62-4305/22	16-7-62	Devon Is.	-	40	2
62-2012/27	25-7-62	Creswell	M,C	36	2
62-2014/30	25-7-62	"	C	35	1
62-2031/44	11-8-62	"	M,C	40	1
62-1106 6	26-7-62	Banks Is.	S,G	7-0	3
62-1101 2	24-7-62	"	M	4	1
61-43/29	28-8-62	Frozen Strait	-	85-92	104
62-7003	29-6-62	Ferguson River	-	-	5
62-4003/10	9-7-62	Cornwallis Is.	S,R	10-30	2

Musculus niger (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	2
62-3001/24	22-7-62	"	M	2-70	1
62-3001/26	22-7-62	"	M	2-70	2
62-3001/30	25-7-62	"	M	2-70	2
62-3001/55	9-8-62	"	M	2-70	8
62-3003/19	17-7-62	"	M,S,G	2-30	5
62-3003/48	5-8-62	"	M,S,G	2-30	1
62-3003/50	5-8-62	"	M,S,G	2-30	4
62-2002/4	26-6-62	Creswell	M,C	33	1
62-7015/4	25-7-62	Wellington Bay	M,C	25	2
62-1103 4	24-7-62	Banks Is.	S,G	2	1
62-1106 6	26-7-62	"	S,G	7-0	2
62-1101 2	24-7-62	"	M	4	6
62-1106 7	26-7-62	"	S,G	7-0	1
58-1003	17-8-58	Frobisher Bay	-	70	4
64-004 110	6-9-64	Cambridge Bay	R,S	38	2
62-7015/6a	9-8-62	"	M,C	25	1 v.
62-3001/15	14-7-62	Eureka Sd.	M	2-70	1

Musculus corrugatus (Stimpson 1851)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/58	12-8-62	Ellesmere Is.	M	2-70	1
62-4006/15	13-7-62	Cornwallis Is.	M,R	5-15	7
62-4006/25	17-7-62	"	M,R	5-15	2
62-4006/42	4-8-62	"	M,R	5-15	6
62-4006/25	17-7-62	Res. Cornwallis	M,R	5-15	1
62-2002/34	4-8-62	Creswell	M,C	33	1
62-2012/27	25-7-62	"	M,C	36	1
62-2030/40	9-8-62	"	C	24-27	2
62-2031/44	11-8-62	"	M,C	40	6
62-2013/26	25-7-62	"	S	15-20	2
62-1017/12	5-8-62	Banks Is.	-	50+	1
62-78	12-9-62	J. A. MacDonald	-	-	1
62-4006/15	13-7-62	Resolute	M,R	5-15	1 v.
62-2081/3	10-9-62	Cambridge Bay	-	-	1

Dacridium vitreum (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/34	4-8-62	Creswell	M,C	33	2

Delectopecten groenlandicus (Sowerby 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/24	22-7-62	Ellesmere Is.	M	2-70	4
62-3001/25	22-7-62	"	M	2-70	1
62-3001/35	27-7-62	"	M	2-70	21
62-3001/36	27-7-62	"	M	2-70	5
62-3001/55	9-8-62	"	M	2-70	2
62-3001/58	12-8-62	"	M	2-70	23
62-3003/20	19-7-62	"	M,S,G	2-30	1
62-3003/49	5-8-62	"	M,S,G	2-30	5
62-3005/31	25-7-62	"	M	20-40	11
62-3005/32	25-7-62	"	M	20-40	2
62-3002/13	11-7-62	Ax. Heiberg Is.	M	29	2
	11-7-62				
62-3002/12	4-7-62	"	M	29	1
62-3004/23	18-7-62	"	M	2-57	88 j.
62-2002/34	4-8-62	Creswell	M,C	33	18
62-2003/23	23-7-62	"	G,C	34-43	1
62-2011/24	23-7-62	"	M,C	-	
			S	40	3
62-2012/27	25-7-62	"	M,C	36	35
62-2014/30	25-7-62	"	C	35	44
62-2030/40	9-8-62	"	C	24-27	7
62-3031/44	11-8-62	"	M,C	40	1
62-2013/26	25-7-62	"	S	15-20	6

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2011/25	24-7-62	Creswell	M,C	-	3
62-2012/27	25-7-62	"	M,C	36	8
62-2032/45	11-8-62	"	C,M	59-62	3
62-7300/2	23-8-62	Wellington Bay	S,M	80	1
62-7301/3	23-8-62	"	-	-	1
62-7307/4	23-8-62	"	-	-	35
65-1050 187	1-9-65	"	-	51	35
62-1017/3	5-8-62	Banks Is.	-	50+	10
62-1100 2	24-7-62	"	M,C	50+	7
62-1103 4	24-7-62	"	S,G	2	6
62-1107 9	26-7-62	"	M	16	56
62-1108 11	26-7-62	"	-	50	34
62-1103 4	24-7-62	"	S,G	2	1
64-004 110	6-9-64	Cambr.Bay in Fr.Bay	R,S	38	11
62-3001/57	12-8-62	Eureka Sd.	M	2-70	1
62-7305/5	24-8-62	Cambridge Bay	R,G	20-30	7
62-7302/4	23-8-62	"	M	50-60	4

Astarte borealis (Schum.) placenta Mörch 1869

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/24	22-7-62	Ellesmere Is.	M	2-70	4
62-3001/25	22-7-62	"	M	2-70	2
62-3001/26	22-7-62	"	M	2-70	23
62-3001/27	22-7-62	"	M	2-70	1
62-3001/29	25-7-62	"	M	2-70	1
62-3001/30	25-7-62	"	M	2-70	2
62-3001/35	27-7-62	"	M	2-70	1
62-3001/36	27-7-62	"	M	2-70	3
62-3001/42	1-8-62	"	M	2-70	2
62-3001/55	9-8-62	"	M	2-70	42
62-3001/58	12-8-62	"	M	2-70	34
62-3001/3	4-7-62	"	M	2-70	2
62-3003/50	5-8-62	"	M,S,G	2-30	32
62-3003/49	5-8-62	"	M,S,G	2-30	2
62-3003/48	5-8-62	"	M,S,G	2-30	25
62-3003/20	17-7-62	"	M,S,G	2-30	14
62-3003/19	17-7-62	"	M,S,G	2-30	47
62-3005/31	25-7-62	"	M	20-40	2
62-3004/21	18-7-62	Ax. Heiberg Is.	-	2-57	4-1 v.
62-3004/23	18-7-62	"	M,S,G	2-57	1
62-2005/8	29-6-62	Creswell	M,G	10	2
62-2008/16	5-7-62	"	S,M	20-45	3
62-7011/2	12-7-62	Wellington Bay	M,S	-	fragm.

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-7015/5	9-8-62	Wellington Bay	M,C	25	7
62-7015/66	9-8-62	"	M,C	25	2
62-7015/4	25-7-62	"	M,C	25	3
62-1103 4	24-7-62	Banks Is.	S,G	2	1
62-1107 10	26-7-62	"	M	16	1
63-007 81	29-7-63	Langten Bay	M	0-11	2
64-004 110	6-9-64	Ambr. Bay Lift 4	R,S	38	1

Astarte crenata (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/35	27-7-62	Ellesmere Is.	M	2-70	6
62-3001/36	27-7-62	"	M	2-70	2
62-3001/58	12-8-62	"	M	2-70	1
62-3005/32	25-7-62	"	M	20-40	3
62-3003/20	17-7-62	"	M,G,S	2-30	1
62-7307/4	23-8-62	Wellington Bay	-	-	2
62-1108/4	26-7-62	Banks Is.	-	50	22
64-004 110	6-9-64	Cambridge Bay	R,S	38	2
62-4003/2	28-6-62	Resolute	R,S	10-30	v.

Astarte crenata crebricostata (Andr. et Forbes 1847)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
64-004 110	6-9-64	Cambridge Bay	R,S	38	1

Astarte striata (Leach 1819)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/35	27-7-62	Ellesmere Is.	M	2-70	3
62-3001/55	9-8-62	"	M	2-70	1
62-3001/58	12-8-62	"	M	2-70	10
62-3003/20	17-7-62	"	M,G,S	2-30	3
62-3003/49	5-8-62	"	M,G,S	2-30	2
62-3003/50	5-8-62	"	M,S,G	2-3	3
62-4003/12	13-7-62	Cornwallis Is.	S,R	10-30	1
62-2031/44	11-8-62	Creswell	M,C	40	1
62-2004/6	29-6-62	"	M,C	9	1
62-78	12-9-62	J. A. MacDonald	-	-	1

Astarte warhami (Hancock 1849)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	1
62-3001/24	22-7-62	"	M	2-70	21
62-3001/25	22-7-62	"	M	2-70	4
62-3001/26	22-7-62	"	M	2-70	41
62-3001/30	25-7-62	"	M	2-70	1
62-3001/35	27-7-62	"	M	2-70	7
62-3001/36	27-7-62	"	M	2-70	2
62-3001/38	27-7-62	"	M	2-70	1
62-3001/55	9-8-62	"	M	2-70	41
62-3001/58	12-8-62	"	M	2-70	46
62-3003/19	17-7-62	"	M,S,G	2-30	25
62-3003/20	17-7-62	"	M,S,G	2-30	16
62-3003/48	5-8-62	"	M,S,G	2-30	11
62-3003/50	5-8-62	"	M,S,G	2-30	15
62-3005/31	25-7-62	"	M	20-40	2
62-3005/30	25-7-62	"	M	20-40	7
62-2031/44	11-8-62	Creswell	M,C	40	7
62-2008/16	5-7-62	"	S,M	20-45	1
62-7015/5	9-8-62	Wellington Bay	M,C	25	1
62-7300/2	23-8-62	"	S,M	30	1
62-7301/3	23-8-62	"	-	-	2
62-1103 4	24-7-62	Banks Is.	S,G	2	10
62-1106 6	26-7-62	"	S,G	7-0	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
63-007 81	29-7-63	Langton Bay	M	0-11	3
64-004 110	6-9-64	Cambridge Bay	R,S	38	1
62-2081/3	10-9-62	"	-	-	7
62-7305/5	24-8-62	Cambridge	R,G	20-30	3

Thyasira gouldi (Philippi 1845)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2005/8	29-6-62	Creswell	M,C	10	1
62-2005 38	29-6-62	"	M,C	11	1

Thyasira dunbari sp. n.

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	3
62-3003/50	5-8-62	"	M,S,G	2-30	1
62-3001/55	9-8-62	"	M	2-70	8
62-4006/42	4-8-62	Cornwallis Is.	M,R	5-15	1
62-7004/2	1-7-62	Wellington Bay	M,S	0-3	1
62-7015/66	9-8-62	"	M,C	25	3
62-3001/40	28-7-62	Eureka	M	2-70	2
62-3011/56	10-8-62	"	M	30-42	2

Axinopsida orbiculata (G. O. Sars 1887)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/22	21-7-62	Creswell	M,C	33	1
62-70	8-9-62	John A. MacDonald	-	-	1

Serripes groenlandicus Bruggiere 1789

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/26	22-7-62	Ellesmere Is.	M	2-70	2
62-4300/19	14-7-62	Devon Is.	-	5	2 v.
62-4302/20	15-7-62	"	R	5	1
62-4006/15	13-7-62	Cornwallis Is.	M,R	5-15	8
62-4006/25	17-7-62	"	M,R	5-15	2
62-4006/42	4-8-62	"	M,R	5-15	1 v.
62-2031/44	11-8-62	Creswell	M,C	40	1
62-2008/15	5-7-62	"	S,M	20-45	1
62-2008/16	5-7-62	"	S,M	20-45	1
62-2007/12	27-7-62	"	M,G	30-0	1
62-2001 1a	25-6-62	"	M,C	10	1
62-7008/3	28-7-62	Wellington Bay	-	-	fragm.
62-1101 2	24-7-62	Banks Is.	M	4	1
62-1106 7	26-7-62	"	S,G	7-0	1

Clinocardium ciliatum (Fabr. 1780)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-7011/2	12-8-62	Wellington Bay	M,S	-	fragm.
62-7300/2	23-8-62	"	M,S	30	1-v.
63-007 81	29-7-63	Langton Bay in Franklin Bay	M	0-11	32 1 small

Liocyma fluctuosa (Gould 1870)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-1106 6	26-7-62	Banks Is.	S,G	7-0	5
62-1101 2	24-7-62	"	M	4	13
62-1106 7	26-7-62	"	S,G	7-0	1
62-1107 10	26-7-62	"	M	16	1
63-007 81	29-7-63	Langton Bay in Franklin Bay	M	0-11	5

Macoma calcarea (Gmelin 1792)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3003/50	5-8-62	Ellesmere Is.	M,S,G	2-30	2
62-4300/19	14-7-62	Devon Is.	-	5	1 v.
62-4006/15	13-7-62	Cornwallis Is.	M,R	5-15	2
62-4006/15	13-7-62	"	M,R	5-15	22
62-4006/25	17-7-62	"	M,R	5-15	2
62-4006/42	4-8-62	"	M,R	5-15	17
62-4009/30	25-7-62	"	-	10	1
62-4016/36	25-7-62	"	-	-	1
62-2031/44	11-8-62	Creswell	M,C	40	1
62-2005 38	29-6-62	"	M,C	10	1
62-7004/2	1-7-62	Wellington Bay	M,S	0-3	2
62-7015/5	9-8-62	"	M,C	25	1
62-7015/66	9-8-62	"	M,C	25	2
58-1003	17-8-58	Frobisher Bay	-	70	1
63-007 81	29-7-63	Langton Bay	M	0-11	1
60-3 2	11-8-60	Richmond Gulf	-	-	2
62-77	11-9-62	J. A. MacDonald	-	-	v.
62-75	9-9-62	"	-	-	1
	11-8-57	John Brown Is.	-	-	3 v.

Macoma moesta (Deshayes 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	1
62-3001/24	22-7-62	"	M	2-70	1
62-3001/25	22-7-62	"	M	2-70	1
62-3001/26	22-7-62	"	M	2-70	1
62-3001/30	25-7-62	"	M	2-70	1
62-3001/55	9-8-62	"	M	2-70	1
62-3003/19	17-7-62	"	M,S,G	2-30	5
62-3003/50	5-8-62	"	M,S,G		2
62-4006/42	4-8-62	Cornwallis Is.	M,R	5-15	6
62-4015	25-7-62	"	-	-	1
62-2002/20	14-7-62	"	M,C	33	1
62-7004/45	1-7-62	Wellington Bay	M,S	0-3	13
62-7015/66	9-8-62	"	M,C	25	1
62-7300/2	23-8-62	"	S,M	30	1
62-7301/3	23-8-62	"	-	-	1
62-7015/4	25-7-62	"	M,C	25	1
62-1103 4	24-7-62	"	S,G	2	3
62-1107 9	26-7-62	Banks Is.	M	16	7
63-007 81	29-7-63	Langton Bay in	M	0-11	1
6a	9-8-62	Franklin Bay			
62-7015/6a	9-8-62	Cambridge Bay	M,C	25	1

Macoma loveni (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/26	22-7-62	Ellesmere Is.	M	2-70	1
62-3001/55	9-8-62	"	M	2-70	1
62-3003/19	17-7-62	"	M,S,G	2-30	2
62-3003/20	17-7-62	"	M,S,G	2-30	1
62-3003/48	5-8-62	"	M,S,G	2-30	2
62-3003/49	5-8-62	"	M,S,G	2-30	1
62-3003/50	5-8-62	"	M,S,G	2-30	2
62-4017/37	25-7-62	Cornwallis Is.	-	8	1

Macoma torelli (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2002/20	14-7-62	Creswell	M,C	33	1
	11-8-57	Coppermine John Brown Is.	-	-	2 v.

Hiatella arctica (Linne 1767)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	2
62-3001/24	22-7-62	"	M	2-70	1
62-3001/25	22-7-62	"	M	2-70	2
62-3001/29	25-7-62	"	M	2-70	3
62-3001/38	27-7-62	"	M	2-70	3
62-3001/55	9-8-62	"	M	2-70	1
62-3002/12	4-7-62	Ax. Heiberg Is.	M	29	7
62-3002/13	11-7-62	"	M	29	1
62-3003/19	17-7-62	"	M,S,G	2-30	1
62-4302/20	15-7-62	Devon Is.	R	5	4
62-4001/46	6-8-62	Cornwallis Is.	-	35-62	2
62-4003/7	6-7-62	"	S,R	10-30	1
62-4003/10	9-7-62	"	S,R	10-30	1
62-4015	25-7-62	"	-	-	1
62-4003/3	1-7-62	"	S,R	10-30	v.
62-4003/10	9-7-62	"	S,R	10-30	1
62-4003/12	13-7-62	"	S,R	10-30	fragm.
62-4003/26	17-7-62	"	S,R	10-30	1
62-4001/46	6-8-62	"	-	35-62	fossil
62-4001/46	6-8-62	"	S,R	35-62	1
62-2012/27	25-7-62	Creswell	M,C	36	14
62-2013/26	25-7-62	"	S	15-20	1
62-2014/30	25-7-62	"	C	35	16

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2031/44	11-8-62	Creswell	M,C	40	10
62-2008/14	3-7-62	"	S,M	20-45	1
62-2008/15	5-7-62	"	S,M	20-45	1
62-2032/45	11-8-62	"	C,M	59-62	3
62-2003/7	29-6-62	"	G	34	
			C	43	1
62-2003/23	23-7-62	"	G	43	1
62-2012/27	25-7-62	"	M,C	36	4
62-2032/45	11-8-62	"	M,C	59-62	3
62-2008/18	2-7-62	"	S,M	20-45	4
62-7011/2	12-7-62	Wellington Bay	M,S	-	fragm.
62-7015/5	9-8-62	"	M,C	25	4
62-7015/66	9-8-62	"	M,C	25	1
58-1003	17-8-58	Frobisher Bay	-	70	2
64-004 110	6-9-64	Cambridge Bay	R,S	38	6
62-2081/3	10-9-62	"	-	-	12
62-7300/1	23-8-62	"	S,M	30	1
61-43/29	28-8-61	Frozen Strait	-	85-92	fossils
62-78	12-9-62	J. A. MacDonald	-	-	valves
62-7003/1	29-6-62	Ferguson River	-	-	1
62-4003/2	28-6-62	Resolute	S,R	10-30	valve
62-4003/14	13-7-62	"	S,R	10-30	1 v.

Cyrtodaria kurriana Dunker 1862

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-1106 6	26-7-62	Banks Is.	S,G	7-0	1
62-1107 9	26-7-62	"	M	16	1
62-1106 7	26-7-62	"	S,G	7-0	5
58-1003	17-8-58	Frobisher Bay	-	70	1
62-4006/42	4-8-62	Cornwallis Is.	M,R	5-15	1

Mya truncata Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3003/50	5-8-62	Ellesmere Is.	M,S,G	2-30	1
62-4300/19	14-7-62	Devon Is.	-	5	2
62-4302/20	15-7-62	"	R	5	1
62-4300/19	14-7-62	"	-	5	1
62-4001/46	6-8-62	Cornwallis Is.	-	35-62	1 v.
62-4003/10	9-7-62	"	S,R	10-30	1 v. 1 y.
62-4007/24	17-7-62	"	M,R	5-15	v.
62-4003/12	13-7-62	"	S,R	10-30	v.
62-2031/44	11-8-62	Creswell	M,C	40	1
62-2008/14	3-7-62	"	S,M	20-45	1
62-2008/15	5-7-62	"	S,M	20-45	1
62-7015/5	9-8-62	Wellington Bay	M,C	25	1
62-7300/2	23-8-62	"	S,M	30	1
58-1003	17-8-58	Frobisher Bay	-	70	3
61-43/29	28-8-61	Frozen Strait	-	65-92	v.
61-43/29	28-8-61	"	-	65-92	35
	29-8-62	Cape Parry	-	-	valves
	7-9-62	"	-	-	4
	11-8-57	Coppermine	-	-	4 v.
		John Brown Is.			
62-3003/50	5-8-62	Seidre Fiorda	M,S,G	2-30	1

Lyonsia arenosa (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-4006/15	13-7-62	Cornwallis Is.	M,R	5-15	4
62-4006/42	4-8-62	"	M,R	5-15	2-1 v.
62-2031/44	11-8-62	Creswell	M,C	40	1
62-2008/16	5-7-62	"	S,M	20-45	1
62-2032/45	11-8-62	"	M,C	59-62	1
62-1017 12	5-8-62	Banks Is.	-	50-	3
62-1103 4	24-7-62	"	S,G	2	4

Pandora glacialis Leach 1819

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-2031/44	11-8-62	Creswell	M,C	40	3
62-1103 4	24-7-62	Banks Is.	S,G	2	1

Thracia (Thracia) devexa (G. O. Sars 1878)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3001/3	4-7-62	Ellesmere Is.	M	2-70	1
62-3001/55	9-8-62	"	M	2-70	2
62-3001/58	12-8-62	"	M	2-70	1
62-3003/48	5-8-62	"	M,S,G	2-30	1
62-3003/23	18-7-62	Ax. Heiberg Is.	M,G,S	2-57	1
62-1103 4	24-7-62	Banks Is.	S,G	2	1
63-007 81	29-7-63	Langton Bank in Franklin Bay	M	0-11	1

Cuspidaria subtorta (G. O. Sars 1878)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3002/12	11-7-62 4-7-62	Ax. Heiberg Is.	M	29	1 v.

Cuspidaria arctica (M. Sars 1865)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
62-3003/20	17-7-62	Ellesmere Is.	M,S,G	2-30	1

List of species of bivalve molluscs collected by the Fisheries Research Board of Canada in the Bathurst and Wellington Inlets, N.W.T., 1963.

Bivalves collected in the Bathurst Inlet:

Species:	Stn. No.	Depth: Metrs.	No. of specimens
Nuculana minuta (Fabr.)	1038	140	1
Portlandia arctica (Gray)	1037	140	4
portlandica Hitchcock	1038	140	347
Bathyarca glacialis (Gray)	1020	35	4
	1021	35	5
Mytilus edulis L.	1021	35	1
	1038	140	4
Musculus discora (Gray) var. laevigatus Jensen	1038	140	38
M. niger (Gray)	1017	10-35	1
Astarte borealis (Schumacher)	1038	140	351
A. warhami Hancock	1038	140	32
A. crenata crenata (Gray)	1019	240	41
Clinocardium ciliatum (Fabr.)	1017	10-35	7
	1038	140	16
Serripes groenlandicus Brugg	1017	10-35	7
Macoma calcarea (Gmelin)	1019	230	1
	1017	10-35	4
	1038	140	203
[illegible]atella arctica (L.)	1017	10-35	6
Lyo[illegible]a arenosa (Moller)	1038	140	1

List of species of bivalves collected by the FRBC, 1963, in the Bathurst and Wellington Inlets, N.W.T.

Wellington Inlet:

Species:	Stn.	Depth Mtrs.	No. of specimens
Nuculana pernula costigera (Leach)	1049	47	1
	1051	40	3
Portlandia arctica (Gray) portlandica Hitchcock	1051	40	1
Yoldiella intermedia (M.Sars)	1044	120	4
Bathyarca glacialis (Gray)	1044	120	13
	1047	50	6
	1048	60	14
	1049	47	6
	1050	51	3
	1051	40	2
Delectopecten groenlandicus (Sow.)	1044	120	18
	1047	50	47
	1048	60	851
	1049	42	42
	1051	40	17
Musculus discors (L.) var. Laevigatus (Gray)	1048	60	3
	1050	51	1
M. niger (Gray)	1047	50	2
	1051	40	2
Astarte crenata crenata (Gray)	1048	60	4
	1049	47	1
Macoma moesta (Deshayes)	1051	40	2
Hiatella arctica (L.)	1048	60	2
	1049	47	15
	1050	51	2
Cuspidaria arctica (G.O. Sars)	1044	120	2

Appendix I - Part 2

2. List of lamellibranch molluscs from Foxe Basin collected by the expeditions of the Fisheries Research Board of Canada, 1955-57.

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954.

Nuculana pernula costigera Leche 1882.

Nuculana minuta (Muller 1776).

Nucula belotti Adams 1856.

Portlandia siliqua (Reeve 1855).

Delectopecten groenlandicus (Sowerby 1845).

Musculus niger (Gray 1824).

Musculus discors var. laevigatus (Gray 1824) Jensen 1912.

Musculus discors var. substriatus (Gray 1824) Jensen 1912.

Musculus corrugatus (Stimpson 1854).

Crenella faba (Müller 1776).

Astarte borealis (Schumacher 1817).

Astarte arctica (Gray 1824).

Astarte borealis placenta Mörch 1857.

Astarte striata (Leach 1819).

Astarte warhami Hancock 1846.

Thyasira gouldii Philippi 1845.

Axinopsida orbiculata (G. O. Sars 1878).

Cardium ciliatum Fabricius 1780.

Serripes groenlandicus Bruggiere 1789.

Macoma calcarea (Gmelin 1872).

Macoma calcarea f. obliqua Soot-Ryen 1932.

Macoma calcarea f. ? .

Macoma moesta (Deshayes 1854).

Macoma torelli (Steenstrup) Jensen 1905.

Macoma loveni (Steenstrup) Jensen 1905.

Mya truncata Linne 1758.

Mya truncata uddevalensis Forbes 1846.

Mya truncata f. ovata Jensen 1900.

Hiatella arctica (Linne 1767).

Pandora glacialis Leach 1819.

Lyonsia arenosa (Moller 1842).

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
715/14	19.9.55	Skeoch Bay	S,M	0-15	1
718/17	25.9.55	Hooper Inlet	M	75	4
719/18	26.9.55	"	M	51	4
722/19	29.9.55	"	M	30-45	9
719/10	5.5.56	"	M	51	3
719/11	19.5.56	"	M	"	1
719/12	30.5.56	"	M	"	6
719/16	13.6.56	"	M	"	4
719/18	19.6.56	"	M	"	2
719/22	11.8.56	"	M	"	8
719/40	2.9.56	"	M	"	3
723/41	4.9.56	Turton Bay	M	22-24	1
808/25	16.8.56	Gifford Fjd.	M	160-174	3
815/29	18.8.56	Fury-Hecla Str.	M	55	1
832/44	8.9.56	Koch Id.-C. Jensen	R,S	71	1
901/2	2.7.57	Rowley Id, Frustration Bay	M	0-34	1
901/5	2.7.57	"	M	"	1
901/6	2.7.57	"	M	"	fragm.
901/7	"	"	M	"	2
901/8	"	"	M	"	2
901/9	"	"	M	"	2
901/10	"	"	M	"	1
901/24	5.7.57	"	M	"	1
901/50	24.8.57	"	M	"	1
901/52	"	"	M	"	1

Nuculana pernula costigera Leche 1882

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	4
715/14	15.9.55	Skeoch Bay		0-15	2
716/15	15.9.55	S. Tern Island	R,S	92-100	1
719/18	29.9.55	Hooper Inlet	M	51	3
719/22	11.9.55	"	M	"	3
718/17	25.9.55	"	M	75	8
722/19	29.9.55	"	M	30-45	3
723/13	1.6.56	Turton Bay	M	22-24	1
723/41	4.9.56	"	M	"	1
815/29	18.8.56	Fury-Hecla Str.	M	55	2
818/32	26.8.56	S. Tern Id.	R,M	95	2
821/37	29.8.56	Murray Maxwell Bay	M	13-30	1
832/44	8.9.56	Koch Id.-C. Jensen	S,R	71	3
901/46	24.8.57	Rowley Id., Frus. B.	M	0-34	2
901/52	"	"	M	"	1
901/56	29.8.57	"	M	"	2
901/62	8.9.57	"	M	"	1

Nuculana minuta (Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay		0-3	1
715/4	19.9.55	Skeoch Bay	S,M	0-15	1
716/15	19.9.55	S. Tern Id.	R,S	92-100	2
719/18	19/6/56	Hooper Inlet	M	51	1 v.
818/32	26.8.56	S. Tern Id.	R,M	95	4

Nucula belloti Adams 1856

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
715/14	19.9.55	Skeoch Bay	S,M	0-15	17
716/5	"	S. Tern Id.	R	92-100	4
718/17	25.9.55	Hooper Inlet	M	75	42
719/10	5.5.56	"	M	50	26
719/11	19.5.56	"	M	"	41
719/16	13.6.56	"	M	"	34
719/17	25.9.55	"	M	"	42
719/18	19.6.56	"	M	"	37
"	29.9.55	"	M	"	17
719/22	11.8.56	"	M,R	"	3
719/40	2.9.56	"	M	"	14
723/1	18.1.56	Turton Bay	M	22-24	2
723/3	1.3.56	"	M	"	2
723/6	13.4.56	"	M	"	2
723/8	21.4.56	"	M	"	3
723/4	23.3.56	"	M	"	1
723/13	1.6.56	"	M	"	5
723/19	29.7.56	"	M	"	1
723/23	26.10.56	"	M	"	8
723/26	28.11.56	"	M	"	7
723/27	12/12/56	"	M	"	1
723/21	4/9/56	"	M	"	4
722/19	23.9.55	Hooper Inlet	M	30-45	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
808/25	16.8.56	Gifford Fjd.	M	177	25
815/29	18.8.56	Fury-Helca	M	70-80	2
818/32	26.8.56	S. Tern Id.	M	93	7
820/34	28.8.56	M. Maxwell Bay	M	73	35
821/37	29.8.56	"	M	13-30	31
811/28	7.8.56	Fury-Helca Str.		106	1
832/44	8.9.56	Koch Id.-C. Jensen	R,S	80-90	1
901/6	2.7.57	Rowley Id.	M	0-34	1

Portlandia siliqua (Reeve 1855)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
715/14	19.9.55	Skeoch Bay	S,M	0-15	38
716/15	"	S. Tern Id.	"	92-100	1
718/17	25.9.55	Hooper Inlet	M,R	75	28
719/18	29.9.55	"	M	50	1
718/10	56	"	M	75	1
719/22	11.8.56	"	M	50	25
723/1	18.1.56	Turton Bay	M	22	14
723/2	3.2.56	"	M	"	3
723/3	1.3.56	"	M	"	36
723/6	13.4.56	"	M	"	36
723/8	21.4.56	"	M	"	15
723/9	4.5.56	"	M	"	2
723/23	26.10.56	"	M	"	21
723/24	28.10.56	"	M	"	4
723/25	14.11.56	"	M	"	2
723/26	28.11.56	"	M	"	10
723/27	12.12.56	"	M	"	9
723/13	1.6.56	"	M	"	58
723/19	29.7.56	"	M	"	3
723/40	2.9.56	"	M	"	1
723/41	4 .9.56	"	M	"	81
723/42	"	"	M	"	18
808/25	16.8.56	Gifford Fjd.	M	160-174	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
820/34	28.8.56	M. Maxwell Bay	M	73	6
821/35	29.8.56	"	M	0-30	36
821/36	"	"	M	"	62
821/37	"	"	M	"	91
822/38	30.8.56	Calthorpe Id.	R	29	2

Delectopecten groenlandicus (Sowerby 1845)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	9
815/29	18.8.56	Fury-Hecla Str.	M	55	2
832/44	8.9.56	Koch Id.-C. Jensen	R,S	79-90	15

Musculus niger (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
718/17	25.9.55	Hooper Inlet	M	75	3
719/10	5.5.56	"	M	51	1
719/11	19.5.56	"	M	"	2
719/18	19.6.56	"	M	"	2
719/22	11.8.56	"	M	"	7
719/40	2.9.56	"	M	"	3, 2 v.
723/41	4.9.56	Turton Bay	M	22-24	1
821/37	29.8.56	M. Maxwell Bay	M	0-30	1
901/52	24.8.57	Rowley Id.	M	0-34	6

Musculus discors var. laevigatus (Gray 1824) Jensen 1912

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
710 L7	8.9.55			shore	4
710/11	"			"	41
713/13	12.9.55	C. Wilson	R	25-49	26
715/14	19.9.55	Skeoch Bay	S,M	0-15	6
716/15	"	S. Tern Id.	R,S	92-100	3
718/17	25.9.55	Hooper Id.	M	75	2
719/18	19.6.56	"	M	50	1
719/22	11.8.56	Hooper Inlet	M	51	3
722/19	29.9.55	"	M	36-45	2
722/21	"	"	M	"	6
723/1	18.1.56	Turton Bay	M	22-24	2
723/3	1.3.56	"	M	"	8
808/25	14.8.55	Gifford Fjd.	M	160-174	2
723/4	23.3.56	Turton Bay	M	22-24	1
723/6	13.4.56	"	M	"	2
723/23	26.10.55	"	M	"	3
723/27	12.12.55	"	M	"	1
723/41	4.9.56	"	M	"	9
723/42	"	"	M	"	10
811/27	17.8.56	Fury-Hecla Str.		106	27
811/28	"	"		"	1
815/29	18.8.56	"	M	55	1
817/30	24.8.56	Skeoch Bay	R,M	19-20	9

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
818/32	26.8.56	S. Tern Id.	R,M	95	10
820/34	28.8.56	M. Maxwell Bay	M	73	3
822/38	30.8.56	Calthorpe Id.	R	29	2
828/43	7.9.56	Koch Id.-Rowley Id.	R	27-33	14
832/44	8.9.56	Koch Id.-C. Jensen	R,S	79-90	1
837/45	9.9.56	Bray Id.-Rowley Id.	S,R	45-55	9
901/20	9.7.57	Rowley Id.	M	0-34	1
901/21	9.7.57	"	M	"	6
901/25	10.8.57	"	M	"	1
901/39	3.8.57	"	M	"	1
901/43	12.8.57	"	M	"	1
901/56	29.8.57	"	M	"	2
901/58	"	"	M	"	1

Musculus discors var. substriatus (Gray 1824) Jensen 1912

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
710 L7	8.9.55	Repulse Bay		0-3	7
711/10	"	"	R	70-100	1
713/13	12.9.55	C. Wilson	R	25-49	6
715/14	19.9.55	Skeooh Bay	S,M	0-15	1
718/17	25.9.55	Hooper Inlet	M	75	1
719/22	11.8.56	"	M	51	2
719/40	2.9.56	"	M	"	1
722/19	20.9.55	"	M	36-45	5
723/2	3.2.56	Turton Bay	M	22-24	1
723/40	2.3.56	"	M	"	1
808/25	10.8.56	Gifford Fjd.	M	160-174	1
811/27	17.8.56	Fury-Hecla Str.		106	52
818/32	26.8.56	S. Tern Id.	R,M	95	26
820/34	28.8.56	M. Maxwell Bay	M	73	2
821/36	29.8.56	"	M	0-30	1
828/43	7.9.56	Koch Id.-Rowley Id.	R	27-33	10
837/45	9.9.56	Rowley Id.	S,R	45-55	20

Musculus corrugatus (Stimpson 1851)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
716/15	19.9.55	S. Tern Id.	R,S	92-100	3
719/10	5.5.56	Hooper Inlet	M	51	1
719/11	19.5.56	"	"	"	3
719/12	30.5.56	"	"	"	2
719/18	29.9.55	"	"	"	2
719/22	11.8.56	"	"	"	12
719/19	29.9.55	"	"	"	1
802/34	28.8.56	M. Maxwell Bay	M	73	1
821/36	29.8.56	"	M	0-30	10
821/37	"	"	"	"	1
901/24	10.7.57	Rowley Id.	M	0-34	2
901/25	"	"	"	"	1
901/26	24.8.57	"	"	"	2
901/50	"	"	"	"	2
901/52	"	"	"	"	28
901/59	3.9.57	"	"	"	1

Crenella faba (Müller 1776)

Station No.	Date	Location	Bottom	Depth M.	No. of Sps.
710 L7	8.9.55	Repulse Bay		0-3	2
821/36	28.8.56	M. Maxwell Bay	M	73	1
828/43	7.9.56	Koch Id.-Rowley Id.	R	27-33	18
901/20	9.7.57	Rowley Id.	M	0-34	1
901/39	3.8.57	"	"	"	1
901/42	12.8.57	"	"	"	1
901/43	"	"	"	"	5
901/44	12.8.57	"	"	"	1
901/48	24.8.57	"	"	"	1
901/49	"	"	"	"	2
901/52	"	"	"	"	1
901/53	25.8.57	"	"	"	1
901/54	"	"	"	"	4
901/58	29.8.57	"	"	"	2
901/62	8.9.57	"	"	"	1

Astarte arctica (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
715 L3	27.7.55	Skeoch Bay		0-15	1
710 L7	8.9.55	Repulse Bay		0-3	4, 3 v.
711/10	"	"	R	70-110	1
713/13	12.9.55	C. Wilson	R	25-49	2
716/15	19.9.55	S. Tern Id.	S,M	92-100	1
722/19	29.9.55	Hooper Inlet	M	30-45	4
723/8	21.3.56	Turton Bay	M	22-24	2
809 L3	16.8.56				1 v.
811/27	17.8.56	Fury-Hecla Str.		106	2

Astarte borealis placenta Mörch 1857

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	4
716/15	19.9.55	S. Tern Id.	S,M	92-100	1
719/10	5.5.56	Hooper Id.	M	51	1
719/16	13.6.56	"	"	"	1
719/18	29.9.55	"	"	"	1
719/22	11.8.56	"	"	"	11
719/40	2.9.56	"	"	"	6
723/9	4.5.56	Turton Bay	M	22-24	1
723/13	29.7.56	"	"	"	2
723/23	26.10.56	"	"	"	1
723/26	25.11.56	"	"	"	1
723/41	4.9.56	"	"	"	2
723/42	"	"	"	"	1

Astarte striata (Leach 1879)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	18
715/14	19.9.55	Skeoch Bay	S	0-15	1
719/16	13.6.56	Hooper Id.	M	51	1
808/24	15.8.56	Gifford Fjd.	M	160-174	1
809/26	17.8.56	"			1
811/27	"	Fury-Hecla Str.		106	1
723/41	4.9.56	"		"	1
821/35	29.8.56	M. Maxwell Bay	M	0-30	2
821/36	"	"	M	"	1

Astarte warhami Hancock 1846

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	5
716/15	19.9.55	S. Tern Id.	R,S	92-100	7
719/11	19.5.56	Hooper Id.	M	51	1
719/12	30.5.56	"	"	"	1
719/18	29.9.55	"	"	"	8
719/22	11.8.56	"	"	"	9
719/40	2.9.56	"	"	"	1
723/2	3.2.56	Turton Bay	M	22-24	2
723/4	23.3.56	"	"	"	1
723/6	13.4.56	"	"	"	1
723/8	21.4.56	"	"	"	4
723/9	4.5.56	"	"	"	1
723/13	1.6.56	"	"	"	13
723/19	29.7.56	"	"	"	15
715/23	15.8.56	Skeoch Bay	S	0-15	2
723/42	4.9.56	Fury-Hecla Str.		106	2
808/25	16.8.56	"	M	"	3
811/28	17.8.56	"		"	1
818/32	26.8.56	S. Tern Id.	R,M	95	2
837/45	9.9.56	Rowley Id.	S,R	45-55	1
901/50	24.8.57	"	M	0-34	1
821/36	29.8.56	M. Maxwell Bay	M	0-30	1

Thyasira gouldi Philippi 1845

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
719/40	2.9.56	Hooper Inlet	M	51	3
811/28	17.8.56	Fury-Hecla Str.		39-55	2
901/3	2.7.57	Rowley Id.	M	0-34	1
901/1	"	"	"	"	1
901/14	5.7.57	"	"	"	1
901/28	"	"	"	"	4
901/62	8.9.57	"	"	"	1
901/52	24.8.57	"	"	"	25
720/22	16.10.55	Turton Bay		0-18	1

Axinopsida orbiculata (G. O. Sars 1878)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
720/22	16.10.55	Turton Bay		0-18	1
901/52	24.8.57	Rowley Id.	M	0-34	10

Cardium ciliatum Fabricius 1780

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	1
715/14	19.9.55	Skeoch Bay	S,M	0-15	1
718/17	25.9.55	Hooper Inlet	M	75	2
719/18	29.9.55	"	"	51	4
722/19	"	"	"	36-45	2
719/16	13.6.56	Hooper Inlet	M		1
719/22	11.8.56	"	"		2
719/40	2.9.56	"	"		1
811/27	17.8.56	Fury-Hecla Str.		39-55	5
818/32	26.8.56	S. Tern Id.	R,M	95	1
821/37	29.8.56	M. Maxwell Bay	M	0-30	2

Serripes groenlandicus Bruggiere 1789

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
710 L7	7.9.55	Repulse Bay		0-3	1
715/8	18.9.55	Skeoch Bay	S		fragm.
715/14	19.9.55	"	S,M	0-15	2, 1 v.
716/15	"	S. Tern Id.	R,S	92-100	1
718/17	25.9.55	Hooper Inlet	M	75	6, 3 v.
719/18	29.9.55	"	"	51	1
720/22	6.10.55	Turton Bay		0-18	3
722/19	29.9.55	Hooper Inlet	M	36-45	2
715/31	26.8.56	Skeoch Bay	S,M	0-15	1
719/11	19.5.56	Hoopër Inlet	M	51	1
719/22	11.8.56	"	"	"	5
719/40	2.9.56	"	"	"	1, 1v.
723/42	4.9.56	Turton Bay	M	22-24	1
821/35	29.8.56	M. Maxwell Bay	M	0-30	3
821/36	"	"	"	"	8
821/37	"	"	"	"	10
901/1	8.7.57	Rowley Id., Frustration Bay	M	0-34	fragm.
901/15	"	"	"	"	"
901/46	24.8.57	"	"	"	2
901/52	"	"	"	"	3
901/59	3.9.57	"	"	"	1
901/62	8.9.57	"	"	"	1

Macoma calcarea (Gmelin 1872)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
715/14	19.9.55	Skeoch Bay	S,M	0-15	1
716/15	"	S. Tërn Id.	R,S	92-100	10
715/16	21.9.55	Skeoch Bay	S,M	0-15	1
718/17	23.9.55	Hooper Inlet	M	75	32
719/10	5.5.56	"	"	51	7
719/11	19.5.56	"	"	"	13
719/12	30.5.56	"	"	"	16
719/16	13.6.56	"	"	"	5
719/18	19.6.56	"	"	"	13
719/22	11.8.56	"	"	"	9, 16v.
722/19	29.9.55	"	"	36-45	2
723/19	"	Turton Bay	M	22-24	3
723/41	4.9.56	"	"	"	1
719/40	2.9.56	Hooper Inlet	M	51	8, 3 v.
808/25	16.8.56	Gifford Fjd.	M	160-174	1
811/28	17.8.56	Fury-Hecla Str.		106	2
818/32	26.8.56	S. Tern Id.	R,M	95	3
820/34	28.8.56	M. Maxwell Bay	M	73	31
821/35	29.8.56	"	"	0-30	2
821/36	"	"	"	"	2
821/37	"	"	"	"	3
832/44	8.9.56	Koch Id.-C. Jensen	R,S	79-90	2
901/17	57	Rowley Id.	M	0-34	1

Macoma calcarea f. obliqua Soot-Ryen 1932

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
808/25	16.8.56	Gifford Fjd.	M	160-174	2

Macoma calcarea f. ?

808/25	16.8.56	Gifford Fjd.	M	160-174	2

Macoma moesta (Deshayes 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
711/10	8.9.55	Repulse Bay	R	70-110	3
722/19	29.9.55	Turton Bay	M	22-24	1
723/23	26.10.55	"	"	"	1
723/26	28.11.55	"	"	"	2
723/27	12.12.55	"	"	"	1
723/41	4.9.56	"	"	"	1
820/34	28.8.56	M. Maxwell Bay	M	73	3
821/35	29.8.56	"	"	0-30	1
901/1	8.6.57	Rowley Id.	M	0-34	1
901/2	2.7.57	"	"	"	1
901/3	"	"	"	"	fragm.
901/4	"	"	"	"	1
901/5	"	"	"	"	1
901/7	"	"	"	"	1
901/9	"	"	"	"	2
901/10	"	"	"	"	1
901/11	"	"	"	"	2
901/14	5.7.57	"	"	"	7
901/15	8.7.57	"	"	"	6
901/17	"	"	"	"	2
901/22	"	"	"	"	1
901/23	10.7.57	"	"	"	fragm.
901/24	"	"	"	"	1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
901/25	10.7.57	Rowley Id.	M	0-34	1
901/26	"	"	"	"	1
901/29	"	"	"	"	1
901/46	24.8.57	"	"	"	1
901/50	"	"	"	"	1
901/52	"	"	"	"	24
901/62	8.9.57	"	"	"	2

Macoma torelli (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
719/11	19.5.56	Hooper Inlet	M	51	1

Macoma loveni (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
832/44	8.9.56	Koch Id.-C. Jensen	R,S	79-90	2

Mya truncata Linne uddevalensis Forbes 1846

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
710 L7	7.9.55	Repulse Bay		0-3	1, 2 v.
716/15	19.9.55	S. Tern Id.	R,S	92-100	1
719/22	11.8.56	Hooper Inlet	M	51	1, 1 v.
720/10	26.9.55	Turton Bay		0-18	1
723/3	1.3.56	"	M	22-24	1
723/8	27.3.56	"	"	"	1
723/19	29.9.55	"	"	"	1
723/27	12.12.56	"	"	"	1

Hiatella arctica (Linne 1767)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
710 L7	8.8.55	Repulse Bay		0-3	1
711/10	"	"	R	70-110	24
715/14	19.9.55	Skeoch Bay	M	0-15	1
716/15	"	S. Tern Id.	R,S	92-100	1
718/17	25.9.55	Hooper Id.	M	75	6
719/18	29.9.55	Hooper Inlet	M	51	1
719/p89	23.12.55	"	"	"	1
719/12	30.5.56	"	"	"	4
719/18	19.6.56	"	"	"	4
719/22	11.8.56	"	"	"	9
719/40	2.9.56	"	"	"	3
722/19	29.9.55	"	"	36-45	6
723/42	4.9.56	Turton Bay	M	22-24	2
808/25	16.8.56	Gifford Fjd.	M	160-174	1
811/27	17.8.56	Fury-Hecla Str.		106	60
811/28	"	"		"	9
815/29	18.8.56	"	M	55	1
818/32	26.8.56	S. Tern Id.	R,M	95	3
820/34	28.8.56	M. Maxwell Bay	M	73	10
821 L4	29.8.56	"	"	0-30	4 v.
822/38	30.8.56	W. Calthorpe Id.	R	29	3
828/43	7.9.56	Koch Id.-Rowley Id.	R	27-33	1
832/44	8.9.56	Koch Id.-C. Jensen	R,S	20	19
837/45	9.9.56	Bray Id., Rowley Id.	S,R	45-55	12
901/62	8.9.57	Rowley Id.	M	0-34	1

Pandora (Kennerlia) glacialis Leach 1819

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
815/29	18.8.56	Fury-Hecla Str.	M	55	1

Lyonsia arenosa (Möller) 1842

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
719/18	19.6.56	Hooper Inlet	M	51	1
821/36	29.8.56	M. Maxwell Bay	M	0-30	7

Appendix I - Part 3

3. List of species of bivalve molluscs from the eastern shores of Hudson Bay, collected by the expedition of the Fisheries Research Board of Canada, 1958.

Arca (Bathyarca) glacialis (Gray 1824)

Arca (Bathyarca) pectunculoides (Scacchi 1833)

Yoldiella lenticula (Möller 1842)

Portlandia arctica (Gray 1824)

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Nuculana pernula (Müller 1779)

Nuculana buccata (Steenstrup 1842)

Nuculana minuta (Müller 1776)

Nucula belloti Adams 1856

Pecten (Chlamys) islandicus (Müller 1776)

Musculus discors var. laevigatus (Gray) Jensen 1912

Musculus discors var. substriatus (Gray) Jensen 1912

Musculus niger (Gray 1824)

Crenella faba (Müller 1776)

Mytilus edulis L. 1758

Mytilus pellucidus Pennant 1777

Astarte striata Leach 1819

Astarte warhami Hancock 1846

Astarte crenata (Gray 1824)

Astarte borealis (Schumacher 1817)

Venericardia borealis (Conrad 1831)

Thyasira gouldii Philippi 1845

Axinopsida orbiculata (G. O. Sars 1878)

Cardium (Clinocardium) ciliatum Fabricius 1780

Serripes groenlandicus Bruggiere 1789

Macoma calcarea (Gmelin 1872)

Macoma balthica (Linne 1758)

Macoma moesta (Deshayes 1854)

Mya truncata Linne 1758

Mya truncata var. uddevalensis Forbes 1876

Mya pseudarenaria Schlesch

Hiatella arctica Linne 1758

Thracia myopsis Möller 1842

Periploma abyssorum (Verill 1893)

Pandora glacialis Leche 1819

Lyonsia arenosa (Möller 1842)

Samples contain many worn-out shells of Cardium ciliatum, Nuculana pernula, Pecten islandicus, Astarte borealis, Hiatella arctica and a few other common species.

Arca (Bathyarca) glacialis (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-37 B-27	23.9	S. Belcher Ids.	M,S	110-125	1 v.

Arca (Bathyarca) pectunculoides (Scacchi 1833)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-37 B-27	23.9	S. Belcher Ids.	M,S	110-125	2 v.

Yoldia hyperborea (Loven) Torell hyperborea Ockelman 1954

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	1
58-28 B-19	10.9	Ottawa Ids.	"	115	1
58-33 B23	16.9	Sleeper Ids.	"	95	fragm.
58-37 B-27	23.9	S. Belcher Ids.	M,S	110-125	1

Yoldiella lenticula (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-28 B-19	10.9	Ottawa Ids.	M,R	115	6
58-33 B-23	16.9	Sleeper Ids.	"	95	1
58-15 B-12	10.7	N. Omarolluk Sd.	"	33	2

Portlandia arctica (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-36 B-26	21.9	S. Innetalling Id.	M,R	79-130	8

Nuculana pernula (Muller 1779)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-8a B-8	27.6	N. Omarolluk Sd.	M	40	many v.
58-9 B-10	5.7	S. Spence Harb.	M,R	19	1
58-15 B-12	10.7	N. Omarolluk Sd.	"	33	5 + v.
58-22 B-15	7.9	Kuvik Bay	"	100	v.
58-28 B-19	10.9	Ottawa Ids.	"	115	5
58-31 B-20	14.9	P. Harrison	M	20-29	2
58-33 B-23	16.9	SE Sleeper Ids.	M,R	90-95	many v.
58-36 B-26	21.9	S. Innetalling Id.	"	79-130	"

Nuculana buccata (Steenstrup 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-33 B-23	16.9	SE Sleeper Ids.	M,R	90-95	3

Nuculana minuta (Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-26 B-14	6.9	W. of Cape Smith	M	165	1

Nucula belloti Adams 1856

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-8a B-8	27.6	N. Omarolluk Sd.	M	40	8
58-22 B-15	7.9	Kuvik Bay	M,R	100	1
58-23 B-16	8.9	Cape Smith	S,G	7	1
58-26 B-17	"	W. of Cape Smith	M	165	2 v.
58-28 B-19	10.9	Ottawa Ids.	M,R	115	1 + 4 v.
58-31 B-20	14.9	P. Harrison	M	20-29	1 + 2 v.
58-33 B-23	16.9	SE Sleeper Ids.	M,R	90-95	35 + v.
58-36 B-26	21.9	S. Innetalling Id.	"	79-130	1
58-37 B-27	23.9	S. Belcher Ids.	M,S	110-125	1

Pecten (Chlamys) islandicus (Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-21 B-14	6.9	W. of Digges Id.	R	50-53	7

Musculus niger (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-26 B-17	8.9	W. of Cape Smith	M	165	2
58-28 B-19	10.9	Ottawa Ids.	M,R	115	5 + 2 v.

Crenella faba (Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-34 B-24	19.9	Trading Post	M,S,R	0-2	3

Mytilus pellucidus Pennant 1777

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-3 B-1	22.6	N. Omarolluk Sd.	R	6-7	2
58-8a B-8	27.6	"	M	40	1
58-34 B-24	19.9	Trading Post	M,S,R	0-2	24
58-34 B-25	"	"	"	"	1

Astarte striata (Leach 1819)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-34 B-5	25.6	Trading Post	M,S,R	0-2	10 + v.

Astarte warhami Hancock 1846

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-9 B-10	5.7	S. Spence Harb.	M,R	19	1
58-21 B-14	6.9	W. Digges Id.	R	50-53	2
58-23 B-16	8.9	Cape Smith	S,G	7	60

Astarte crenata (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-36 B-26	21.9	S. Innetalling Id.	M,R	79-130	3

Astarte borealis (Schumacher 1817)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58- B-5					3
58-23 B-16	8.9	Cape Smith	S,G	7	13

Venericardia borealis (Conrad 1831)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-21 B-14	6.9	W. Digges Id.	R	50-53	3 + 2 v.

Cardium ciliatum Fabricius 1780

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-23 B-16	8.9	Cape Smith	S,G	7	1
58-28 B-19	10.9	Ottawa Ids.	M,R	115	2
58-33 B-23	16.9	SE Sleeper Ids.	"	90-95	4
58-34 B-24	19.9	Trading Post	M,S,R	0-2	2

Serripes groenlandicus Bruggiere 1789

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-34 B-25	19.9	Trading Post	M,S,R	0-2	1

Macoma calcarea (Gmelin, 1872)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-8- B-8	27.6	N. Omarolluk Sd.	M	40	1
58-15 B-12	10.7	"	M,R	33	17
58-23 B-16	8.9	Cape Smith	S,G	7	11
58-26 B-17	"	W. Cape Smith	M	165	2 v.
58-31 B-20	14.9	P. Harrison	"	20-29	7 v
58-33 B-23	16.9	SE Sleeper Ids.	M,R	90-95	1
58-34 B-24	19.9	Trading Post	M,S,R	0-2	1
58-36 B-26	21.9	S.Innetalling Id.	M,R	79-130	2

Macoma balthica (Linne 1758)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-34 B-24	19.9	Trading Post	M,S,R	0-2	1
58-34 B-25	"	"	"	"	40

Macoma moesta (Deshayes 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	1

Mya truncata Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-3 B-1	22.6	N. Omarolluk Sd.	R	6-7	1
58-23 B-16	8.9	Cape Smith	S,G	7	1

Mya truncata var. uddevalensis Forbes 1876

58-	B-5				2

Mya pseudarenaria Schlesch 1931

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-31 B-20	14.9	P. Harrison	M	20-29	1 + 2 v.
58-34 B-24	19.9	Trading Post	M,S,R	0-2	1 ✓
58-34 B-25	"	"	"	"	1 ✓
58-31 B-20	14.9	P. Harrison	M	20-29	1 + v.

Hiatella arctica (Linne 1758)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-4 B-3	23.6	N. Omarolluk Sd.	R	6-7	5
58- B-5					many v.
58-9 B-11	5.7	S. Spence Harb.	M,R	19	6
58-15 B-12	10.7	N. Omarolluk Sd.	"	33	1
58-21 B-14	6.9	W. Digges Id.	R	50-53	1
58-32 B-21	15.9	Sleeper Ids.	"	12	3
58-33 B-22	16.9	SE Sleeper Ids.	M,R	90-95	3
58-34 B-24	19.9	Trading Post	M,S,R	0-2	1

Thyasira gouldii (Philippi 1845)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-9 B-10	5.7	S. Spence Harb.	M,R	19	9
58-15 B-12	10.7	N. Omarolluk Sd.	"	33	4
58-28 B-19	10.9	Ottawa Ids.	"	115	5
58-33 B-23	16.9	SE Sleeper Ids.	"	90-95	3

Axinopsida orbiculata (G. O. Sars 1878)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	2
58-23 B-16	8.9	Cape Smith	S,G	7	7

Thracia myopsis Möller 1842

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	3

Periploma abyssorum Verill 1893

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	2

Pandora glacialis Leche 1819

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-15 B-12	10.7	N. Omarolluk Sd.	M,R	33	12

Lyonsia arenosa (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
58-33 B-23	16.9	SE Sleeper Ids.	M,R	90-95	1

Littoral collections, 1958

L-2	Mytilus edulis L.	8 sp.
L-5, Sta. 5	Mytilus edulis L.	7 sp.
L-7	Mytilus edulis L.	5 sp.
	Macoma balthica L.	4 sp.
L-8	Mytilus edulis L.	1 sp.
L-9,Sta. 18	Mytilus edulis L.	3 sp.
	Crenella faba (Müller)	1 sp.
	Macoma balthica (L.)	1 sp.
	Macoma calcarea (Gmelin)	2 sp.

Appendix I - Part 4

4. List of species of the bivalve molluscs collected by the expedition of the Fisheries Research Board of Canada to the Belcher Islands, 1959.

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Nuculana pernula (O. F. Müller 1776)

Nuculana pernula costigera Leche 1882

Nuculana minuta (Müller 1776)

Nucula belloti Adams 1856

Portlandia arctica (Gray 1824)

Portlandia arctica var. portlandica Hancock 1846

Yoldiella lenticula (Möller 1842)

Delectopecten groenlandicus (Sowerby 1845)

Pecten (Chlamys) islandicus O. F. Müller 1776

Mytilus edulis Linne 1758

Mytilus pellucidus Pennant 1777

Musculus niger (Gray 1824)

Musculus discors var. laevigatus (Gray) Jensen 1912

Musculus discors var. substriatus (Gray) Jensen 1912

Musculus corrugatus (Stimpson 1851)

Crenella faba (O. F. Müller 1776)

Astarte borealis var. placenta Mörch 1857

Astarte striata (Leach 1819)

Astarte warhami Hancock 1846

Astarte crenata (Gray 1824)

Thyasira gouldii Philippi 1845

Thyasira equalis Verill and Bush 1898 (Fide Ockelmann 1958)

Cardium ciliatum Fabricius 1780

Macoma calcaria (Gmelin 1872)

Macoma balthica (Linne 1758)

Macoma torelli (Steenstrup) Jensen 1905

Macoma moesta (Deshayes 1854)

Macoma loveni (Steenstrup) Jensen 1905

Mya truncata Linne 1758

Mya pseudarenaria Schlesch 1931

Hiatella arctica (Linne 1767)

Cuspidaria subtorta (G. O. Sars 1878)

Pandora glacialis Leach 1878

Lyonsia arenosa (Möller 1842)

Thracia (Thracia) myopsis (Beck) Möller 1842

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-6 B-5	23.6	S. James Bay	M,S,R	65	1
59-15 B-13	10.7	Grey Goose Id.	M,R	55-63	1
59-36 B-27	9.8	S. Belchers	M	95-130	1
59-31 B-23	3.8	Belcher Ids.	M,R	102	1
59-66 B-49	31.8	Cape Maria	M	70	2
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1

Nucula belloti Adams 1856

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	2
59-40 B-29	10.8	Richmond Gulf	M	40-42	1
59-38 B-28	9.8	"	"	90-130	1
59-31 B-23	3.8	Belcher Ids.	M,R	102	6
59-45 B-35	12.8	SW Cotter Id.	R,M	50-91	1
59-48 B-35	16.8	Harrison-Marcopets	S	53-70	1
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	14
59-52 B-38	21.8	E. Eskimo Harb.	R	47	1
59-53 B-39	"	W. Omarolluk	"	18-22	1
59-58 B-44	26.8	Cape Jones	M,R	62-70	1
59-61 B-46	30.8	W. Bear Id.	M	51	3
59-66 B-49	31.8	Cape Maria	"	70	3
59-68 B-50	"	"	"	107	9
59-69 B-51	"	Kugony Id.	M,S,G	119-126	6
59-71 B-53	1.9	"	"	73	80

Nuculana pernula costigera (Leche 1883)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-6 B-5	23.6	S. James Bay	M,S,R	65	4
59-15 B-13	10.7	Grey Goose Id.	M,R	55-63	1
59-16 B-14	12.7	S. Belcher Ids.	"	62-65	1
59-28 B-21	31.8	"	"	9-18	1
59-31 B-23	3.8	Belcher Ids.	"	102	2
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	1
59-48 B-35	16.8	Harrison-Marcopeets S		53-70	12
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	7
59-52 B-38	21.8	E. Eskimo Harb.	R	47	4
59-61 B-46	31.8	W. Bear Id.	M	51	11
59-66 B-49	"	Cape Maria	"	70	28
59-68 B-50	"	"	"	107	7
59-69 B-51	"	Kugony Id.	M,S,G	119-126	3
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	3
59-71 B-53	1.9	Kugony Id.	M,S,G	73	20

Nuculana minuta (O. F. Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	3
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	7
59-66 B-49	31.8	Cape Maria	M	70	1
59-69 B-51	31.8	Kugony Id.	M,S,G	119-126	1

Portlandia arctica (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-11 B-10	30.6	James Bay	M,R	22	30
59-11 B-11	"	"	"	"	4
59-13 B-12	1.7	"	M,S	12	5
59-40 B-29	10.8	Richmond Gulf	M	40-42	28
59-41 B-30	"	"	"	60	3
59-43 B-32	11.8	"	"	120	1
59-61 B-46	30.8	W. Bear Id.	"	51	45
59-72 B-54		"	"	95	many

Yoldiella lenticula (Møller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-36 B-27	9.8	S. Belchers	M	95-130	16 + v.
59-38 B-28	"	Richmond Gulf	"	90-130	4
59-40 B-29	10.8	"	"	40-42	2
59-52 B-38	21.8	E. Eskimo Harb.	R	47	1
59-61 B-46	30.8	W. Bear Id.	M	51	52
59-68 B-50	"	Cape Maria	"	107	60
59-69 B-51	31.8	Kugony Id.	M,S,G	119-126	4
59-71 B-53	1.9	"	"	73	2
59-28 B-21	21.8	S. Belcher Ids.	M,R	9-18	1
59-72 B-54		W. Bear Id.	M	95	many

Delectopecten groenlandicus (Sowerby 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-4 B-4	22.6	W. Weston Id.	S,R	60	1
59-15 B-13	10.7	Grey Goose Id.	M,R	55-63	1
59-26 B-19	25.7	Manitounuk Id.	M	82-90	115
59-31 B-23	3.8	Belcher Ids.	M,R	102	1
59-36 B-27	9.8	S. Belchers	M	95-130	50
59-38 B-28	"	Richmond Gulf	"	90-130	42
59-43 B-32	11.8	"	"	120	4
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	4
59-56 B-42	21.8	W. Omarolluk	"	42-47	7
59-61 B-46	30.8	W. Bear Id.	M	51	many v.
59-68 B-50	31.8	Cape Maria	"	107	1

Pecten (Chlamys) islandicus O. F. Müller 1776

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-21 B-16	21.7	Cape Bartlett	R	36	6
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	5
59-48 B-35	16.8	Harrison-Marcopeets	S	53-70	2 + v.
59-50 B-36	"	"	R	36-60	8 + v.
59-52 B-38	21.8	E. Eskimo Harb.	"	47	6 + v.
59-53 B-39	"	W. Omarolluk	"	18-22	1 + v.
59-56 B-42	"	"	R,M	42-47	1 + v.
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1 + v.

Mytilus edulis Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-6 B-6	23.6	S. James Bay	M,S,R	65	1 v.
59-8 B-7	27.6	SE James Bay	M	18	2 v.
59-15 B-13	10.7	Grey Goose Id.	M,R	55-63	2 v.
59-28 B-21	31.8	S. Belcher Ids.	"	9-18	11
59-36 B-27	9.8	S. Belchers	M	95-130	3 v.
59-41 B-30	11.8	Richmond Gulf	"	3-17	20
59-55 B-41	21.8	NE Belchers	R	18	10
59-3 L-1	21.6	S. James Bay			5
59-8 B-7		SE James Bay	M	18	10

Mytilus pellucidus Pennant 1777

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-10 B-9	29.6	James Bay	M	2-6	15
59-5 L-2	22.6	"		shore	many old v.
59-17 L-4		S. of Belchers			many
59-24 L-5	22.7	E. Hudson Bay		shore	"
59-48 L-7	11.8	Harrison-Marcopeets			"

Musculus discors var. laevigatus (Gray 1824) Jensen 1912

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-4 B-4	22.6	W. Weston Id.	S,R	60	4
59-9 B-8	27.6	James Bay	M	17-24	2
59-11 B-10	30.6	"	M,R	22	29
59-11 B-11	"	"	"	"	1
59-15 B-13	10.7	Grey Goose Id.	"	55-63	2
59-66 B-49	31.8	Cape Maria	M	70	v.

Musculus discors var. substriatus (Gray 1824) Jensen 1912

59-21 B-16	21.7	Cape Bartlett	R	36	1
59-36 B-27	9.8	S. Belchers	M	95-130	1
59-53 B-39	21.8	W. Omarolluk	R,M	42-47	1
59-69 B-51	31.8	Kugony Id.	M,S,G	119-126	1
59-28 B-21	31.7	S. Belcher Ids.	M,R	9-18	1

Musculus corrugatus (Stimpson 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-6 B-5	23.6	S. James Bay	M,S,R	65	3
59-68 B-50	31.8	Cape Maria	M	107	1
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1

Musculus niger (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-48 B-35	16.8	Harrison-Marcopeets	S	53-70	1
59-66 B-49	31.8	Cape Maria	M	70	v.
59-69 B-51	"	Kugony Id.	M,S,G	119-126	1

Crenella faba (Müller 1776)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-11 B-10	30.6	James Bay	M,R	22	17
59-36 B-27	9.8	S. Belchers	M	95-130	2
59-29 B-22	3.8	Hudson Bay	R	37-40	2

Astarte crenata (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-4 B-4	22.6	W. Weston Id.	S,R	60	20
59-6 B-5	23.6	S. James Bay	M,S,R	65	1
59-11 B-10	30.6	James Bay	M,R	22	13
59-11 B-11	"	"	"	"	2
59-15 B-13	10.7	Grey Goose Id.	"	55-63	33 + v.
59-15 B-13	"	"	"	"	4
59-16 B-14	12.7	S. Belcher Ids.	"	62-65	1
59-33 B-24	6.8	Hudson Bay	R	67-93	1
59-36 B-27	9.8	S. Belchers	M	95-130	1
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	81
59-58 B-44	26.8	Cape Jones	M,R	62-70	1

Astarte striata (Leach 1819)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-48 B-35	16.8	Harrison-Marcopeets	S	53-70	25
59-50 B-36	"	"	R	36-60	8

Astarte warhami Hancock 1846

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	11
59-52 B-38	21.8	E. Eskimo Harb.	R	47	1
59-71 B-53	1.9	Kugony Id.	M,S,G	73	16

Astarte borealis (Chemnitz 1784)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-11 B-10	30.6	James Bay	M,R	22	16

Thyasira gouldii Philippi 1845

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-11 B-10	30.6	James Bay	M,R	22	7
59-71 B-53	1.9	Kugony Id.	M,S,G	73	3

Thyasira equalis Verill and Bush 1898 (fide Ockelmann 1958)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	1

Cardium (Clinocardium) ciliatum Fabricius 1780

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-9 B-8	27.6	James Bay	M	17-24	many v.
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	1
59-21 B-16	21.7	Cape Bartlett	R	36	1
59-28 B-21	31.8	S. Belcher Ids.	M,R	9-18	1
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	1 + v.
59-48 B-35	16.8	Harrison-Marcopeets	S	53-70	many v.
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	18 + v.
59-52 B-38	21.8	E. Eskimo Harb.	R	47	2 + v.
59-66 B-49	31.8	Cape Maria	M	70	many v.
59-68 B-50	31.8	"	M	107	1
59-61 B-46	"	W. Bear Id.	M	51	3
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1

Macoma balthica (Linne 1758)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-1 B-1	20.6	James Bay	M,R	9	40
59-4 B-4	22.6	W. Weston Id.	S,R	60	1
59-6 B-5	23.6	S. James Bay	M,S,R	65	v.
59-13 B-12	1.7	James Bay	M,S	12	3
59-41 B-30	10.8	Richmond Gulf	M	60	3
59-61 B-46	30.8	W. Bear Id.	M	51	1

Macoma calcarea (Gmelin 1872)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-6 B-5	23.6	S. James Bay	M,S,R	65	2
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	30
59-31 B-23	3.8	Belcher Ids.	"	102	3
59-36 B-27	9.8	S. Belchers	M	95-130	1
59-38 B-28	"	Richmond Gulf	M	90-130	5 + v.
59-57 B-37	20.8	Hudson Bay	R	32	many v.
59-68 B-50	31.8	Cape Maria	M	107	1 v.
59-69 B-51	"	Kugony Id.	M,S,G	119-126	2
59-71 B-53	1.9	Kugony Id.	S,M,G	73	3

Macoma torelli (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	1
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1

Macoma moesta (Deshayes 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-71 B-53	1.9	Kugony Id.	M,S,G	73	1
59-68 B-50	31.8	Cape Maria	M	107	1
59-36 B-27	9.8	S. Belchers	M	95-130	1

Macoma loveni (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-45 B-33	12.8	SW Cotter Id.	R,M	50-91	1

Mya truncata Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-48 L-1	11.8	Harrison-Marcopeets		shore	1
59-27 B-20	29.7	Belcher Ids.			1
59-50 B-36	16.8	Harrison-Marcopeets	R	36-60	1
59-51 B-37	20.8	N. of Belchers	M,S,R	59-94	1
59-52 B-38	21.8	E. Eskimo Harb.	R	47	1

Mya pseudarenaria Schlesch 1931

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-28 B-21	31.7	S. Belcher Ids.	M,R	9-18	4 v.

Hiatella arctica (Linne 1767)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-4 B-4	22.6	W. Weston Id.	S,R	60	2
59-9 B-8	27.6	James Bay	M	17-24	1
59-11 B-11	30.6	"	M,R	22	1
59-13 B-12	1.7	"	M,S	12	1
59-21 B-16	21.7	Cape Bartlett	R	36	1
59-28 B-21	31.7	S. Belcher Ids.	M,R	9-18	20
59-41 B-30	10.8	Richmond Gulf	M	60	many
59-50 B-36	16.8	Harrison-Marcopeets	R	36-60	4
59-52 B-38	21.8	E. Eskimo Harb.	R	47	30
59-53 B-39	"	W. Omarolluk	R,M	18-22	47
59-54 B-40	"	Belcher Ids.	R	15	5
59-55 B-41	"	NE Belchers	R	18	9

Cuspidaria subtorta (G. O. Sars 1878)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-43 B-32	11.8	Richmond Gulf	M	120	many

Pandora glacialis Leach 1878

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-52 B-38	21.8	E. Eskimo Harb.	R	47	2
59-61 B-46	31.8	W. Bear Id.	M	51	3

Lyonsia arenosa (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-61 B-46	31.8 W.	Bear Id.	M	51	1 v.

Thracia (Thracia) myopsis (Beck) Möller 1842

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
59-16 B-14	12.7	S. Belcher Ids.	M,R	62-65	1

Appendix I - Part 5

5. List of bivalve molluscs from Ungava Bay, Hudson Bay, Hudson Strait, Cumberland Sound and Frobisher Bay, collected by the expeditions of the Fisheries Research Board of Canada in 1947-54.

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954.

Nuculana pernula (Muller 1779).

Nuculana pernula var. costigera Leche 1883.

Nuculana buccata (Steenstrup 1842).

Nuculana minuta (Müller 1776).

Nucula belloti Adams 1856.

Pecten (Chlamys) islandicus (Müller 1776).

Delectopecten groenlandicus (Sowerby 1842).

Mytilus edulis Linne 1758.

Musculus niger (Gray 1824).

Musculus discors var. laevigatus (Gray 1824).

Musculus discors var. substriatus (Gray 1824).

Musculus corrugatus (Stimpson 1851).

Crenella faba (Müller 1776).

Crenella decussata (Montagui 1808).

Astarte borealis (Schumacher 1817).

Astarte borealis var. placenta Mörch 1877.

Astarte borealis var. arctica Gray 1824.

Astarte montagui (Dillwyn 1817).

Astarte warhami Hancock 1846.

Astarte striata (Leach 1819).

Astarte banksi (Leach 1819).

Astarte fabula Reeve 1855.

Astarte globosa Möller 1842.

Venericardia borealis (Conrad 1831).

Thyasira gouldii (Philippi 1845).

Cardium (Clinocardium) ciliatum Fabricius 1780.

Serripes groenlandicus Bruggiere 1789.

Macoma calcarea (Gmelin 1792).

Macoma balthica (Linne 1758).

Macoma moesta (Deshayes 1854).

Macoma torelli (Steenstrup) Jensen 1905.

Mya truncata Linne 1758.

Mya truncata var. uddevalensis Forbes 1846.

Mya truncata ovata Jensen 1900.

Hiatella arctica (Linne 1758).

Cyrtodaria kurriana Dunker 1862.

Periploma abyssorum (Verill MS) Bush 1893.

Pandora (Kennerlia) glacialis Leche 1819.

Thracia (Thracia) myopsis Möller 1842.

Thracia (Crassithracia) septentrionalis Jeffrey 1872.

Lyonsia arenosa (Möller 1842).

Yoldia hyperborea (Loven) Torell hyperborea Ockelmann 1954

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
102/2	30.6.49	Forbes Sound	R,M	90-130	1 v.
201/1	29.6.50	Adlorilik	M	80-100	20
234/16	31.8.50	Adlorilik W.	M	82-90	1
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Strait	R,S	70-75	14
612/7	10.8.54	NW Cape Pembroke	C	225	1 v.
613/11	11.8.54	C. Pembroke	R,S,M	198	9
611/6	10.8.54	Benkas-Coats Id.	R,S	49	6
526/8	8.8.53	Nuvuk	M,R	50-53	2
		Cumberland Sound, 1951-52			
416/6	6.8.52	Quickstep Harb.	M	279	2

Nuculana pernula (Müller 1779)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
102/2	30.6.49	Forbes Sd.	R,M	90-130	many v.
231/13	27.8.50	Adlorilik	R,M	63-90	1
201/1	29.6.50	"	M	"	1
33/16	10.8.47	Keglo Bay	R,M	18-27	2 many v.

Nuculana pernula costigera Leche 1883

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Str.	R	73-75	11
610/5	10.8.54	Benkas Id.	S,M,R	36	2
611/6	10.8.54	"	R,S	49	19
613/11	11.8.54	C. Pembroke	R	144	14
614/14	12.8.54	C. Pembroke	S	13-18	1 v.
		Cumberland Sound, 1952			
416/6	6.8.52	Clearwater Fjd.	M	274-284	1 v.

Nuculana buccata (Steenstrup 1842)

Station No.	Date	Location	Bottom	Depth m	No. of Sps.
		Hudson Bay, 1943-54			
526/8	8.8.53	Nuvuk	M	50-53	½ v.

Nuculana minuta (Müller 1776)

Station No.	Date	Location	Bottom	Depth m	No. of Sps.
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Strait	R	73-75	6
610/5	10.8.54	Benkas-Coats	S,M,R	36	1 v.
611/6	"	"	R,S	49	4
613/11	11.8.54	Pembroke	M	198	1 v.
542/13	27.8.53	Schooner Harbour	M	0-38	1 v.
		Ungava Bay, 1947-51			
107/6-49	7.7.49	Forbes Sd.	R,M	55-73	1
103/7	7.8.49	Burwell		145-275	1
102/2	30.6.49	Forbes Sd.	R,M	90-130	5
13/7	18.7.47	Hopes-Advance		46-55	many v.

Nucula belloti Adams 1856

Station No.	Date	Location	Bottom	Depth m	No. of Sps.
		Hudson Bay and Strait, 1953-54			
526/8	8.8.53	Nuvuk	M	50	2
613/11	11.8.54	Coats Id.	M,S	198	4
		Ungava Bay, 1947-51			
234/16	31.8.50	Adlorilik	M	50	2
33/16	10.8.47	Keglo Bay	M	27	8 N. tenuis f. inflata sensu Gould 1871
		Cumberland Sound, 1951-52			
416/6	6.8.52	Clearwater Fjd.	M	273	2
		Frobisher Bay, 1951-52			
329/10	21.8.51	Victoria Bay	M	100	4

Pecten (Chlamys) islandicus (Müller 1776)

Station No.	Date	Location	Bottom	Depth m	No. of Sps.
		Ungava Bay, 1947-51			
126/11	23.8.49	Payne-Ampatok	R	70-91	12
208/4	20.7.50	Cape Hopes Advance	R	80-90	5
210/5	21.7.50	Diana Bay	R	90-100	7
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Str.	R	73-75	2
611/6	10.8.54	Benkas-Coats	R	49	1
526/8	8.8.54	Nuvuk	M,R	55-82	5 v.
520/5	4.8.54	Mansel Id.	R	73-137	5 v.
609/4	10.8.54	Benkas-Coats	R	18	1
616/16	16.8.54	Walrus Id.	R	85-90	2
		Frobisher Bay, 1951-52			
319/6	11.8.51	Mouth of the Bay	R	113-118	1 v.
		Cumberland Sound, 1951-52			
413/5	5.8.52	Quickstep Harbour		shore	3

Delectopecten groenlandicus (Sowerby 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Str.	R,S	73-75	10
603/1	4.7.54	NE Coats Id.	R	108	2
611/6	10.8.54	Benkas-Coats	R	49	2
612/7	10.8.54	Cape Pembroke	C	225	2
613/9	11.8.54	"	R,S,M	198	2
613/10	"	"	"	"	35
613/11	"	"	"	"	34

Mytilus edulis Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
212L8	21.7.50	Diana Bay		shore	5
208L7	21.7.50	Cape Hopes Advance		"	4
215L9	24.7.50	Diana Bay		"	2
31L4	5.8.47	Koksoak River		"	1
5L8	29.6.47	Leaf Bay - Koksoak		"	20 v.
8L11	5.7.47	Leaf Bay		"	1
107L1	11.7.49	Forbes Sd.		"	4
224L15	18.8.50	P. Burwell		"	4
64L4	4.7.48	False River		"	1
66L3	7.8.48	Burwell		"	38
		Hudson Bay and Strait, 1953-54			
513L2	29.7.53	Mansel Id.		0-9	5 v.
519L4	4.8.53	"		"	6 v.
528L6	9.8.53	Erik Cove		0-36	6
525L5	8.8.53	Nuvuk		0-9	8
555L2	21.9.53	Churchill		0	5
504L1	23.7.53	Chesterfield Inlet		0-7	3 v.
217L11	30.7.53	Wakeham Bay		0-18	8

Musculus niger (Gray 1824)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
107/6	7.7.49	Forbes Sd.	R,M	55-73	1
102/2	30.6.49	"	"	90-130	4
201/1	29.6.50	Adlorilik	M	100	1
231/13	27.8.50	"	R,M	63-90	1
33/16	8.8.47	Keglo Bay	"	18-27	1
		Hudson Strait and Bay, 1953-54			
542/13	27.8.53	Schooner Harbour		0-38	1
610/5	10.8.54	Benkas-Coats	S,M,R	30	3
611/10	11.8.54	"	R,S	49	5
613/11	"	C. Pembroke	M	198	2
		Frobisher Bay, 1951-52			
321/7	11.8.51	Mouth of Frob. Bay	R	71	1
		Cumberland Sound, 1951-52			
416/6	6.8.52	Clearwater Fjd.	M	274-284	1

Musculus discors var. laevigatus (Jensen 1912)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
226/12	13.8.50	Button Ids.	R	90-100	3
225/11	12.8.50	"	R		1
67 L4	8.8.48	Burwell			2
107/6	7.7.49	Forbes Sd.	R,M	55-73	1
231/13	27.8.50	Adlorilik	R,M	63-90	1
33/14	8.8.47	Keglo Bay	R,M	18-27	11
33/16	10.8.47	"	R,M	"	6
3/1	29.6.47	Koksoak	R	28	1
203/2	8.7.50	Inuksulok	M	30	3
53/1	10.7.48	Koksoak River	M	16-17	1
27/10	19.7.47	Leaf Bay	R	47	1
20-21/6	18.7.47	Payne Bay	R,S,M	64	1
13/7	"	Hopes Adv. Bay	R,S	46-55	2
		Hudson Bay and Strait, 1953-54			
533/10	14.8.53	Cape Dorset	M,R	12	1
542/13	27.8.53	Schooner Harb.	M,R	0-38	2
613/9	11.8.54	C. Pembroke	M	198	1
613/10	"	"	M	"	1
613/11	"	"	M	"	1
616/16	16.8.54	Walrus Id.	R	85-90	6
622 LD10		C. Dorset			1
12c LD8					1

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Frobisher Bay, 1951-52			
322/9	12.8.51	C. of Warwick Sd.	S,G	119	4
333/12	24.8.51			104-137	1
329/10	21.8.51	Victoria Bay	M	183	1
317/1	9.8.51	C. of Warwick Sd.	R	27-36	3
331/11	22.8.51	"		77	7
		Cumberland Sound, 1951-52			
413/5	5.8.52	Quickstep Harb.		shore	1
418/7	15.8.52	Ptarmigan Fd.	M	18-55	4

Musculus discors var. substriatus (Jensen 1912)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
226/12	13.8.50	Button Ids.	R	90-100	26
67 I4	8.8.48	Burwell		shore	27
103/4	6.7.49	W. P. Burwell	R	142-275	1
58ba2	28.7.48	"	S,R	20	1
232/18	27.8.50	Adlorilik	R,M	10	1
33/14	8.8.47	Keglo Bay	R,M	18-27	1
33/16	10.8.47	"	"	"	1
30/12	20.7.47	Koksoak R. Mouth	R	36	1
3/1	29.6.47	N. of Koksoak River	R	28	1
27/10	19.7.47	Leaf Bay	R	47	8
126/11	23.8.49	Payne-Ampatok	R	70-91	2
		Hudson Strait and Hudson Bay, 1953-54			
547/15	3.9.53	Seahorse Pt.	R	73	20
613/11	11.8.54	C. Pembroke	M	198	5
		Frobisher Bay, 1951-52			
317/1	9.8.51	C. Warwick Sd.	R	27-36	12
406/3	22.7.52	"	R	46	1

Musculus corrugatus (Stimpson 1851)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
106/5	7.7.49	Burwell, C. Smith	R	100-110	1
201/1	29.6.50	Adlorilik	M	80-100	1
33/16	10.8.47	Keglo Bay	R,M	18-27	1
203/2	8.7.50	Inuksulok	M	30	3

Crenella faba (O. F. Müller 1776)

Station No.	Date	Location	Bottom	Depth M	No. of Sps.
		Ungava Bay, 1947-51			
64 L1	4.7.48	False River		shore	1
Ia L3		Koksoak River			2
65 L2	4.7.48	"		shore	100
5 L8	29.6.47	Leaf Bay, Koksoak R.			1
215 L9	24.7.50	Diana Bay South		shore	3
229 L17	28.8.50	Adlorilik		0-13	3
40 L15	16.8.47	Keglo Bay		shore	1
224A L15	18.8.50	Outer Burwell		18-60	2
67 L4	8.8.48	Burwell		shore	4
66 L3	7.8.48	"		"	6
66 L3	"	"		"	5
52/20	30.8.47	N. of False River	S,R	16-17	108
53/1	10.7.48	Mouth Koksoak R.	S,R	9	3
3/1	29.6.47	Koksoak	M	28	4
203/2	8.7.50	Inuksulok	M	30	1
28/11	19.7.47	Leaf Bay	R	27	4
234/16	21.8.50	Adlorilik	R,M	82-90	5
45/17	23.8.47	Burwell	R,M	27-37	1
103/7	7.8.49	"	R	145-255	5
58/3	28.7.48	Burwell	S,R	20	47
225/11	12.8.50	Button Ids.	R	22	50

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay and Strait, 1953-54			
549 L4	4.8.53	Evans Str.			2
528 L6	9.8.53	Erik Cove		0-36	2
534 L8	16.8.53	Cape Dorset		12	3
542 L9	28.8.53	Schooner Harb.		0-38	1
622 LD11	14.8.54	C. Dorset		0-30	1
622 LD10	14.8.54	"		"	11
624 LD3	13.8.54	Keltie Inlet		shore	2
625 LD4	13.8.54			"	2
625 LD6	54			"	2
LD7 D23d	54				1
523/6	5.8.53	Nuvuk	R	7-20	3
542/14	27.8.53	Schooner Harb.		0-38	1
547/15	3.9.53	Seahorse Pt.	R	73	1
614/14	12.8.54	C. Pembroke	S	13-18	1
609/4	10.8.54	Benkas-Coats Id.	R	18	2
217 L11	30.7.50	Wakeham Bay		18	4
		Frobisher Bay, 1951-52			
317/1	9.8.51	C. Warwick Sd.	R	27-36	1
94bA2	23.8.48	Sylvia G. River	R	60	1
		Cumberland Sound, 1951-52			
418 L2	14.8.52	Ptarmigan Fd.		shore	2
413 L2/2	5.8.52	Quickstep Harbour		"	1
413 L2/3	"	"		"	2
412 L5	10.8.52	Pangnirtung		"	3

Crenella decussata (Montagu 1808)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
P 26	18.7.47				2

Astarte arctica (Gray 1824)

Station No.	Date	Location	Bottom	Depth	No. of Sps.
		Ungava Bay, 1947-51			
212/6	22.7.50	Diana Bay	R	3-18	1
45/18	23.8.47	Burwell	R,M	27-37	1

Astarte globosa Möller 1842

Station No.	Date	Location	Bottom	Depth	No. of Sps.
		Ungava Bay, 1947-51			
126/11	23.8.49	Akpatok	R	70-91	1

Astarte warhami Hancock 1846

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
20-21/6	18.7.47	Payne Bay	R,S,M	64	3
30/12	20.8.47	Koksoak River	R	36	2
33/16	10.8.47	Keglo Bay	R,M	18-27	2 v.
33/14	8.8.47	"	"	"	2 v.
102/2	30.6.49	Forbes Sound	"	90-130	5
231/13	27.8.50	Adlorilik	"	63-90	7
		Hudson Bay and Strait, 1953-54			
533/10	14.8.53	C. Dorset	M,R	12	1
542/13	27.8.53	Schooner Harb.	R	0-38	5

Astarte striata (Leach 1819)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
30/12	20.8.47	Koksoak River	R	36	2
18P26	17.7.47				1
210/5	21.7.50	Diana Bay	R	90-100	1
102/2	30.6.49	Forbes Sound	R,M	90-130	v.
216/8	24.7.50	Diana Bay	R	18-20	7
212/7	22.7.49	"		3-18	1
		Hudson Bay and Strait, 1953-54			
542/13	27.8.53	Schooner Harb.	R	0-38	1
549/16	4.9.53	Evans Str.	"	73-75	1 v.
534 L8	16.8.53	C. Dorset		0-30	1 v.
526/8	8.8.53	Nuvuk	M,R	50-53	1 v.
547/15	3.9.53	Seahorse Pt.	R	73	5
		Frobisher Bay, 1951/52			
406/3	22.7.52	C. Warwick Sd.	R	46	1
418/7	15.8.52	Ptarmigan Fjd.	M	18-55	1
317/1	9.8.51	C. Warwick Sd.	R	27-36	1

Astarte borealis (Schumacher 1817)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
123 L8	10.8.49	Button Ids.		shore	1
231/13	27.8.50	Adlorilik	R,M	63-90	6
203/2	8.7.50	Inuksalik	M	30	3
17/5	18.7.47	Payne Bay	R,S	62	1
126/11	23.8.49	Payne-Akpatok	R,S	70-91	2
216/8	24.7.50	Diana Bay	R	18-20	1
20-21/6	18.7.47	Payne Bay	R,S,M	64	1
45/18	23.8.47	Burwell	R,M	27-37	4
12 L13	12.8.47	Hopes Adv. Bay		4-5	1
102/2	30.6.49	Forbes Sd.	R,M	90-130	1, 3 v.
126/11	23.8.47	Payne Bay-Akpatok	R,S	70-91	1
		Hudson Bay and Strait, 1953-54			
534/12	26.8.53		R	20-30	v.
542/14	27.8.53	Schooner Harb.		65-74	v.
542/13	"	"	R	0-38	5
528 L6	9.8.53	Erik Cove			v.
525 L5	"	Nuvuk			v.
547/15	3.9.53	Seahorse Pt.	R	73	v.

Astarte borealis placenta Mörch 1857

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
107/6	7.7.49	Forbes Sd.	R,M	55-73	2
33/14	8.8.47	Keglo Bay	"	18-27	2
203/2	8.7.50	Inuksalik	M	30	3

Venericardia borealis (Conrad 1831)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
107/6	7.7.49	Forbes Sd.	R,M	55-73	3
106/5	7.7.49	Burwell	R	100-110	3, 3 v.
102/2	30.6.49	Forbes Sd.	R,M	90-130	2
45/8	23.8.47	Burwell	R,M	27-37	3, 4 v.
232/14	27.8.50	Adlorilik	R,M	10	1
231/13	27.8.50	"	"	63-90	2 v.
33/14	8.8.47	Keglo Bay	R,M	18-27	10
33/16	10.8.47	"	"	"	3
126/11	23.8.49	Akpatok	R	70-90	10, 6 v.

Thyasira gouldii (Philippi 1845)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
102/2	30.6.49	Forbes Sd.	R,M	90-130	1
20-21/1	18.7.47	Payne Bay	R,S,M	64	1
216/8	24.7.50	Diana Bay	R	18-20	8
		Hudson Bay and Hudson Strait, 1953-54			
547/16	4.9.53	Seahorse Pt.	R	73	1

Cardium (Clinocardium) ciliatum Fabricius 1780

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
102/2	30.6.49	Forbes Sd.	R,M	90-130	5
201/1	29.6.50	Adlorilik	M	0-12	6
232/14	27.8.50	"	R,M	10	1
33/16	10.8.47	Keglo Bay	R,M	18-27	23
20-21/6	18.7.47	Payne Bay	R,S,M	53	2
126/11	23.8.49	Akpatok	R	70-91	1
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Str.	R,S	73-75	18
611/10	10.8.54	Benkas-Coats	R,C	18	12

Serripes groenlandicus Bruggiere 1789

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
231/13	27.8.50	Adlorilik	R,M	63-90	1
		Hudson Bay and Strait, 1953-54			
549/16	4.9.53	Evans Str.	R	73-75	1
610/5	10.8.54	Benkas-Coats	S,M,R	18	1 v.
611/6	"	"	R,S	49	3 v.
614/14	12.8.54	C. Pembroke	S	13-18	1
		Frobisher Bay, 1951-52			
319/6	11.8.51	Mouth of Frob. Bay	R	113-118	1 v.

Macoma calcarea (Gmelin 1792)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
107/6	7.7.49	Forbes Sd.	R,M	55-73	1
102/2	30.6.49	Forbes Sd.	"	90-130	7
45/18	23.8.47	P. Burwell	"	27-37	4
231/13	27.8.50	Adlorilik	"	63-90	17
33/16	10.8.47	Keglo Bay	"	18-27	5
216/6	24.7.50	Diana Bay	R	18-20	26
102/2	30.6.49	Forbes Sd.	R,M	90-130	many v.
20-21 B6	18.7.47	Payne Bay	R,S,M	64	v.
		Hudson Bay and Strait, 1953-54			
526/8	8.8.53	Nuvuk Harb.	M,R	50-53	2
542/13	27.8.53	Schooner Harb.	R	0-38	18
549/16	4.9.53	Evans Str.	R	73-75	16
610/5	10.8.54	Benkas-Coats	S,M,R	36	1
613/10	11.8.54	C. Pembroke	R	198	4
622LD10					1
607/2	9.8.54	S. Coats	R	14	many v.
612/7	10.8.54	C. Pembroke	R,S,M	225	"
		Frobisher Bay, 1951-52			
319/6	11.8.51	M. of Frobisher B.	R	113-118	1
318/3	9.8.51	C. Warwick Sd.	R	55	v.
329/10	21.8.51	Victoria Bay		183	many v.

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Cumberland Sound, 1951-52			
416/6	6.8.52	Clearwater Fjd.	M	274-284	v.

Macoma balthica (Linne 1758)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
1A L6	24.6.47	Koksoak River	M,S	18-31	13
		Cumberland Sound, 1951-52			
412 L5	10.8.52	Pangnirtung		shore	5
418 L7	52	Ptarmigan Fjd.		"	7

Macoma moesta (Deshayes 1854)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
231/13	27.8.50	Adlorilik	R,M	63-90	2
33/16	10.8.47	Keglo Bay	"	18-27	11
		Hudson Bay and Strait, 1953-54			
611/6	10.8.54	Benkas-Coats	R,C	49	1

Macoma torelli (Steenstrup) Jensen 1905

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay and Strait, 1953-54			
216/8	24.7.50	Diana Bay	R	18-20	1
613/11	11.8.54	C. Pembroke	R,S,M	198	1

Mya truncata Linne 1758

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-1951			
67 L4	8.8.48	Burwell		shore	12 f. uddevalensis
48/18	25.8.47	"	R,M	14-18	3 f. uddevalensis
215/L9	24.7.50	Diana Bay		shore	2 f. uddevalensis
102/2	30.6.49	Forbes Sd.	R,M	90-130	"
107	7.7.49	"		shore	many v.
208	20.7.50	"		"	"
L7	1952			"	4 f. typica
		Hudson Bay and Hudson Strait, 1953-54			
610/5	10.8.54	Benkas-Coats	S,M,R	36	5, 3 v. f. typica
611/6	10.8.54	"	R,S	49	3, 9 v. f. uddevalensis
614/14	12.8.54	C. Pembroke	S	13-15	17
525 L5	8.8.53	Nuvuk Harb.		0-9	2, many v. f. uddevalensis
622LD10		C. Dorset		0-30	2 f. uddevalensis
217 L11	30.7.50	Wakeham Bay		shore	8 f. typica
534	15.7.53				many v.
533	14.8.53				"
319	11.8.53				"

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Cumberland Sound, 1951-52			
417 L4	7.8.52	Clearwater Fjd.	M	shore	2
413 L2(3)	5.8.52	Quickstep Harb.		"	2
412 L5	10.8.52	Pangnirtung		"	7
412 L7				"	3
		Mya truncata f. ovata Jensen 1900			
		Forbes Sound, Ungava Bay, 1947-51			
107/6	7.7.49		R,M	55-73	1 v.

Hiatella arctica (Linne 1758)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
67 L4	8.8.48	Burwell		shore	5
45/18	23.8.47	P. Burwell	R,M	27-37	2
102/7	7.8.49	"	"	shore	3
201/1	29.6.50	Adlorilik		10-12	1
231/13	27.8.50	"	R,M	63-90	1
234/16	31.8.50	"	"	82-90	8
33/14	8.8.47	Keglo Bay	"	18-27	45
33/16	"	"	"	"	1
25/9	19.7.47	Gyrfalcon Id.	R	35	1
28/11	"	Leaf Bay	R	27	1
27/10	"	"	R	47	2
208/4	20.7.50	C. Hopes Advance	R	80-90	3
210/5	21.7.50	Diane Bay	R	90-100	9

Stations 229, 1950; 106, 1949; 30, 1947; 28, 1947; 126, 1949; 208, 1950 contain many shells.

		Hudson Bay and Hudson Strait, 1953-54			
217/9	30.7.50	Wakeham Bay	R	0-18	2
502/1	13.7.53	Churchill	R	22-27	11
553/19	13.9.53	Term Point	R	30-73	1
608/3	9.8.54	Coats Id. W.	R	32	5
611/6	10.8.54	Benkas Coats	S,C	18	2
614/4	12.8.54	C. Pembroke	S	13-18	2

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
615/15	16.8.54	Walrus Id.	R	18-36	1
616/16	16.8.54	"	R	85-90	3
625LD6					2
12cLd8					2
D23d,LD7					1
L38					1
622LD10					5
549/16	4.9.53	Evans Str.	R	73-75	3
514	31.7.53	Coats Id.	R	9	many v.
607	9.8.54	"	R	14	"
612	10.8.54	C. Pembroke	R,S,M	225	"
613	11.8.54	"	R	198	"
547	3.9.53	Seahorse Pt.	R	13	"
		Frobisher Bay, 1951-52			
317/1	9.8.51	C. of Warwick Sd.	R	27-36	7
331/11	23.8.51	"		77	4
333/12	24.8.51	"		104-137	1
334/13	24.8.51	"		183-192	2
406/3	22.7.52	"	R	46	10
317	9.8.51	"	R	27-36	many v.
318	9.8.51	"	R	55	"
321	11.8.51	M. of Frobisher Bay	R	71	"

Cyrtodaria kurriana Dunker 1862

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay, 1953-54			
622LD10	17.8.54		R	0-30	3
12cLD8	17.6.54				1

Periploma abyssorum (Verrill MS) Bush 1893

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay, 1953-54			
549/16	4.9.53	Evans Str.	R	73-75	1
611/6	10.8.54	Benkas Coats	R	49	2

Pandora (Kennerlia) glacialis Leche 1819

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
20-21/6	18.7.48	Payne Bay	R,S,M	64	3
33/16	10.8.47	Keglo Bay	R,M	18-27	1

Thracia (*Thracia*) *myopsis* Möller 1842

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Frobisher Bay, 1951-52			
406/3	22.7.52	C. Warwick Sd.	R	46	1

Thracia (Crassithracia) septentrionalis Jeffrey 1872

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Hudson Bay, 1953-54			
614/12	12.8.54	C. Pembroke	S	13-18	1

Lyonsia arenosa (Möller 1842)

Station No.	Date	Location	Bottom	Depth m.	No. of Sps.
		Ungava Bay, 1947-51			
33/16	10.8.47	Keglo Bay	R,M	18-27	1 v.
		Hudson Bay, 1953-54			
610/5	10.8.54	Benkas-Coats	R,M	18	2, 4 v.
614/14	12.8.54	C. Pembroke	"	13-18	1
549/16	4.9.53	Evans Str.	R	73-75	1

Appendix I - Part 6

List of bivalve molluscs from the Hole-in Fog Bay, Isachsen Island, coll. by S.D.MacDonald, 1954. National Museum of Canada.

Species:	Stn:	Depth Mtrs.	Bottom	Sps. No
Portlandia arctica (Gray)	25	30	Mud	10
	26	10	"	4
	27	68	"	1
Portlandia sulcifera (Reeve)	14	91	"	275
Delectopecten groenlandicus (Sow.)	24	30	"	1
	27	68	"	1
Serripes groenlandicus Bruggiere	26	10	"	1
	27	68	"	1
Astarte borealis placenta (Mörch)	25	30	"	7
	26	10	"	2
A. warhami Hancock	25	30	"	8
Thyasira dunbari sp. n.	14	91	"	20
Thracia devexa G.O.Sars	25	30	"	1
	26	10	"	1
Cuspidaria subtorta (G.O.Sars)	27	68	"	1

List of bivalve molluscs from the Ellesmere Land.

Collected by S.D. MacDonald in 1951 and 1955.

National Museum of Canada.

Parr Inlet, Alert:

Portlandia arctica (Gray) ..... 10 sps.

Delectopecten groenlandicus (Sow.) ..... 1 "

Musculus niger (Gray) ..... 1 "

Astarte warhami Hancock ..... 7 "

A. borealis (Schum.) ..... 2 "

Thyasira dunbari sp. n. ..... 2 "

Lyonsia arenosa (Müller) ..... 1 "

Slidre Fjord:	Stn.	Depth	Bottom	No.
Bathyarca glacialis (Gray)	10	168 ft	Mud	1
Portlandia arctica (Gray)	5	114	"	200
	10	168	"	4
P. intermedia (M. Sars)	10	168	"	1
Yoldiella lenticula (Müller)	10	168	"	3
Delectopecten groenlandicus (Sow.) .	10	168	"	1
	5	114	"	1
Clinocardium ciliatum (Fabr.)	5	114	"	1
Musculus laevigatus (Gray)	5	114	"	1
M. substriatus (Gray)	5	114	"	1
M. niger (Gray)	5	114	"	3
Astarte borealis (Schum.)	10	118	"	30
A. warhami Hancock	5	114	"	1
Thracia myopsis (Beck) Moller	10	168	"	1
Lyonsia arenosa (Müller)	10	168	"	1

List of bivalve molluscs from Mould Bay, Prince Patrick Island.

Collected by S.D. MacDonaldm k952,

National Museum of Canada.

Species:	Stn.	Depth feet:	Bottom:	No. of specimens:
Nucula belloti Adams	17	75-100	Mud	1
	19	80	"	1
Nuculana pernula costigera (Leche)	13	100-135	"	3
	12	100-125	"	1
	17	75-100	"	1
Yoldiella frigida (Torell)	13	100-135	"	1
Y. intermedia (M. Sars)	17	75-100	"	1
Portlandia arctica (Gray) ...	11	40	"	1
	13	100-135	"	3
	15	100-125	"	39
	17	75-100	"	18
Bathyarca glacialis (Gray) ..	13	100-135	"	1
Delectopecten groenlandicus (Sow.)	13	100-135	"	40
	12	100-125	"	68
	17	75-100	"	13
Astarte borealis placenta (Mørch)	13	100-135	"	1
	19	80	"	1
A. warhami Hancock	11	40	"	5
	13	100-135	"	19
	12	100-125	"	20
	17	75-100	"	20
Thyasira dunbari sp. no.	13	100	"	2
Macoma moesta (Deshayes)	11	40	"	2
	12	100-135	"	2
	17	75-100	"	1
Nya truncata uddevalensis Hancock	15	75-	"	17
Cuspidaria subtorta (G.O.Sars)	13	100-135	"	8
	15	105-135	"	1
Thracia myopsis (Beck) Moller	13	100-135	"	1
Thracia devexa (G.O. Sars)	15	100-135	"	1

List of bivalve molluscs collected by Fritz Johannsen, 1920, in the southern Hudson Bay and James Bay.

National Museum of Canada.

N.B. Bivalves in this list have been identified by J.F. Whiteaves, but were not published. I have identified in samples Mya pseudarenaria Schlesch and and some young forms. Nomenclature of J.F. Whiteaves is readjusted to a recent one.

Nuculana pernula buccata (Steenstrup)

N. minuta (Müller)

Crenella faba (Müller)

Musculus discors (L.)

Mytilus edulis L. (= M. pellucidus Penn.)

Chlamys islandica (Muller)

Astarte banksi (Leach)

Serripes goenlandicus Brugg

Clinocardium ciliatum (Fabr.)

Macoma calcarea (Gm.)

Macoma inconspicua Br. et Sow. (= M. balthica L., det. Lubinsky)

Hiatella arctica (L.)

Mya truncata L.

M. pseudarenaria Schlesh. (det.Lubinsky) - only valves.

List of species of bivalve molluscs collected by A. Clarke, National Museum of Canada, in the south-eastern Hudon Bay and in James Bay, July 1963. Identified by I. Lubinsky.

Nucula belotti Adams

N. dephinodonta Migh. Adams

N. pernula costigera (Leche)

Yoldiella lenticula Möller)

Portlandia arctica (Gray)

Bathyarca glacialis (Gray)

Dacridium vitreum (Möller)

Musculus discors (L.)

Crenella decussata (Mont.)

Mytilus edulis L.

Chlamys islandica (Müller)

Delectopecten groenlandicus (Sow.)

Astarte warhami Hancock.

Macoma calcarea (Gm.)

M. balthica L.

M. moesta Deshayes

Serripes ciliatum (Fabr.)

Mya truncata L.

M. pseudarenaria Schlesh. (valves)

Pandora glacialis (Leach)

Lyonsia arenosa Moller

Thracia devexa G.O. Sars

List of species of bivalve molluscs from the Saguenay Fjord. Collected by Station Biologique Marine, Grand Riviere, Quebec. 1962.

Species:	Station:
Nuculana minuta (Müller)	62-21
N. pernula costigera (Leche)	62-16, -21
Yoldia sp. fragments	62-9
Bathyarca glacialis (Gray)	61-132, 62-9, -16, -21, -33 a,b, -34
Crenella faba (O.F. Muller)	62-3, -5, -30, 591, 617
Musculus discors L.	62-4, -5, -7, -359, 621.
M. corrugatus (Stimpson)	62-2
Mytilus edulis L.	59-101
Chlamys islandica (Müller)	62-2, -3, -4
Astarte borealis (Schum.)	62-4, -5, -9
A. elliptica Brown	62-2, -4, -5, -9, -623
A. striata (Leach)	62-4, -5, -6, -8
A. crenata crebricostata (Forbes)	62-34, -100, -560
Venericardia borealis (Conrad)	62-4
Thyasira gouldi Phil.	62-2, -12, -16, -13, -17, -21, -23
Vlinocardium ciliatum(Fabr.)	62-5
Macoma moesta (Deshayes)	62-9
M. loveni (Desh.)	61-1, -6, -107
M. balthica L.	62-65, -637
Panopea norvegica (Spengl.)	Fossil shells
Periploma fragilis (Totten)	Valves 62-11.
Hiatella arctica L.	62-3, -4, -5, -6, -10, -524, -584,-620
Cuspidaria subtorta (G.O. Sars)	62-21

Appendix II to the thesis:

Marine Bivalve Molluscs of the Canadian Arctic.

by I. Lubinsky

Maps of distribution of bivalve molluscs

in the Canadian Arctic. No. 1-61.

LIST of

Maps indicating distribution of species of Bivalvia
in the Canadian Arctic

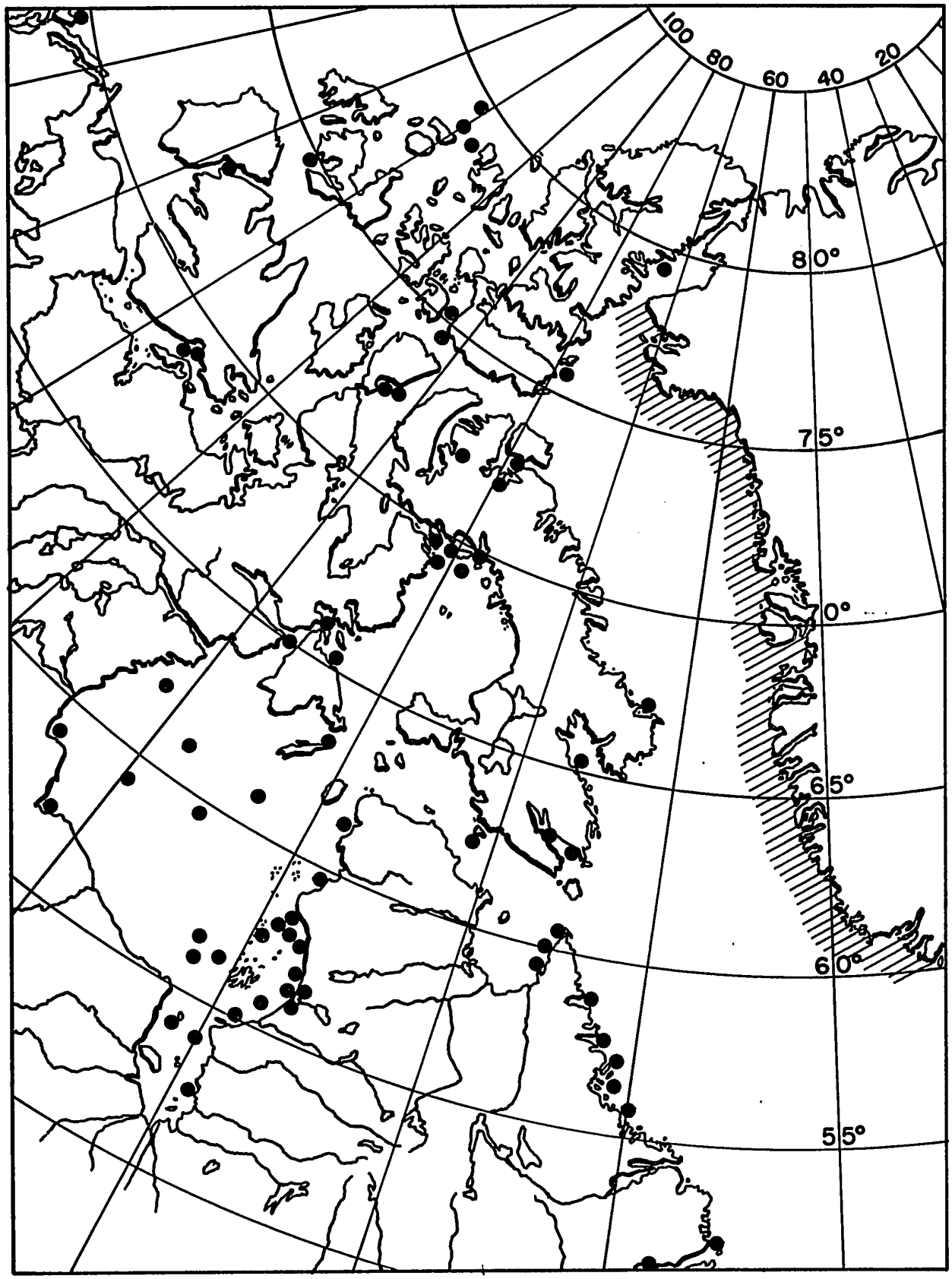
Map No:	Name of species:
1	Nucula belloti Adams
2	Nucula delphinodonta Migh. and Adams
3	Nuculana pernula (Müller)
4	Nuculana minuta (Fabricius)
5	Yoldia hyperborea (Loven) Torell s.l.
6	Yoldia myalis (Couthoy)
7	Yoldiella frigida (Torell)
	" lenticula (Møller)
8	Yoldiella intermedia (M. Sars)
	" tamara Gorbunov
9	Portlandia arctica (Gray)
10	Portlandia arctica siliqua (Reeve)
11	Portlandia sulcifera (Reeve)
12	Bathyarca glacialis (Gray)
13	Bathyarca pectunculoides (Scacchi)
14	Mytilus edulis Linné
15	Dacridium vitreum (Møller)
16	Musculus corrugatus (Stimpson)
17	Musculus discors (Linné)
18	Musculus niger (Gray)
19	Crenella decussata (Montagu)
20	Crenella faba (Müller)
21	Chlamys islandica (Müller)
22	Delectopecten groenlandicus (Sowerby)
23	Lima subaruiculata Montagu
24	Astarte arctica (Gray)
25	Astarte globosa (Møller)
	" banksi (Leach)
26	Astarte borealis (Schumacher)
27	Astarte crenata (Gray)
28	Astarte crenata crebricostata (McAndrews and Forbes)
29	Astarte elliptica (Brown)
30	Astarte soror Dall
31	Astarte striata (Leach)
32	Astarte warhami Hancock
33	Venericardia borealis (Conrad)
34	Montacuta substriata (Montagu)
35	Turtonia minuta (Fabricius)
36	Axinopsida orbiculata (G.O. Sars)
37	Thyasira dunbari sp. n.
38	Thyasira gouldi (Philippi)
39	Clinocardium ciliatum (Fabricius)
40	Serripes groenlandicus Bruggiere
41	Liocyma fluctuosa (Gould)
42	Macoma balthica (Linné)

Map No:	Name of species:
43	Macoma calcarea (Gmelin) obliqua Soot-Ryen
44	Macoma inconspicua (Brod. and Sow.)
45	Macoma loveni (Steenstrup) Jensen
46	Macoma moesta (Deshayes)
47	Macoma torelli (Steenstrup) Jensen
48	Macoma planiuscula Grant and Gale
49	Mya arenaria Linne
50	Mya truncata Linne
51	Cytodaria kurriana Dunker
52	Hiatella arctica (Linné)
53	Pandora glacialis Leach
54	Lyonsia arenosa (Møller)
55	Periploma abyssorum Verrill
56	Thracia devexa (G.O. Sars)
57	Thracia myopsis (Beck) Møller
58	Thracia septentrionalis Jeffrey
59	Cuspidaria arctica (G.M. Sars)
60	Cuspidaria glacialis (G.O. Sars)
61	Cuspidaria subtorta (G.O. Sars)

Map No. 1

Distribution of Nucula belloti Adams

in the Canadian Arctic

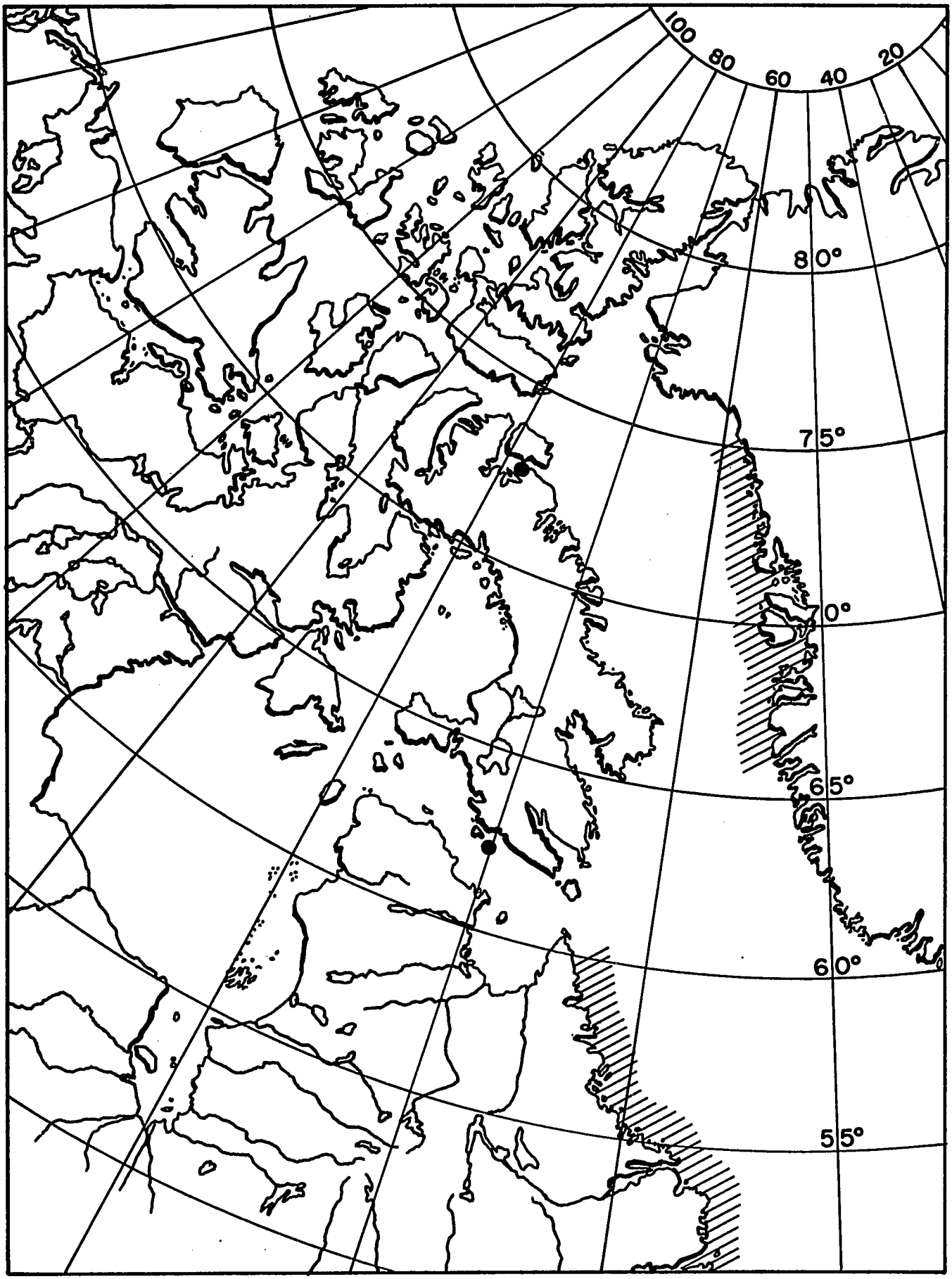


Map No.1

Map No. 2

Distribution of Nucula delphinodonta Migh. and Adams

in the Canadian Arctic

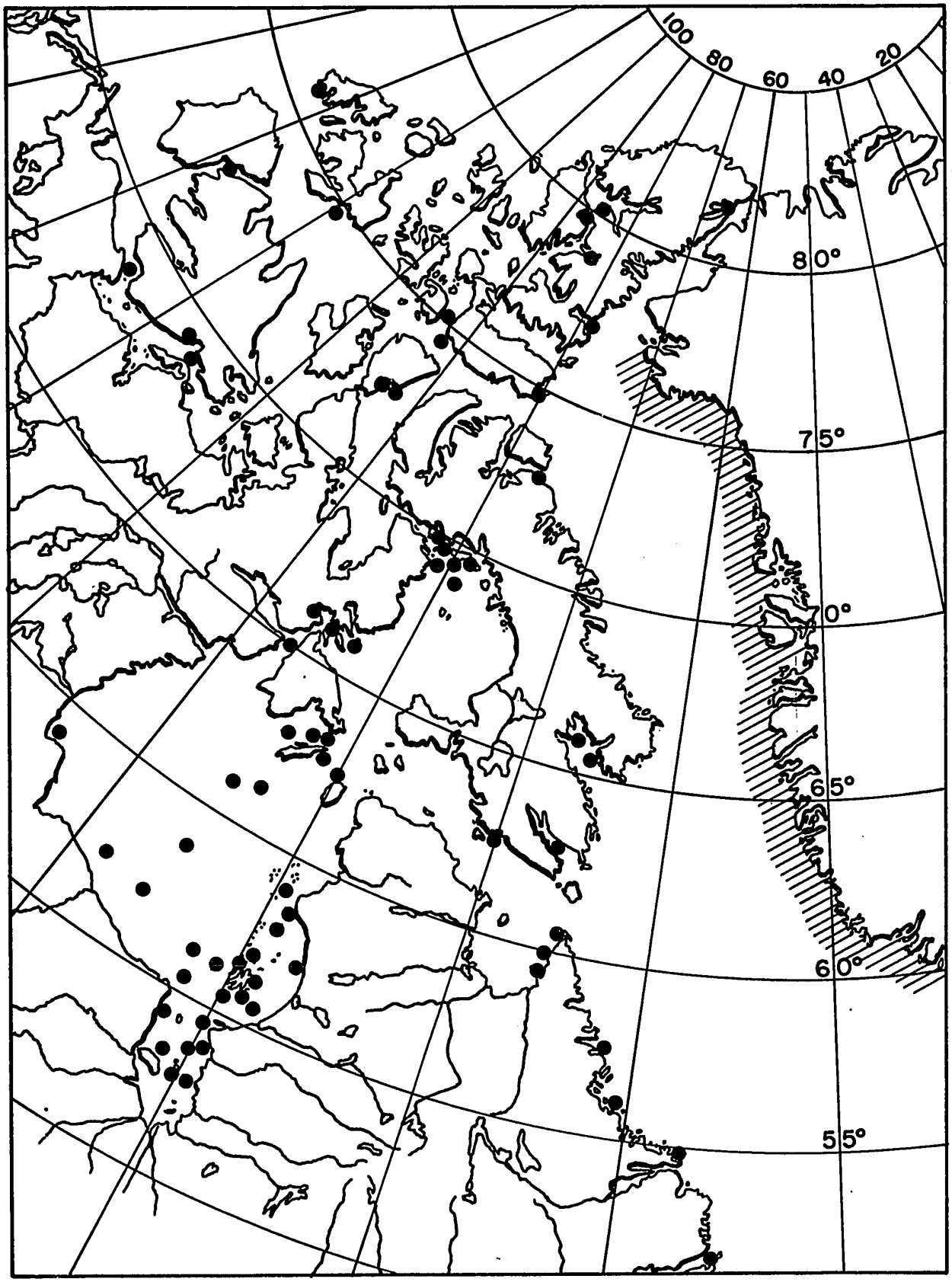


Map No.2

Map No. 3

Distribution of Nuculana pernula (O.F. Müll.)

in the Canadian Arctic

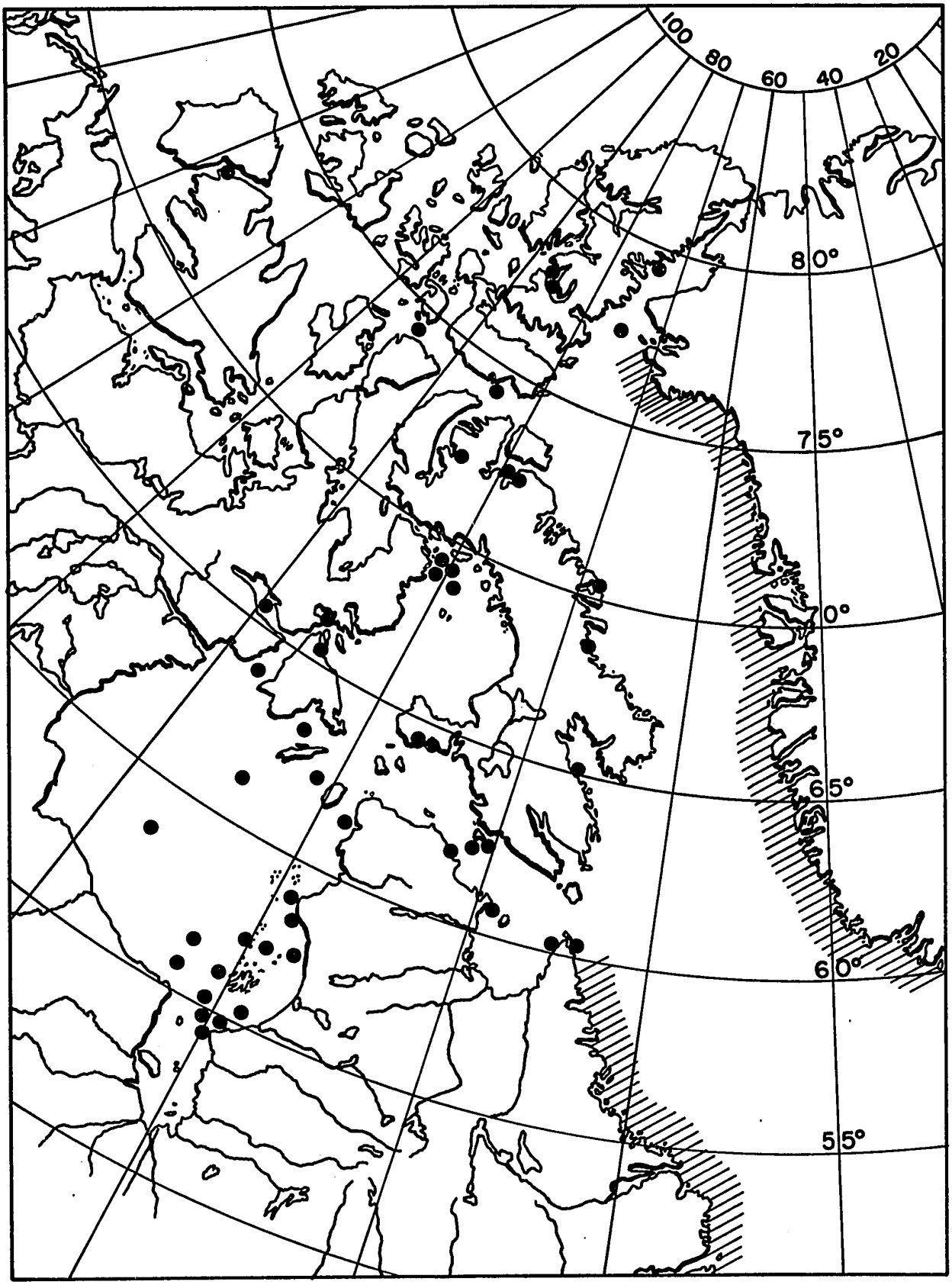


Map No.3

Map No. 4

Distribution of *Nuculana minuta* (Fabr.)

in the Canadian Arctic



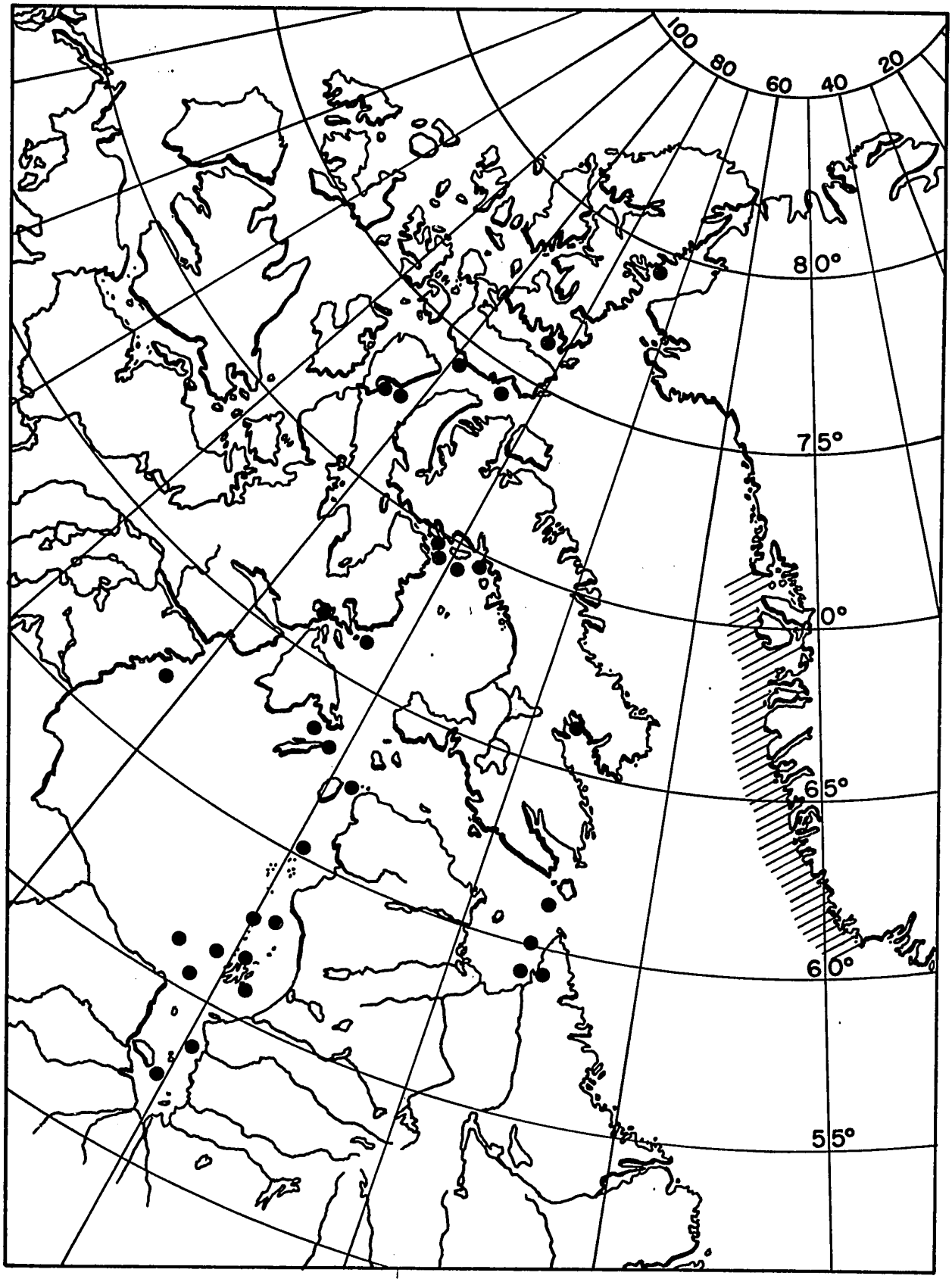
Map No.4

Map No. 5

Distribution of

Yoldia hyperborea hyperborea (Loven) Torell

in the Canadian Arctic

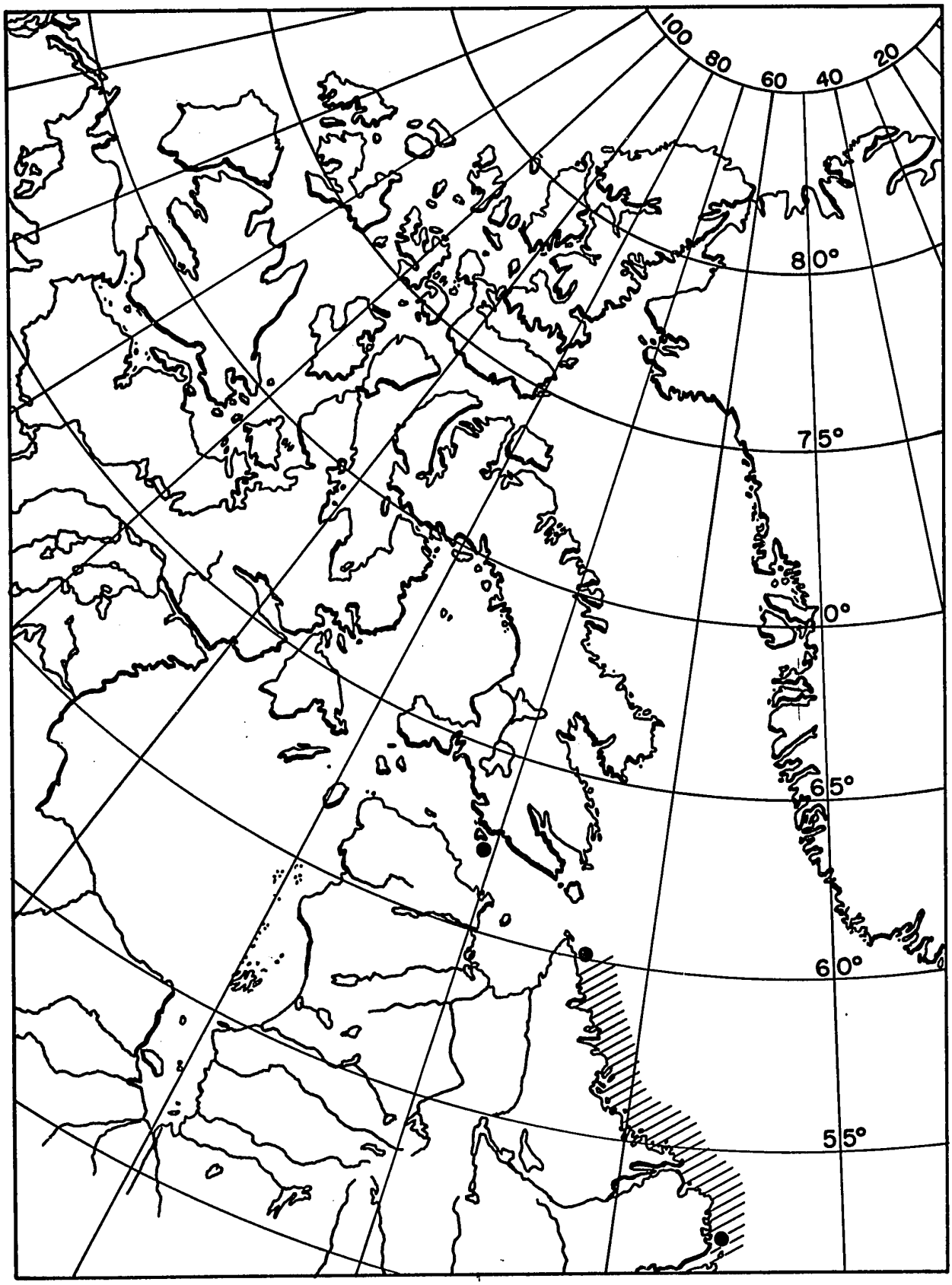


Map No.5

Map No. 6

Distribution of Yoldia myalis (Couthoy)

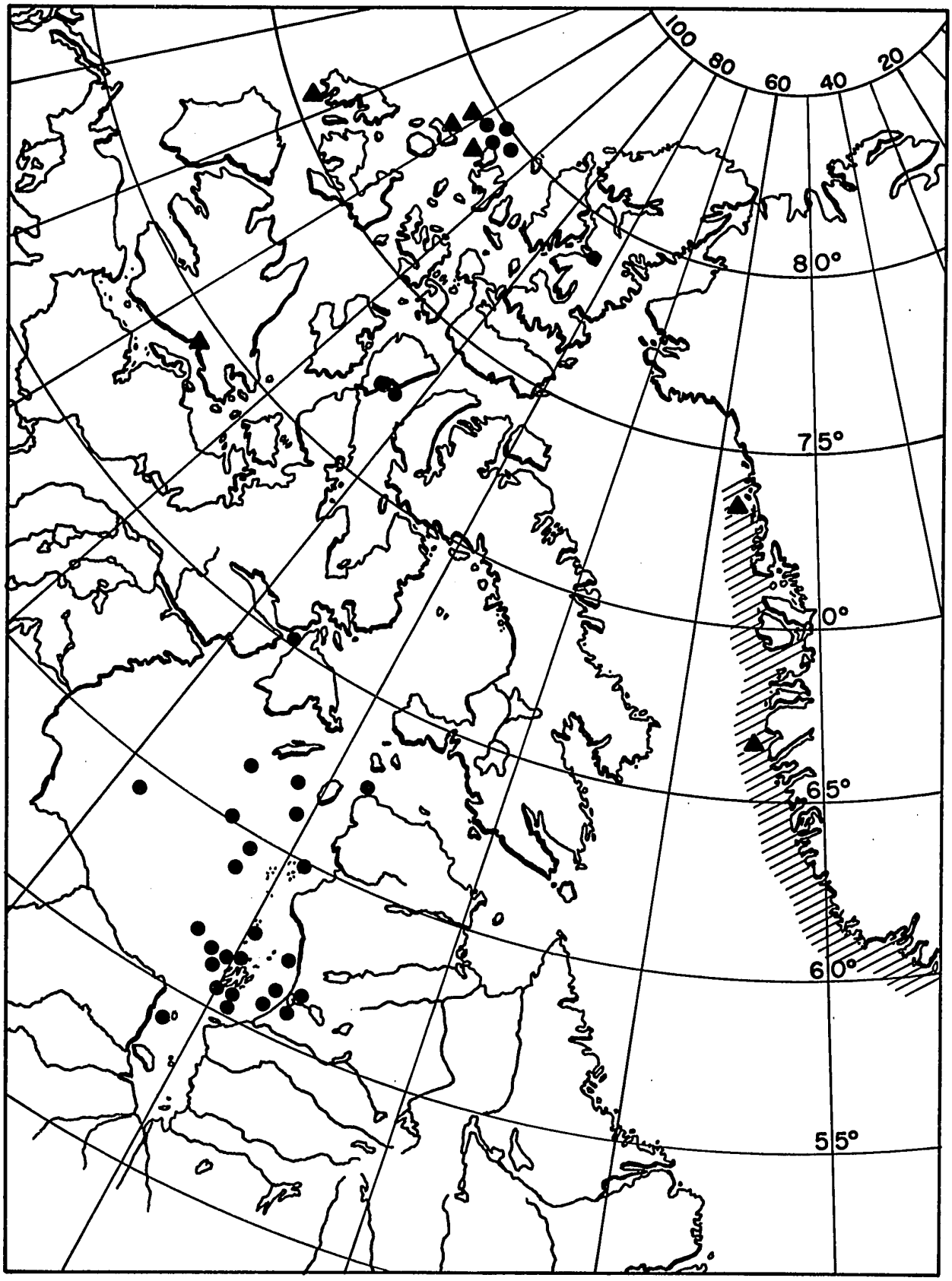
in the Canadian Arctic



Map No.6

Map No. 7

Distribution of Yoldiella lenticula (Møller)
and Yoldiella frigida (Torell), triangles,
in the Canadian Arctic



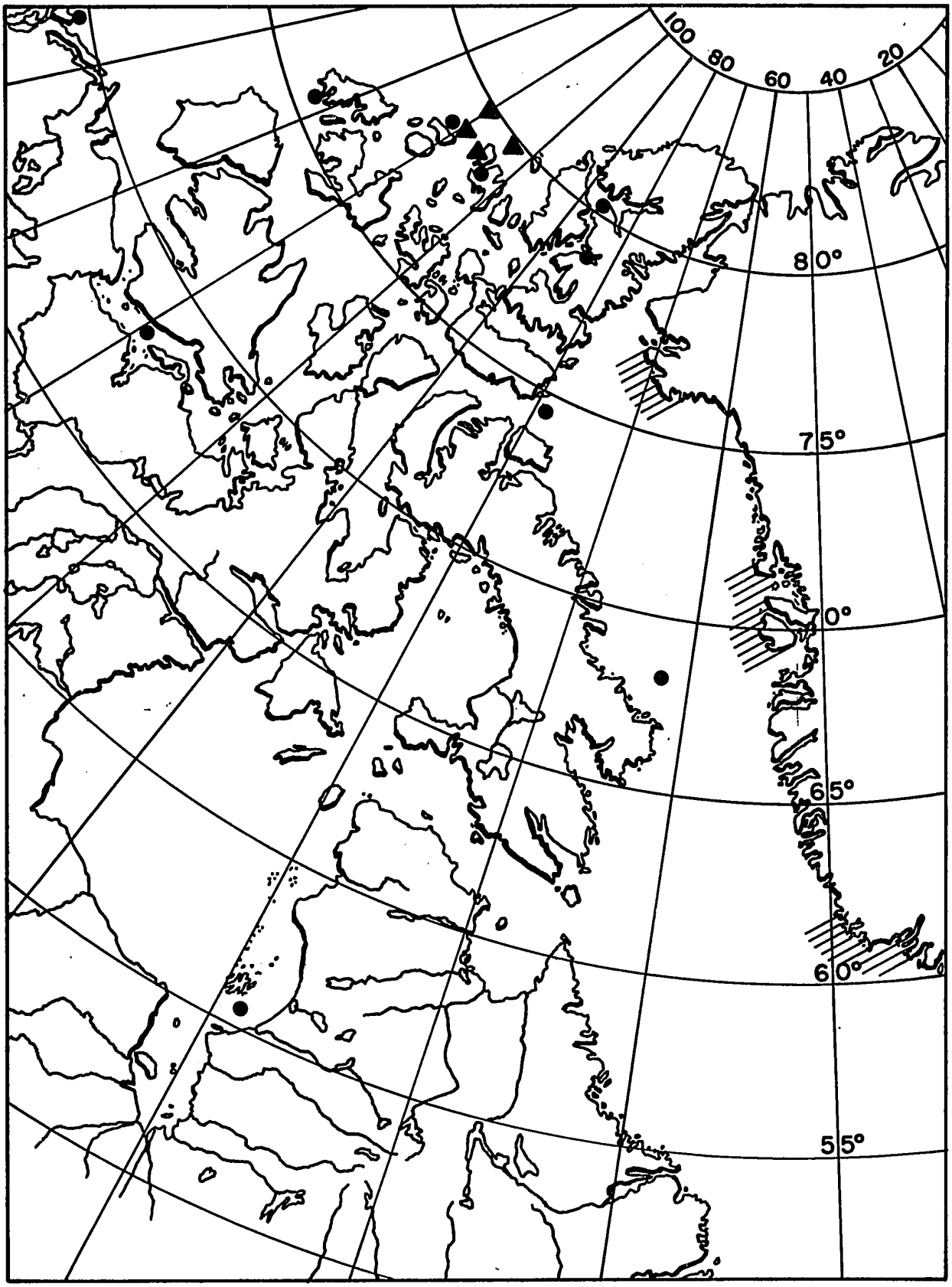
Map No.7

Map No. 8

Distribution of Yoldiella intermedia (M. Sars)

and Y. tamara (Gorbunov), triangles,

in the Canadian Arctic



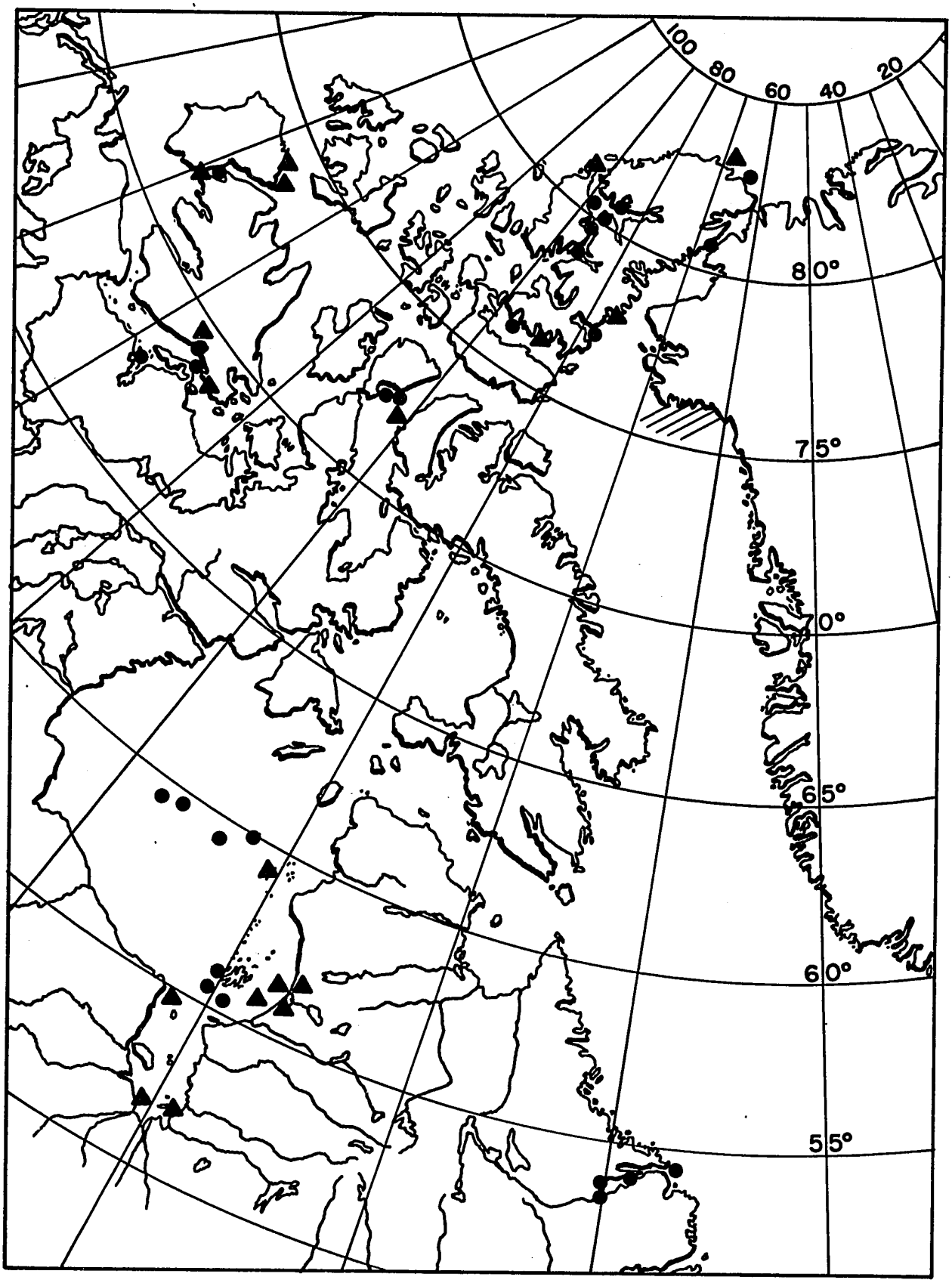
Map No.8

Map No. 9

Distribution of *Portlandia arctica* (Gray)

and *P. arctica* var. *portlandica* (Hitchcock), triangles,

in the Canadian Arctic

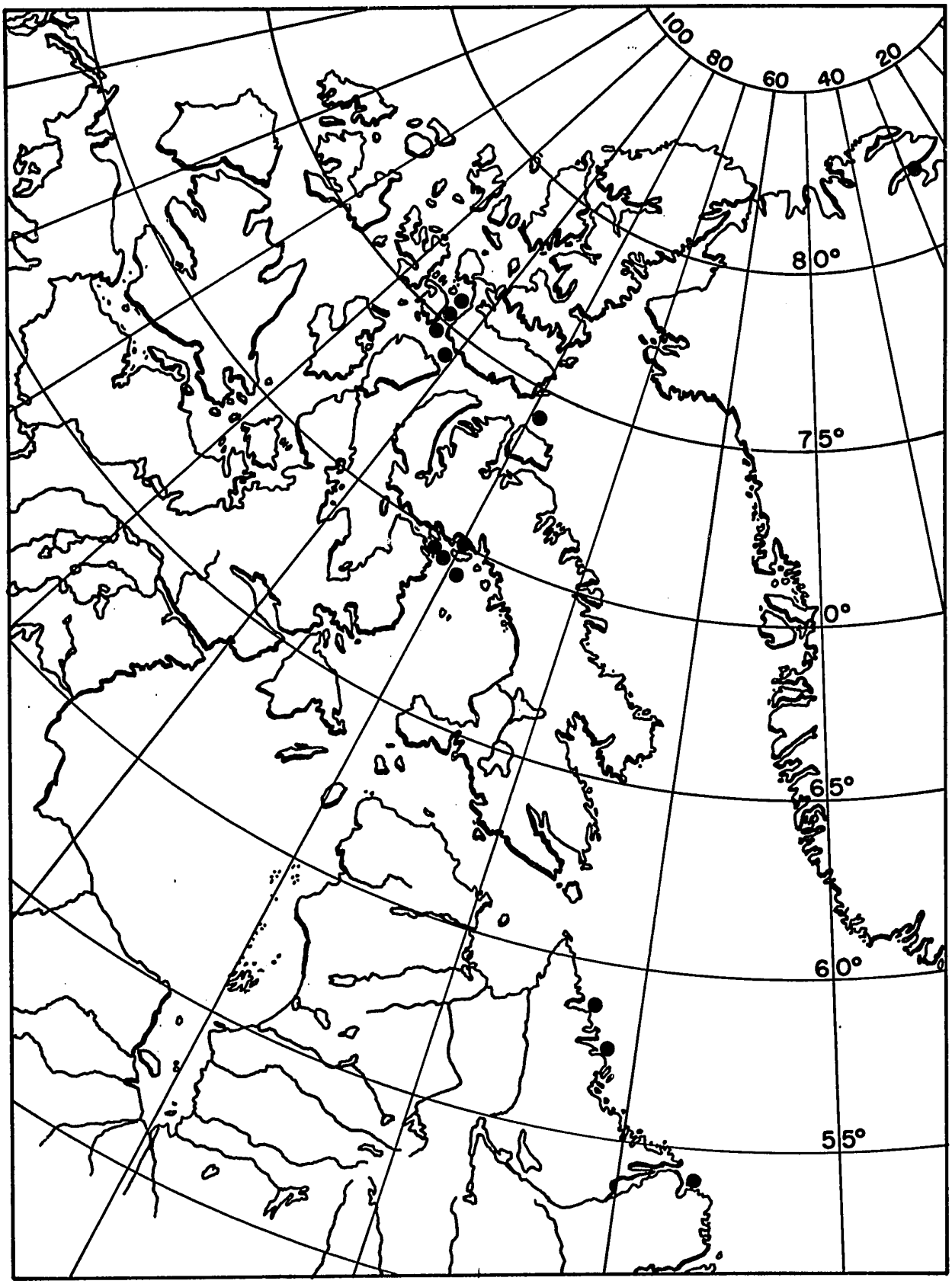


Map No.9

Map No. 10

Distribution of Portlandia arctica siliqua (Reeve)

in the Canadian Arctic

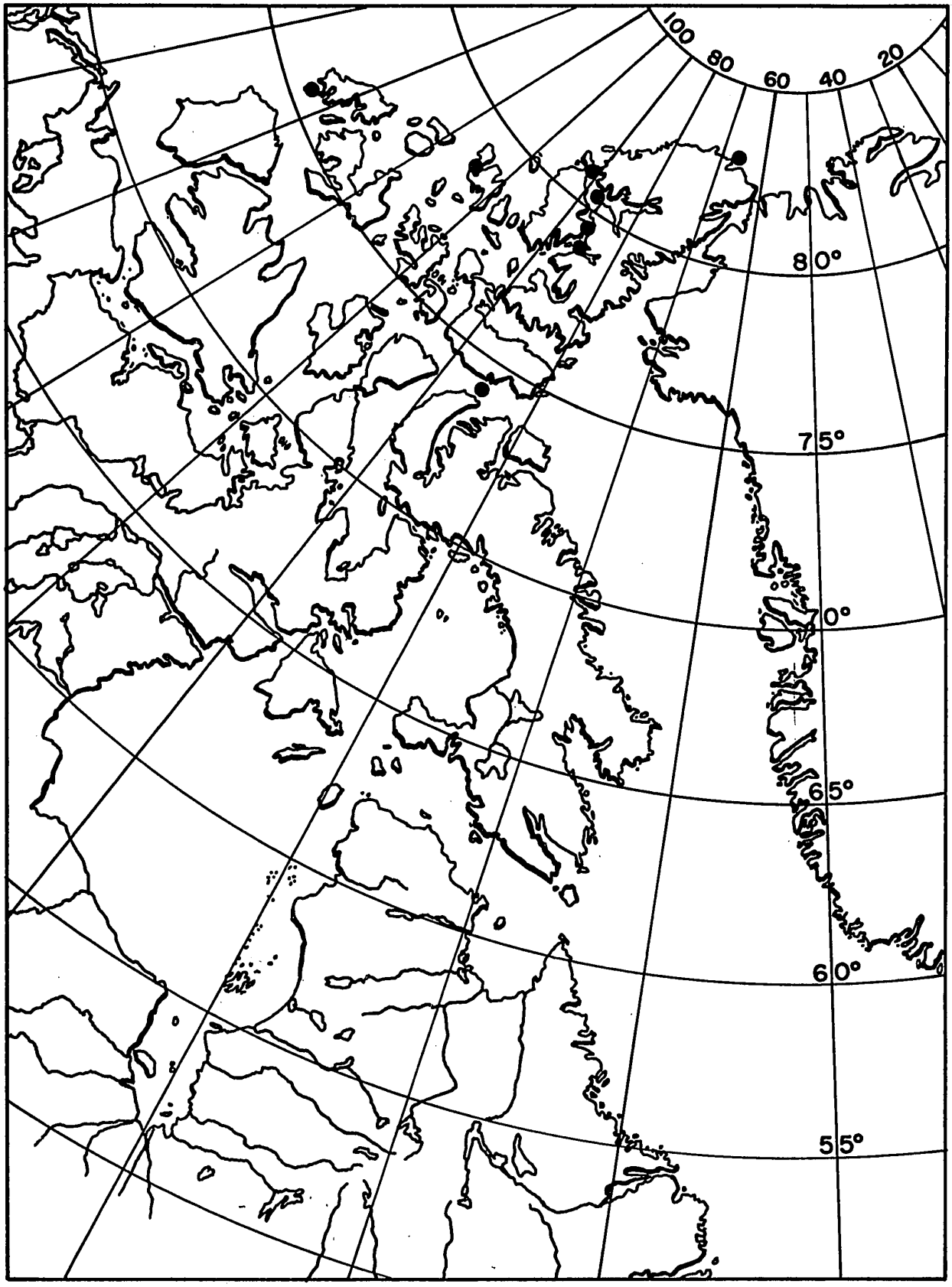


Map No.10

Map No. 11

Distribution of *Portlandia sulcifera* (Reeve)

in the Canadian Arctic

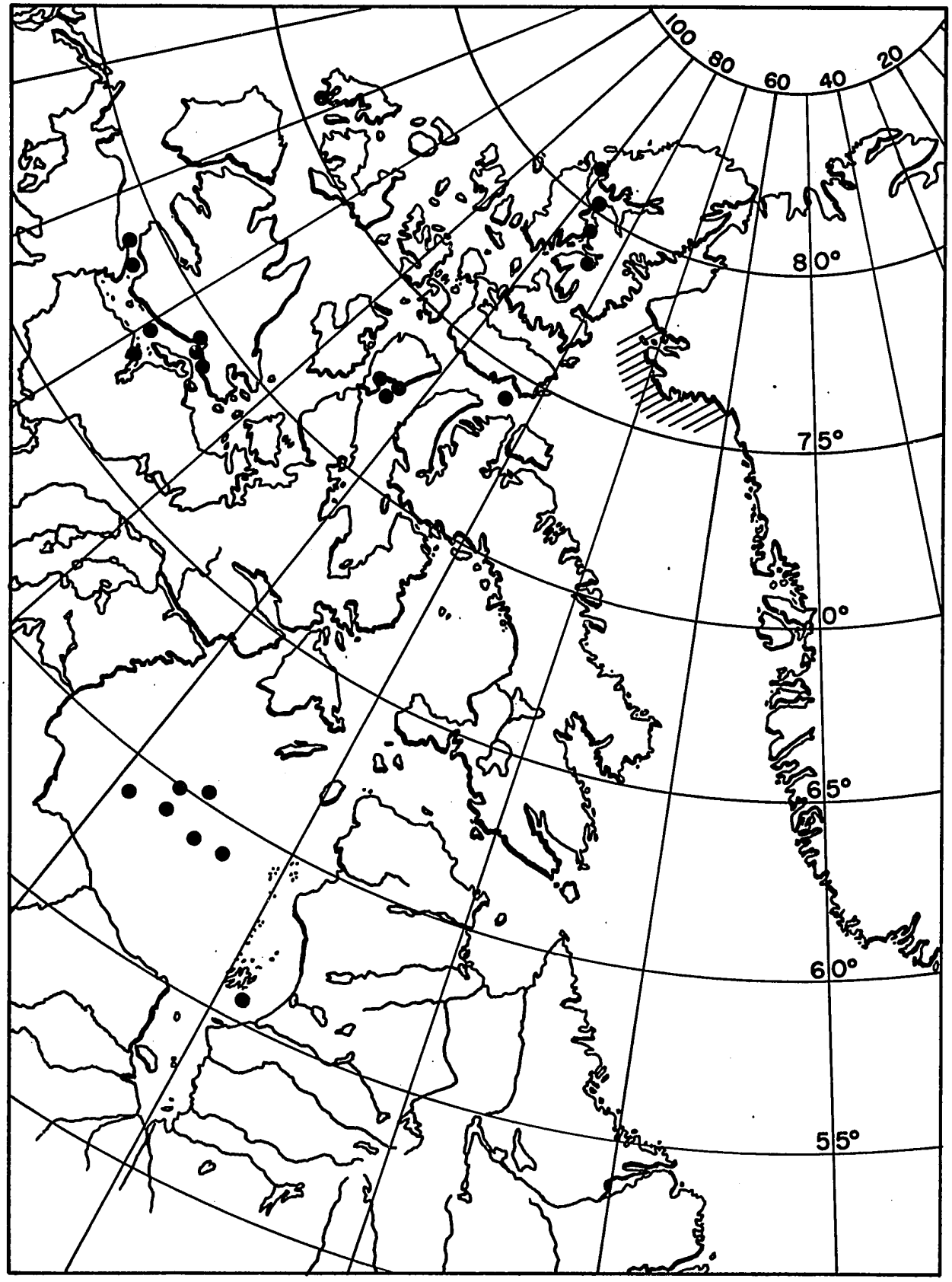


Map No. 11

Map No. 12

Distribution of Bathyarca glacialis (Gray)

in the Canadian Arctic

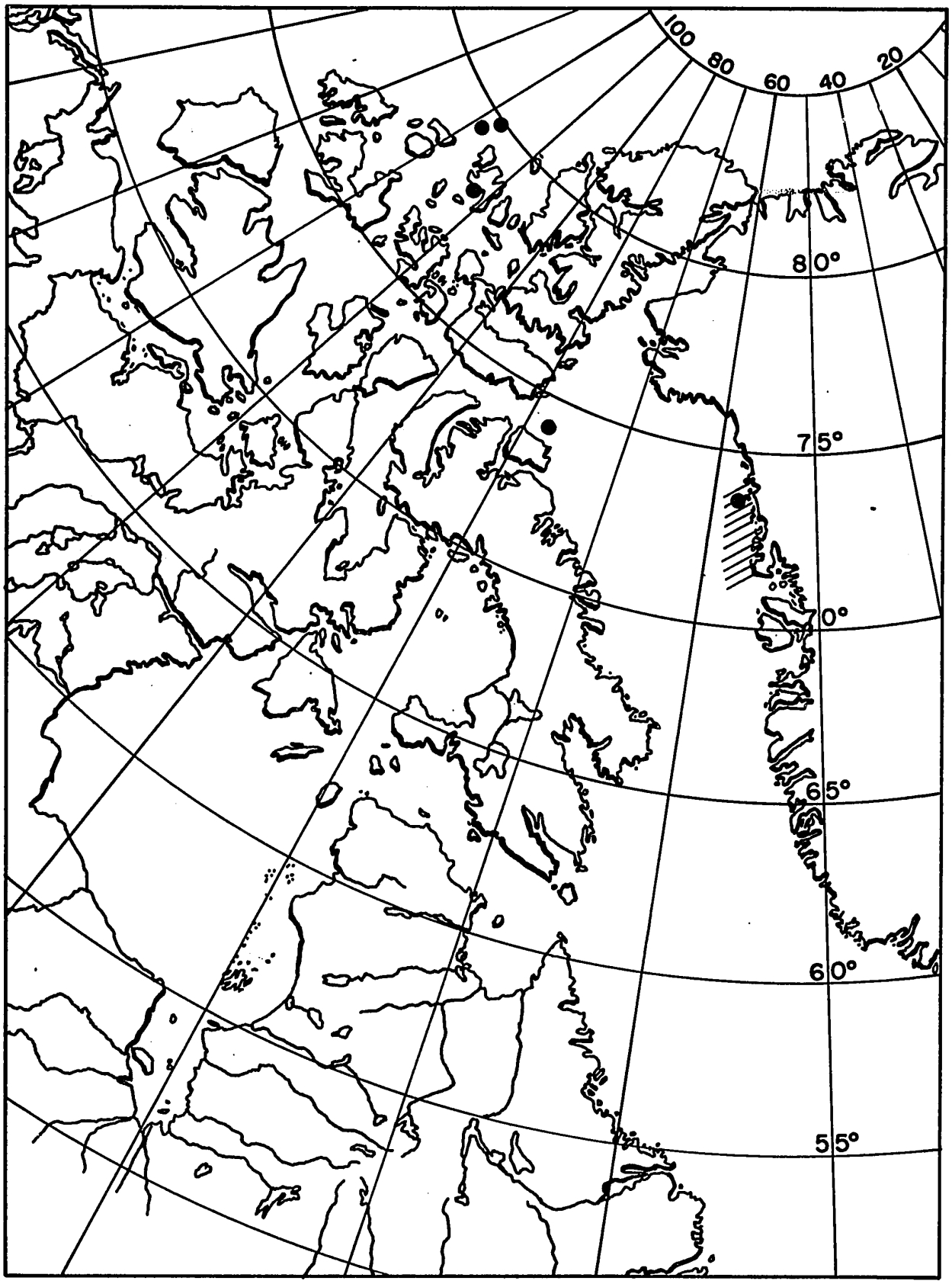


Map No.12

Map No. 13

Distribution of Bathyarca pectunculoides (Scacchi)

in the Canadian Arctic

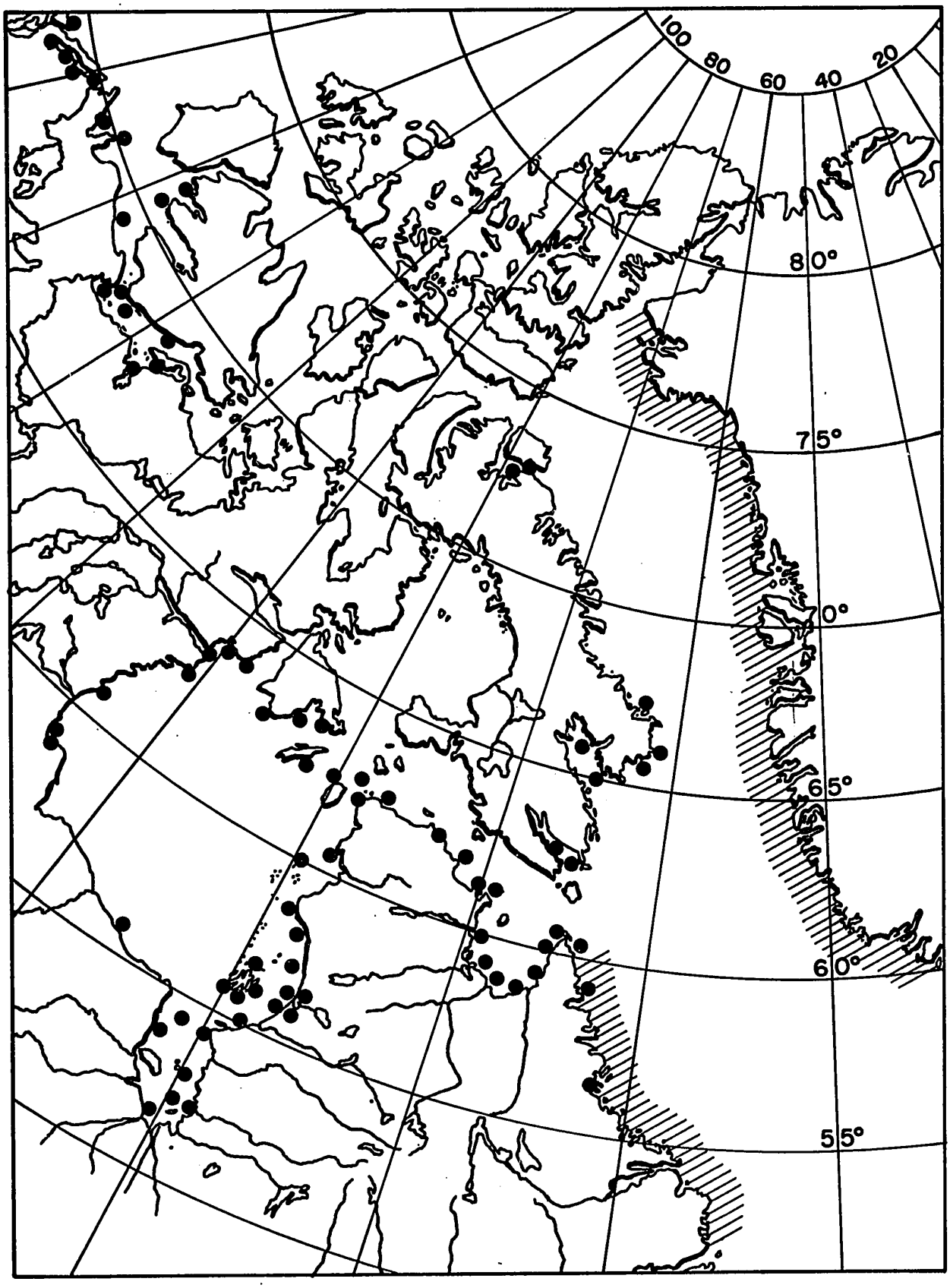


Map No.13

Map No. 14

Distribution of *Mytilus edulis* Linne'

in the Canadian Arctic

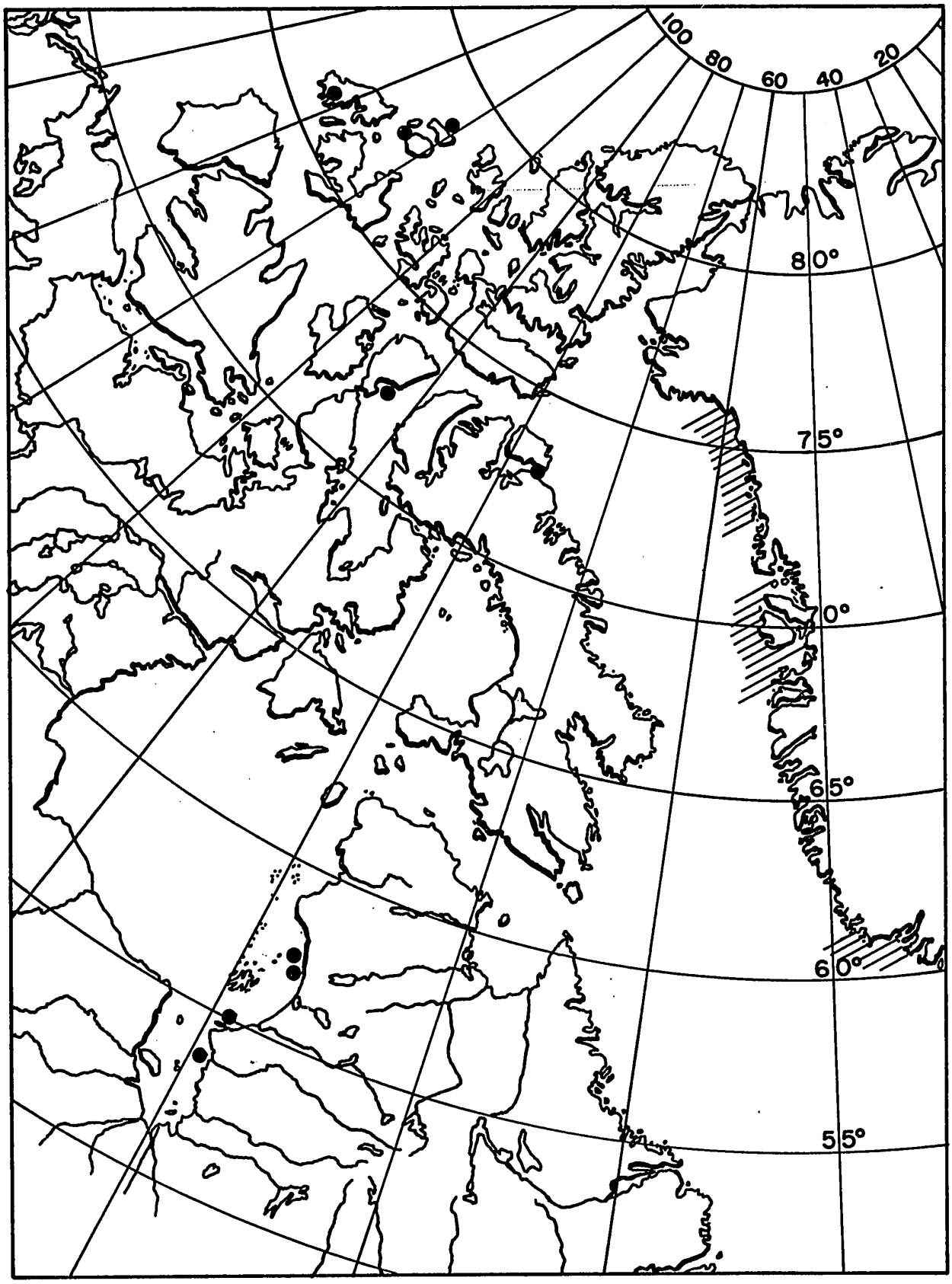


Map No.14

Map No. 15

Distribution of *Dacridium vitreum* (Møller)

in the Canadian Arctic

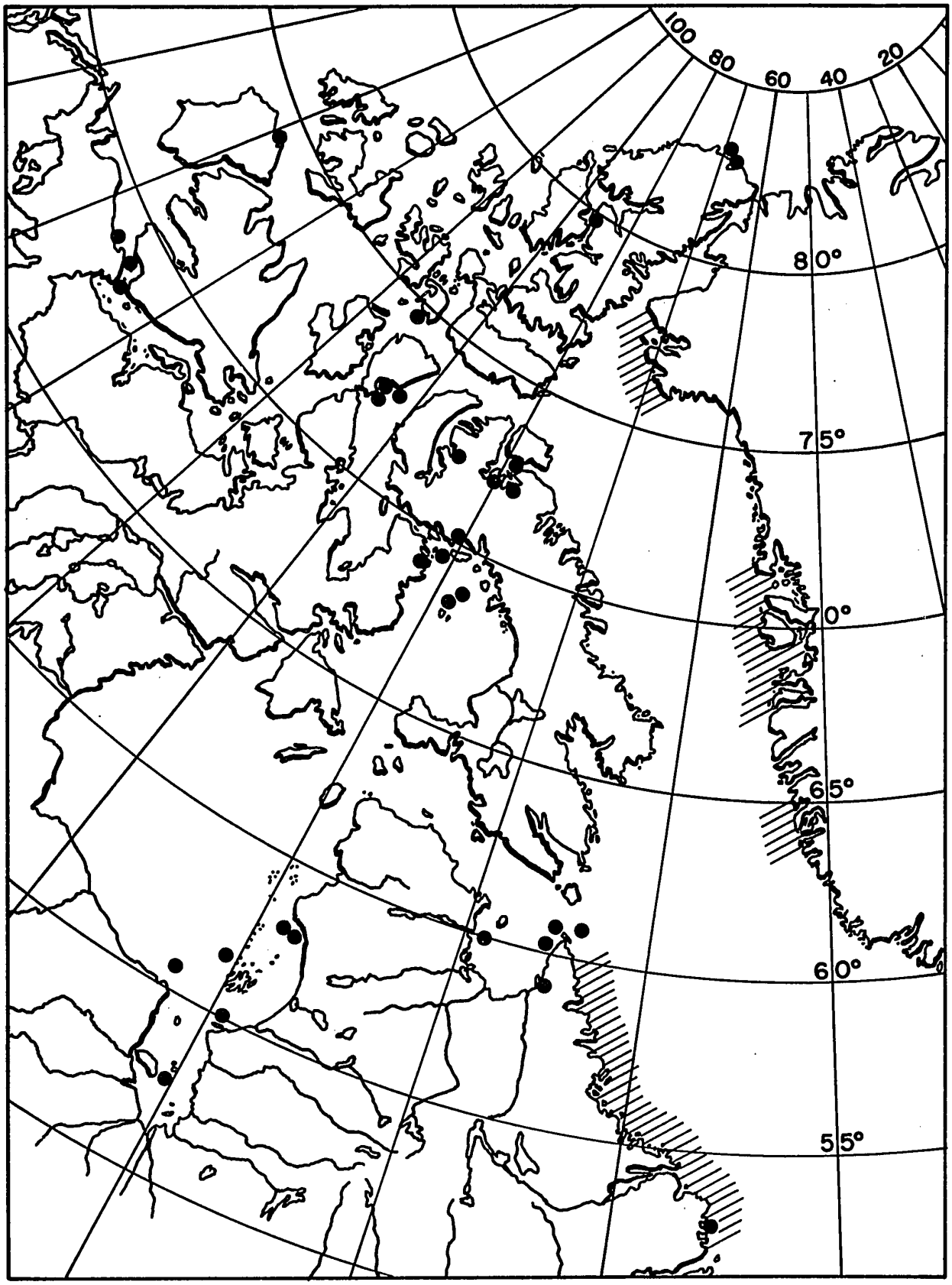


Map No.15

Map No. 16

Distribution of *Musculas corrugatus* (Stimpson)

in the Canadian Arctic



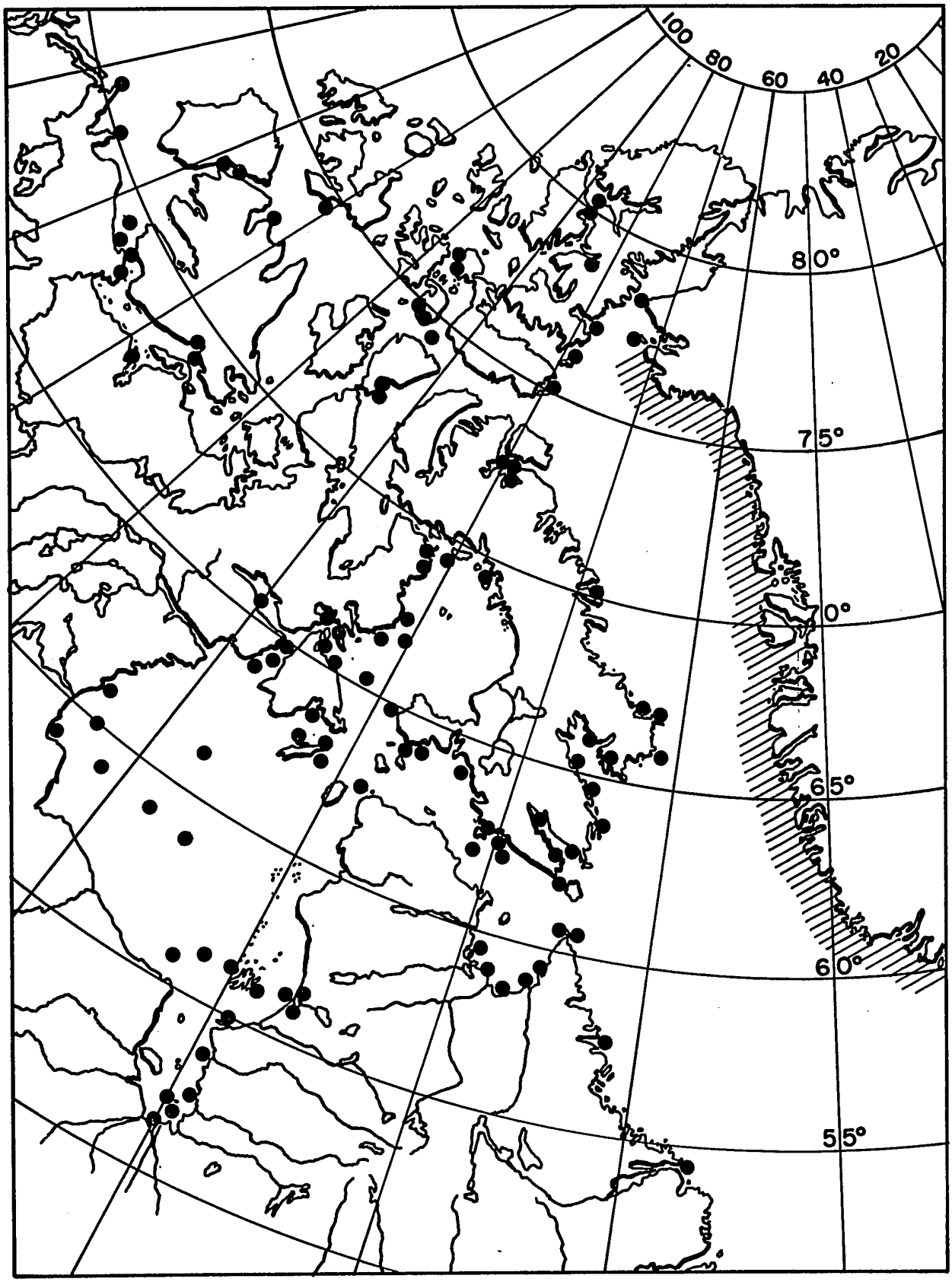
Map No.16

Map No. 17

Distribution of Musculus discors (Linne) var. laevigatus (Gray)

and var. substriatus (Gray)

in the Canadian Arctic

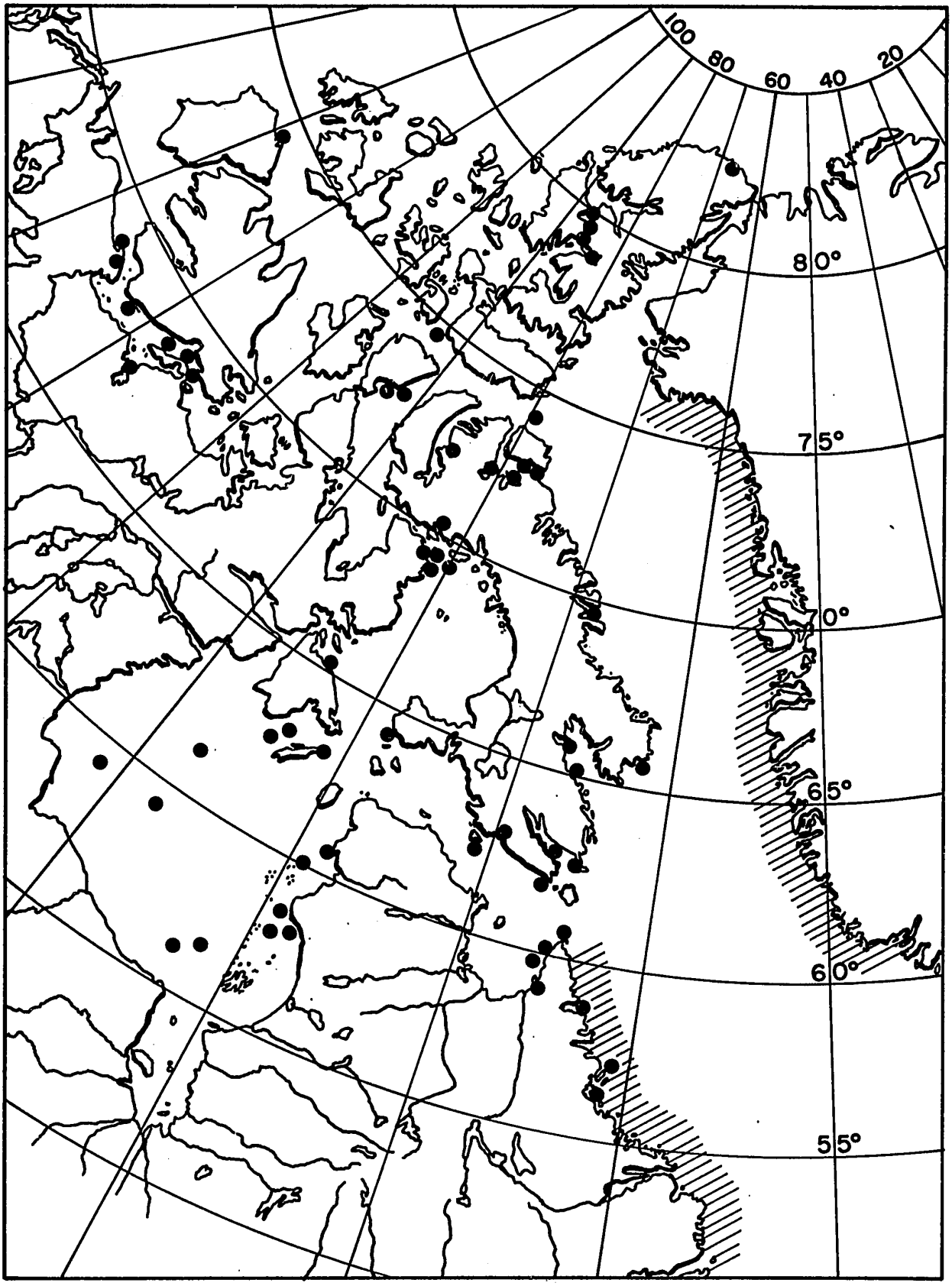


Map No.17

Map No. 18

Distribution of Musculus niger (Gray)

in the Canadian Arctic

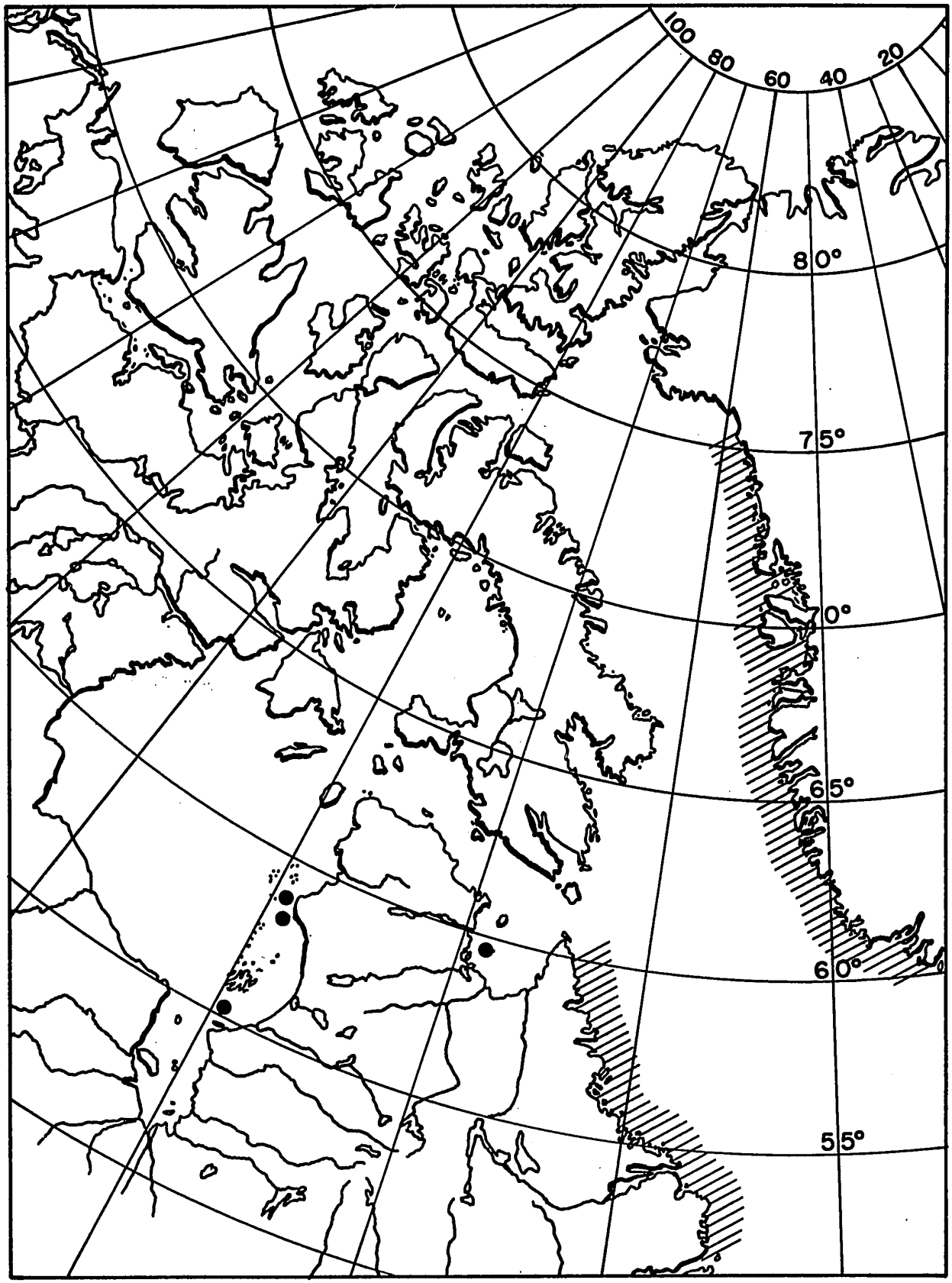


Map No.18

Map No. 19

Distribution of *Crenella decussata* (Mont.)

in the Canadian Arctic

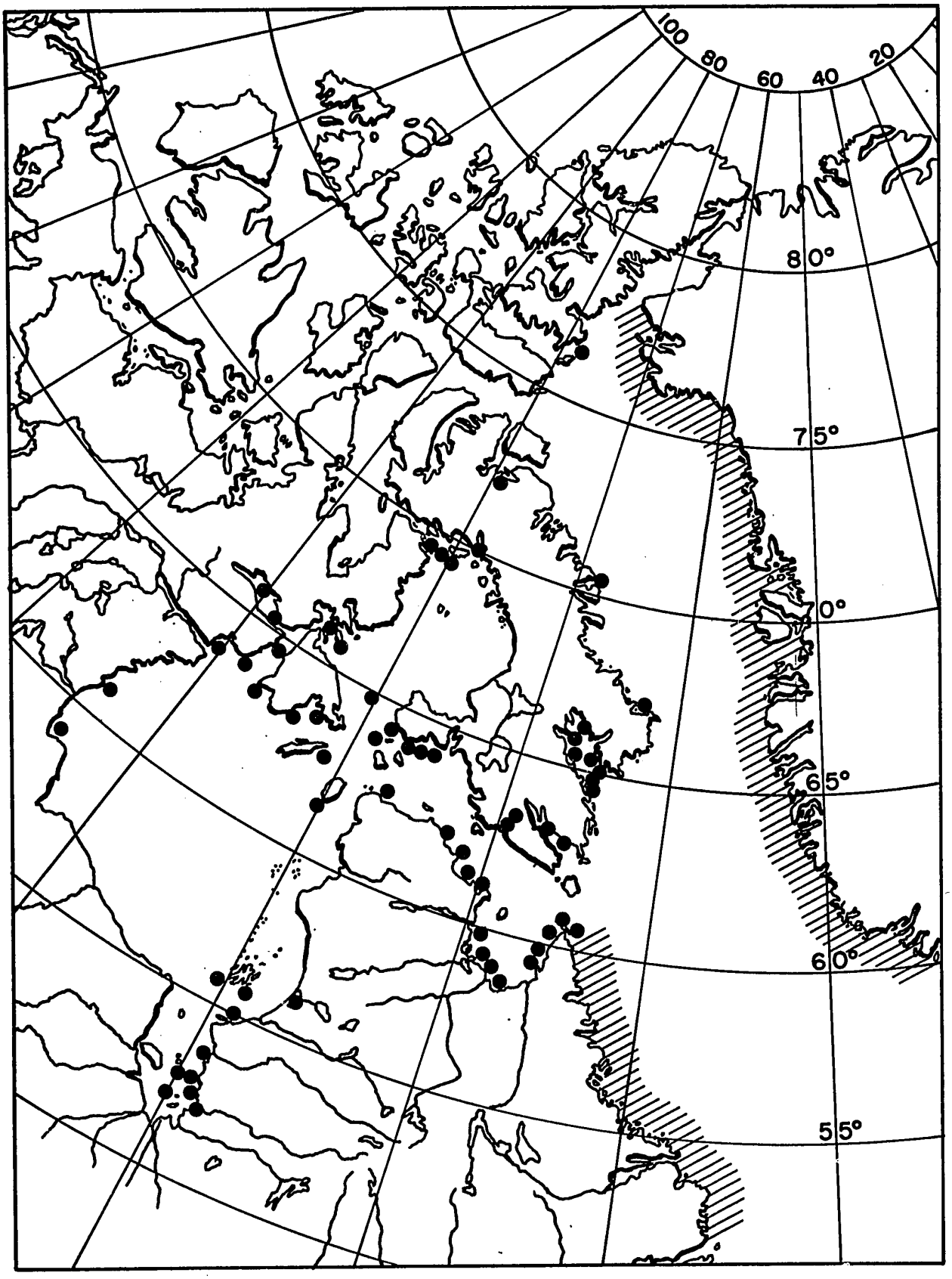


Map No.19

Map No. 20

Distribution of *Crenella faba* (O.F. Müll.)

in the Canadian Arctic

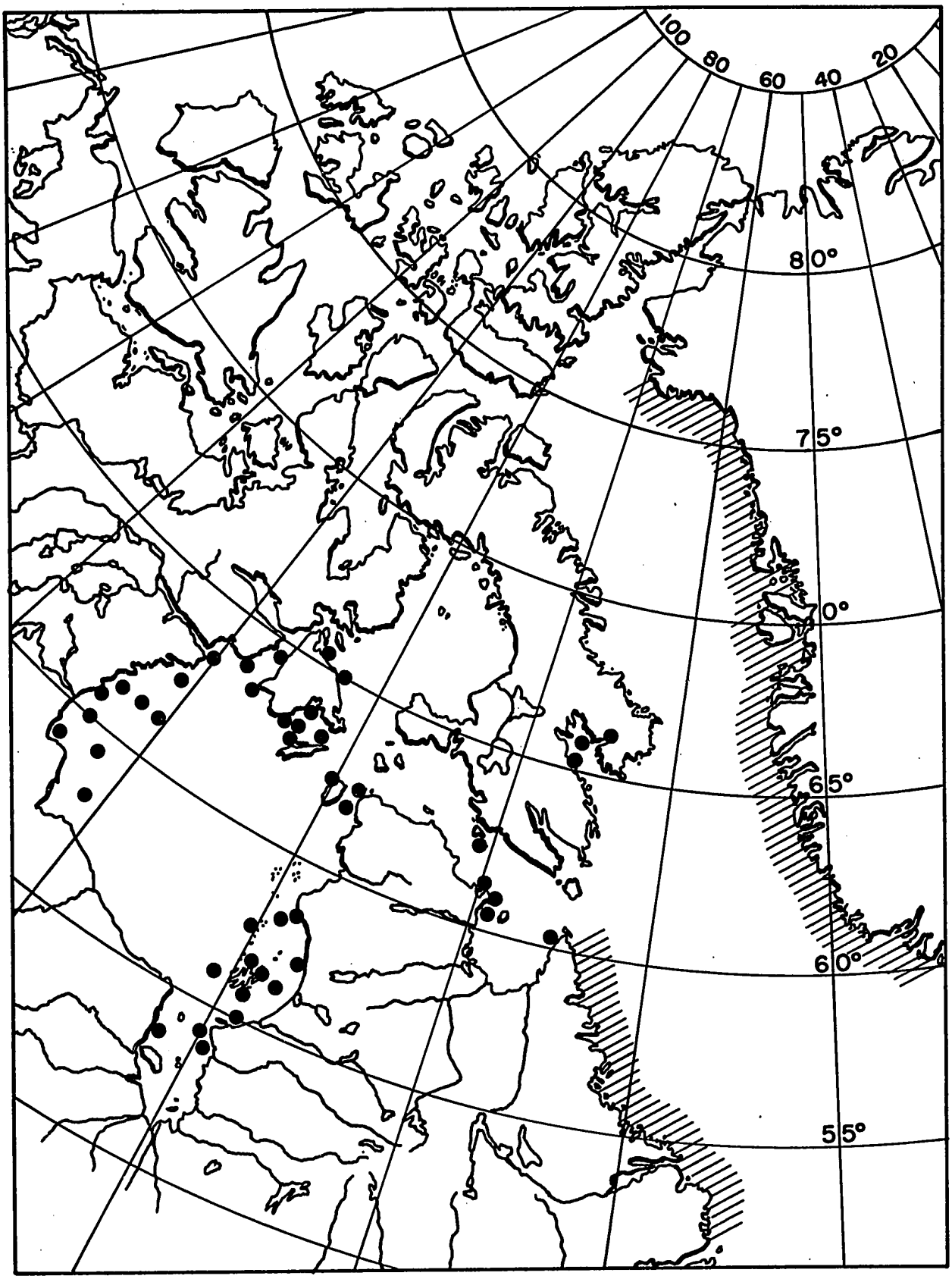


Map No.20

Map No. 21

Distribution of *Chlamys islandica* (O.F. Müller)

in the Canadian Arctic

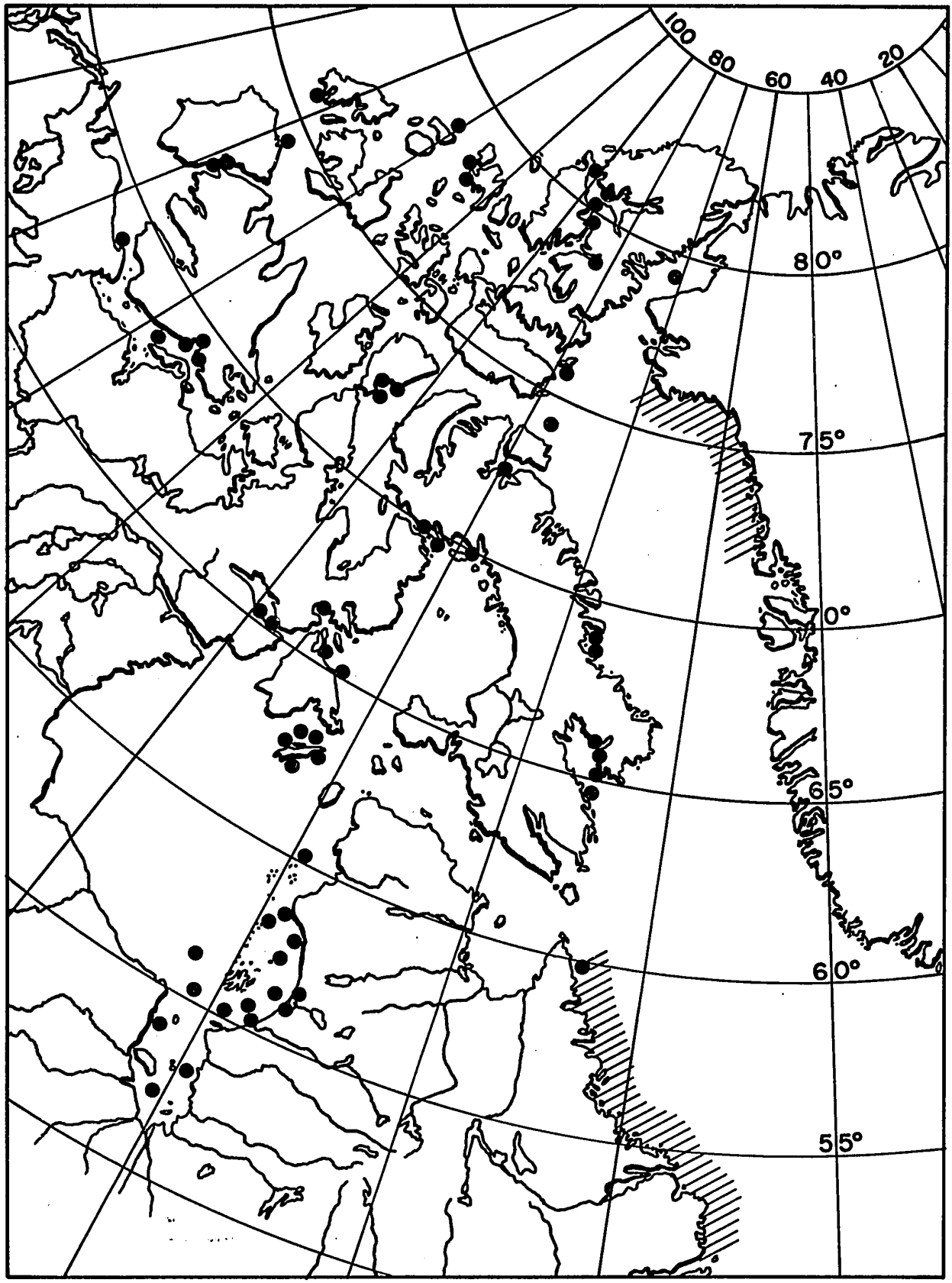


Map No.21

Map No. 22

Distribution of Delectopecten groenlandicus (Sowerby)

in the Canadian Arctic

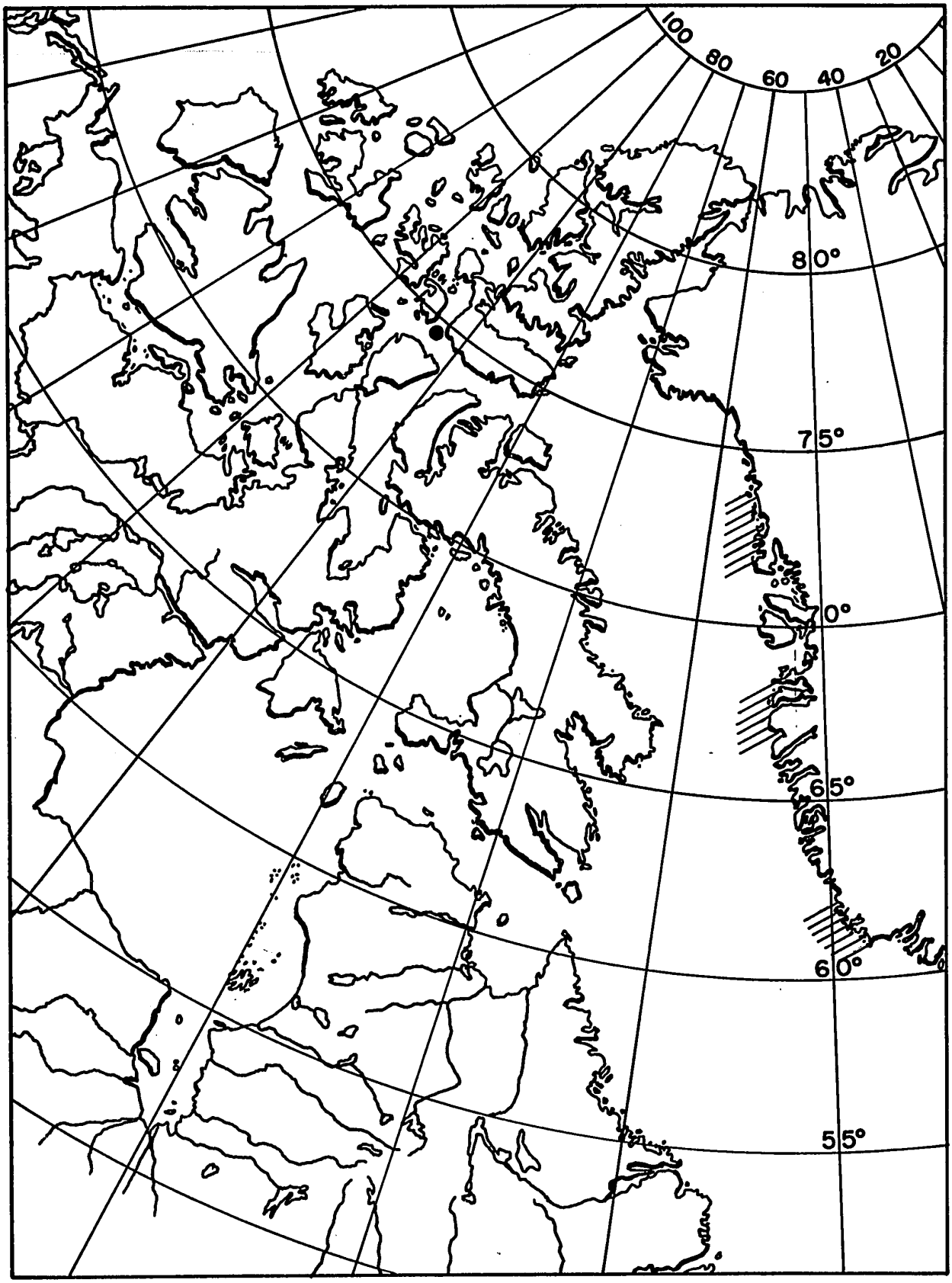


Map No. 22

Map No. 23

Distribution of *Limatula subauriculata* Mont.

in the Canadian Arctic

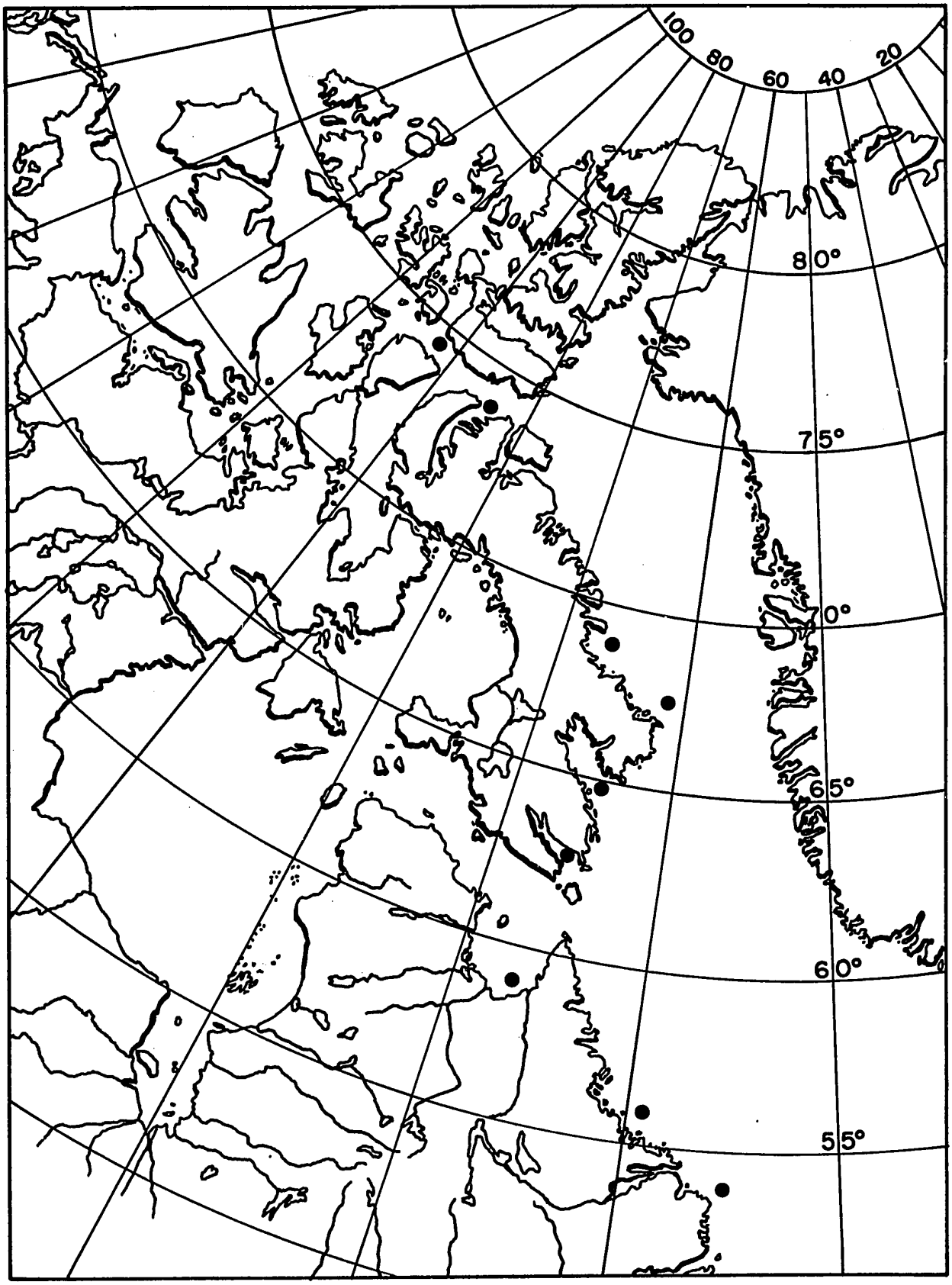


Map No.23

Map No. 24

Distribution of *Astarte arctica* (Gray)

in the Canadian Arctic



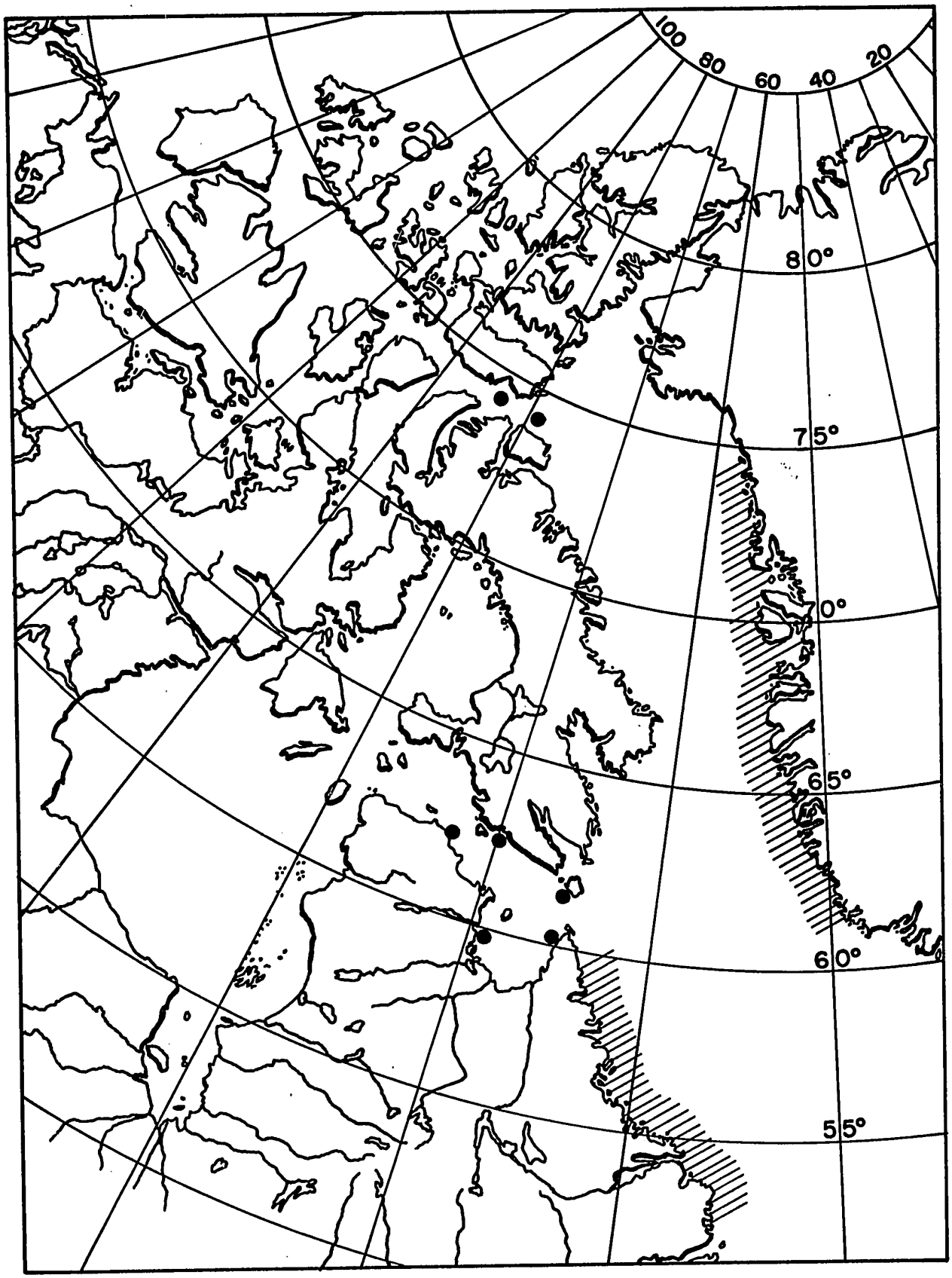
Map No.24

Map No. 25

Distribution of *Astarte banksi* (Leach)

and *A. globosa* Møll.

in the Canadian Arctic

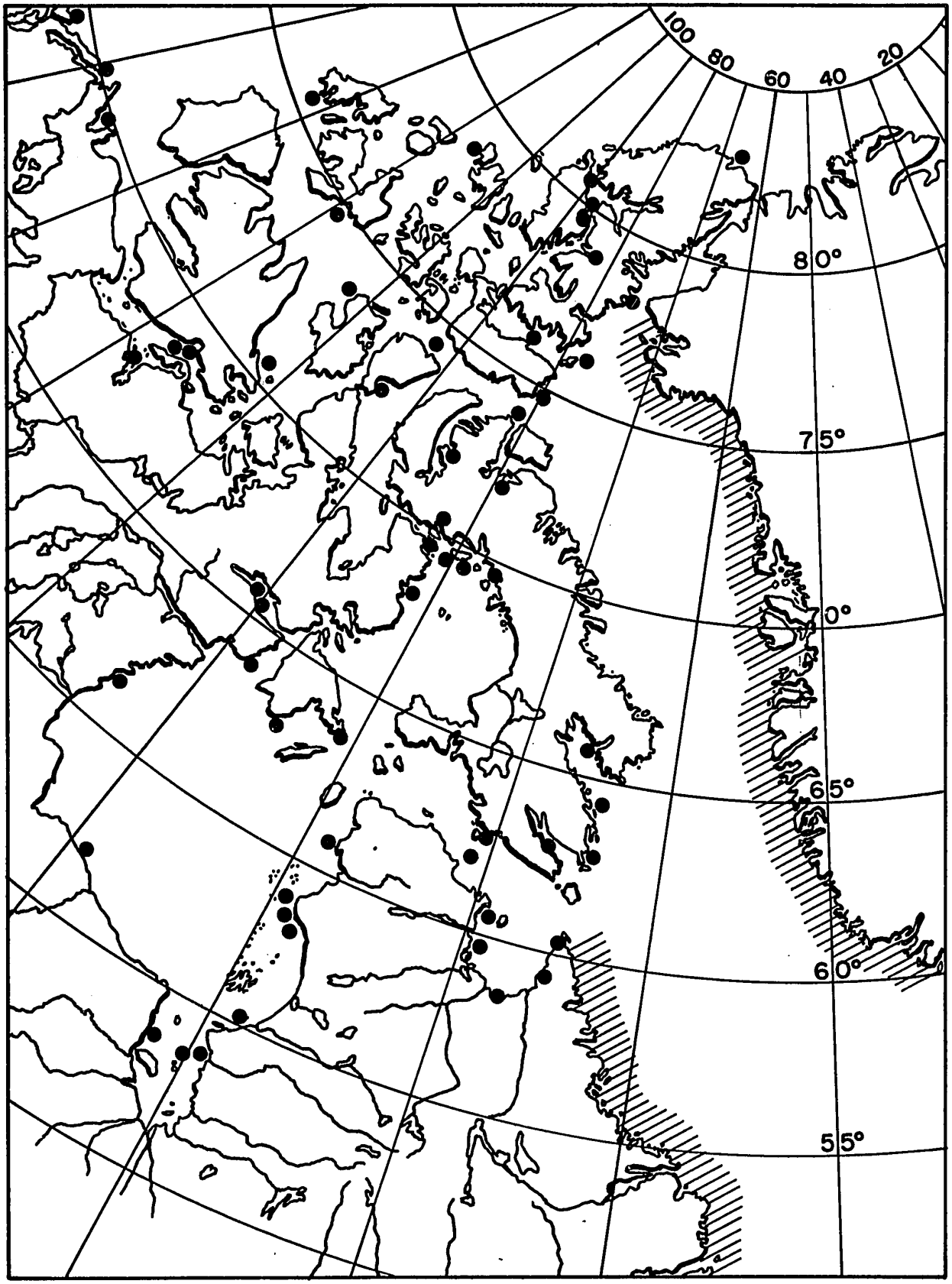


Map No.25

Map No. 26

Distribution of *Astarte borealis* (Schum.)

in the Canadian Arctic

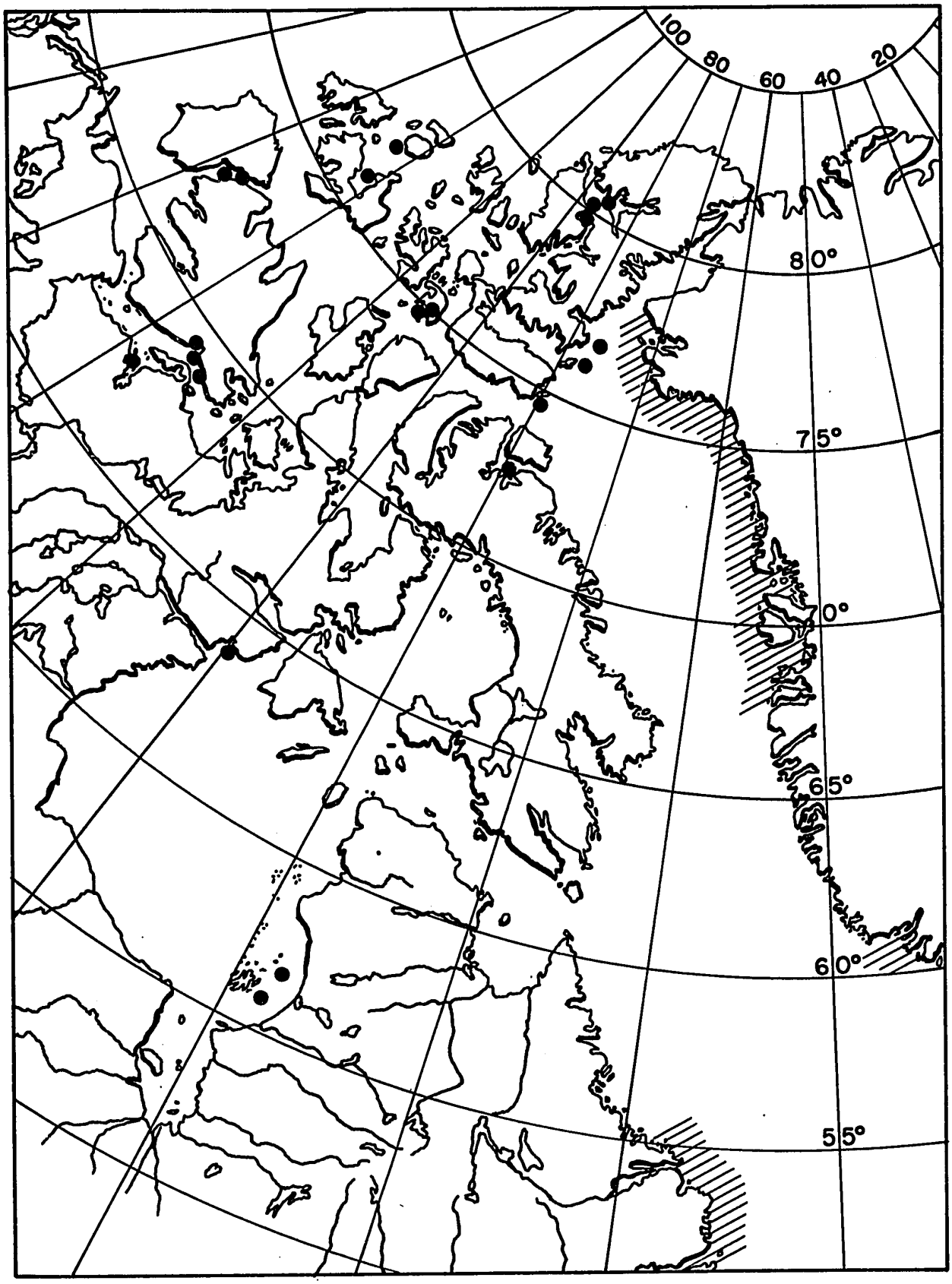


Map No.26

Map No. 27

Distribution of *Astarte crenata crenata* (Gray)

in the Canadian Arctic



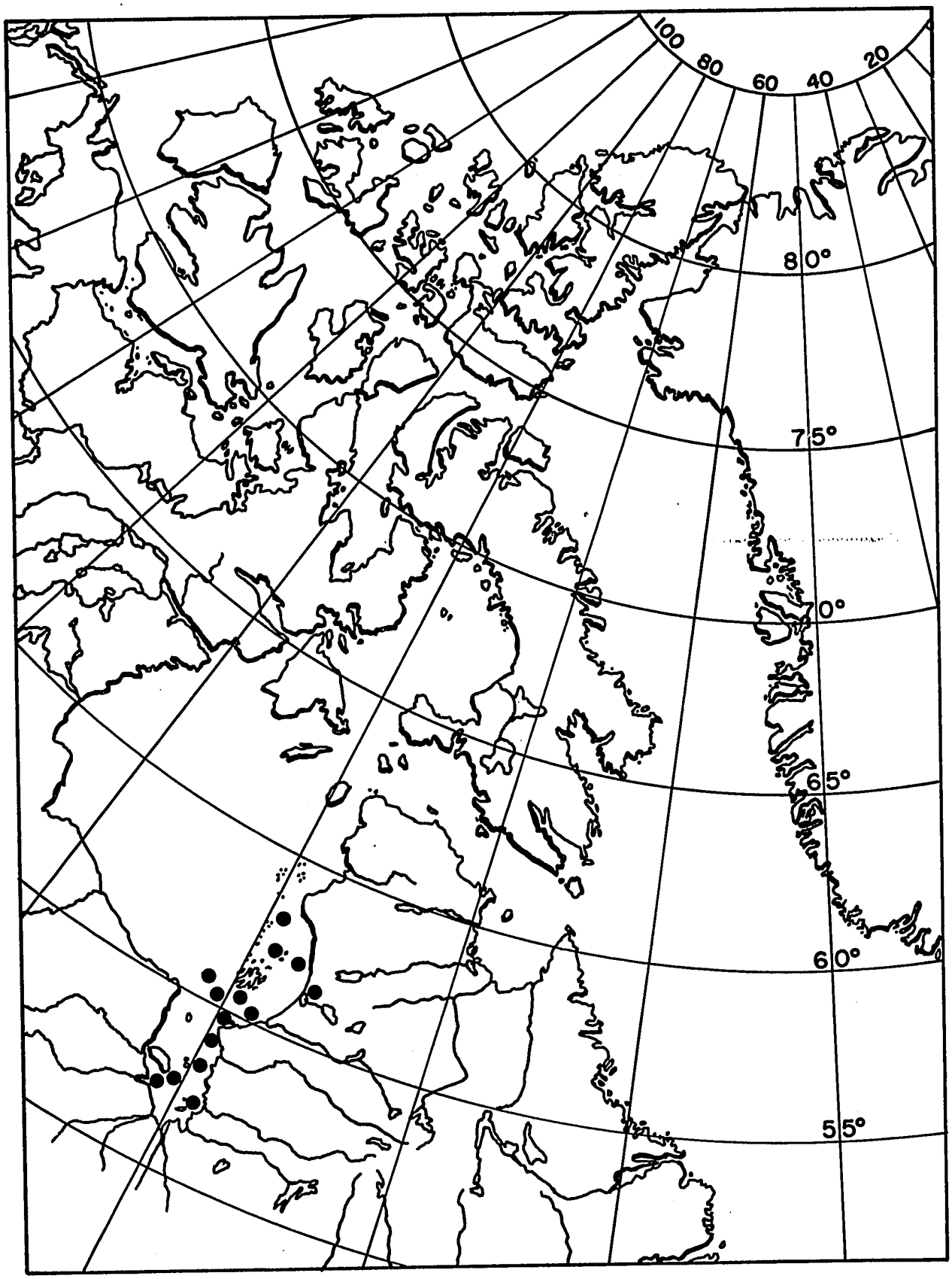
Map No.27

Map No. 28

Distribution of Astarte crenata crebricostata

Andrews and Forbes

in the Canadian Arctic

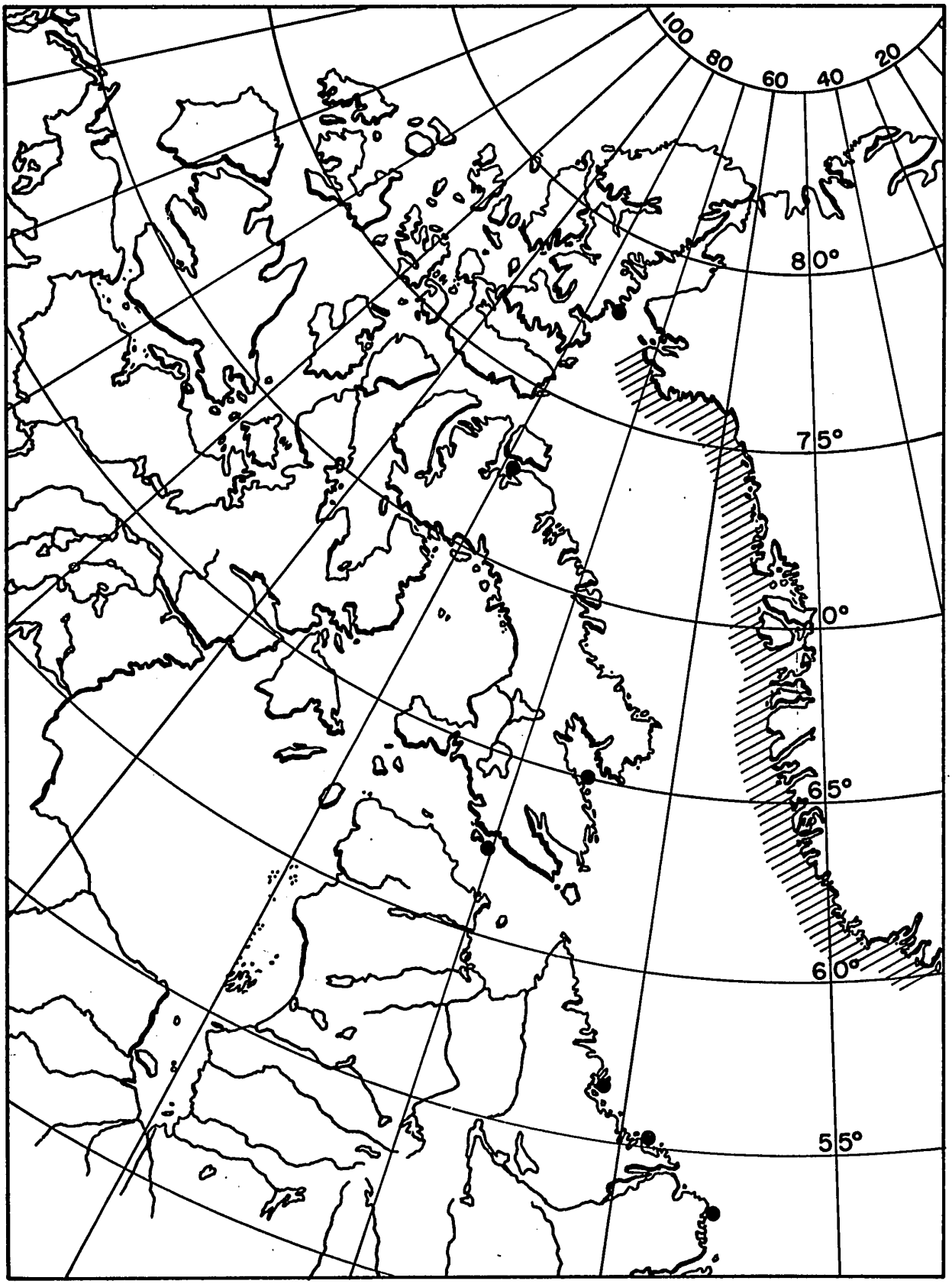


Map No.28

Map No. 29

Distribution of *Astarte elliptica* (Brown)

in the Canadian Arctic

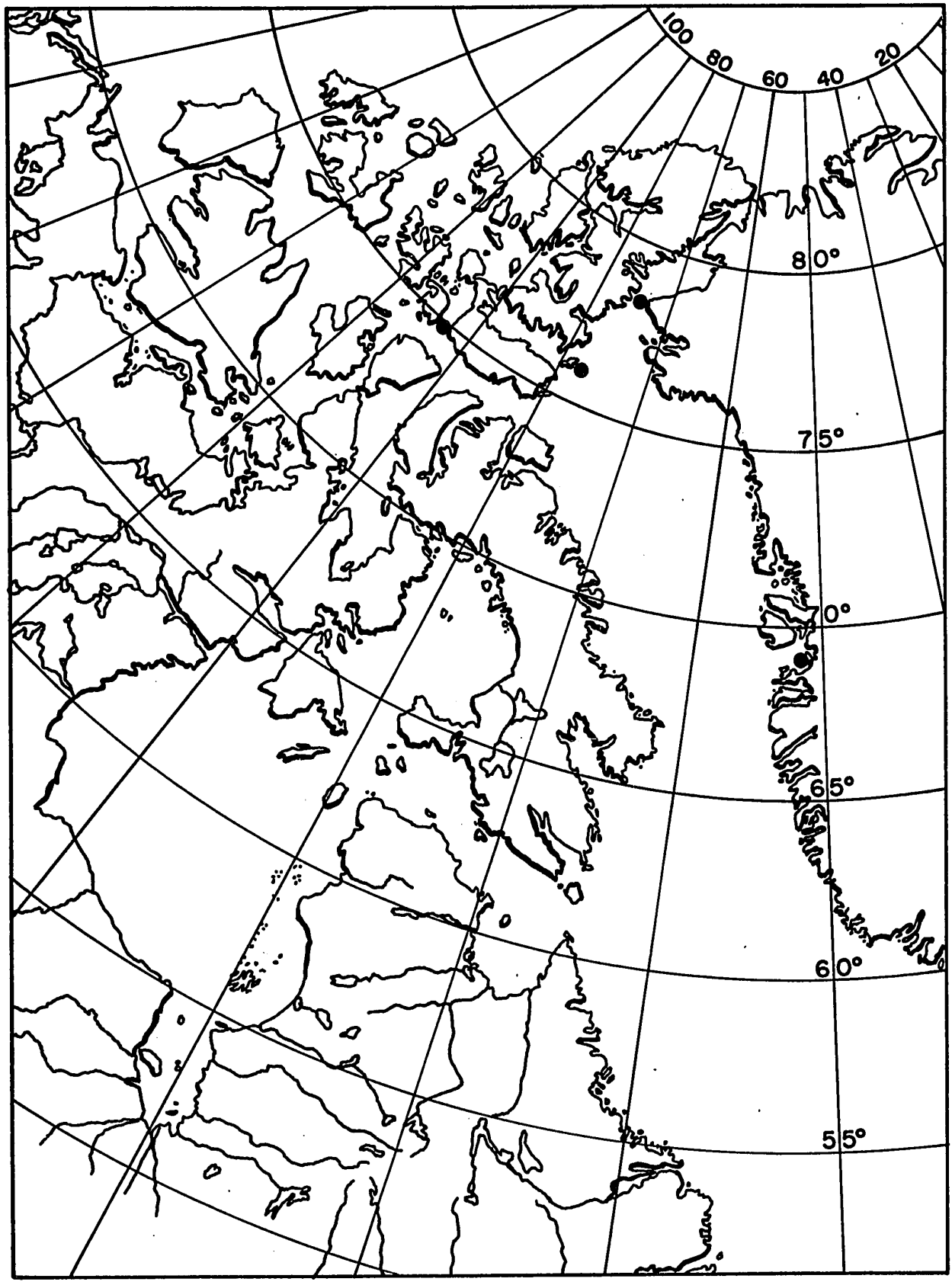


Map No. 29

Map No. 30

Distribution of *Astarte soror* Dall

in the Canadian Arctic

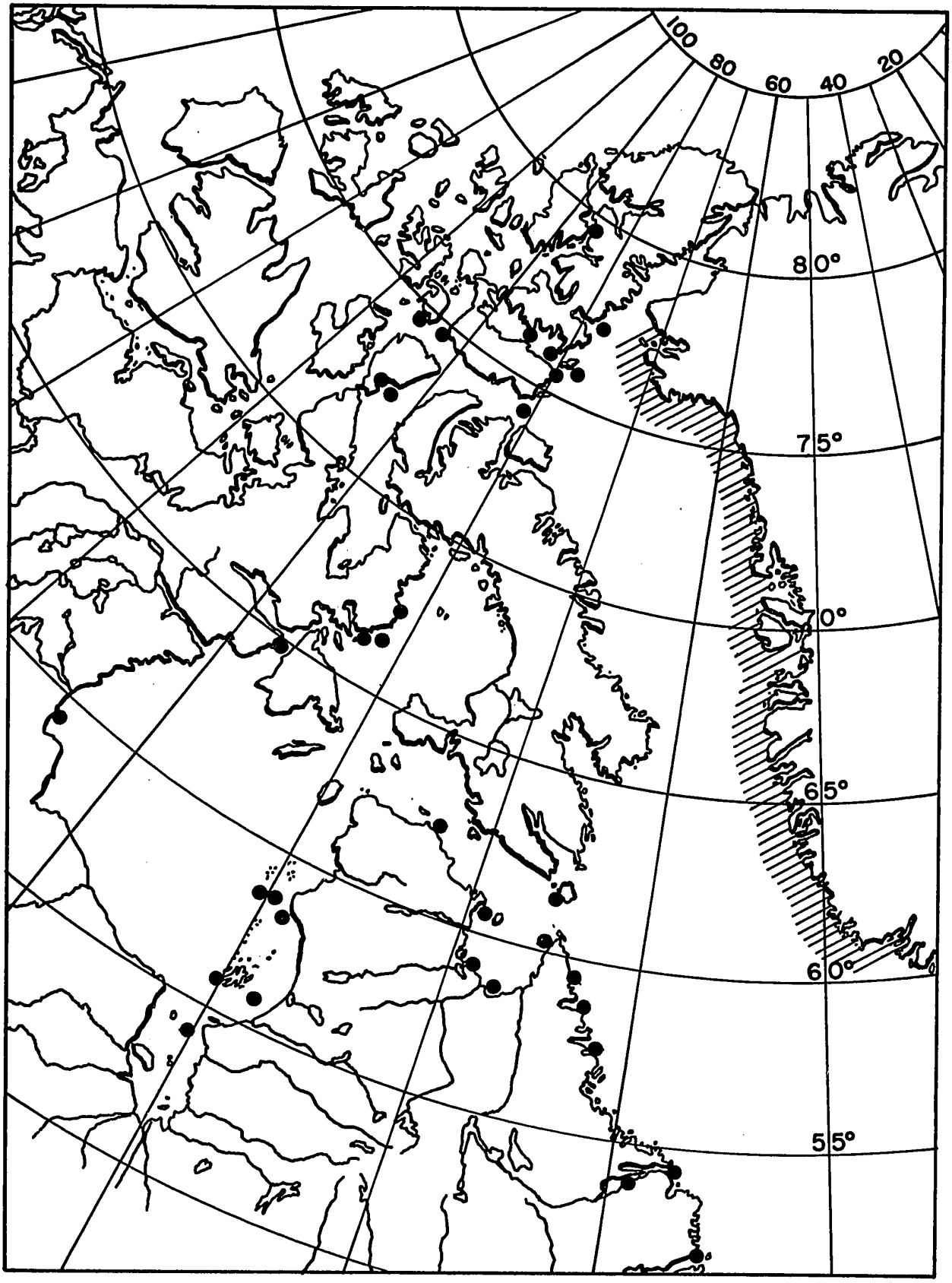


Map No. 30

Map No. 31

Distribtuion of *Astarte striata* (Leach)

in the Canadian Arctic

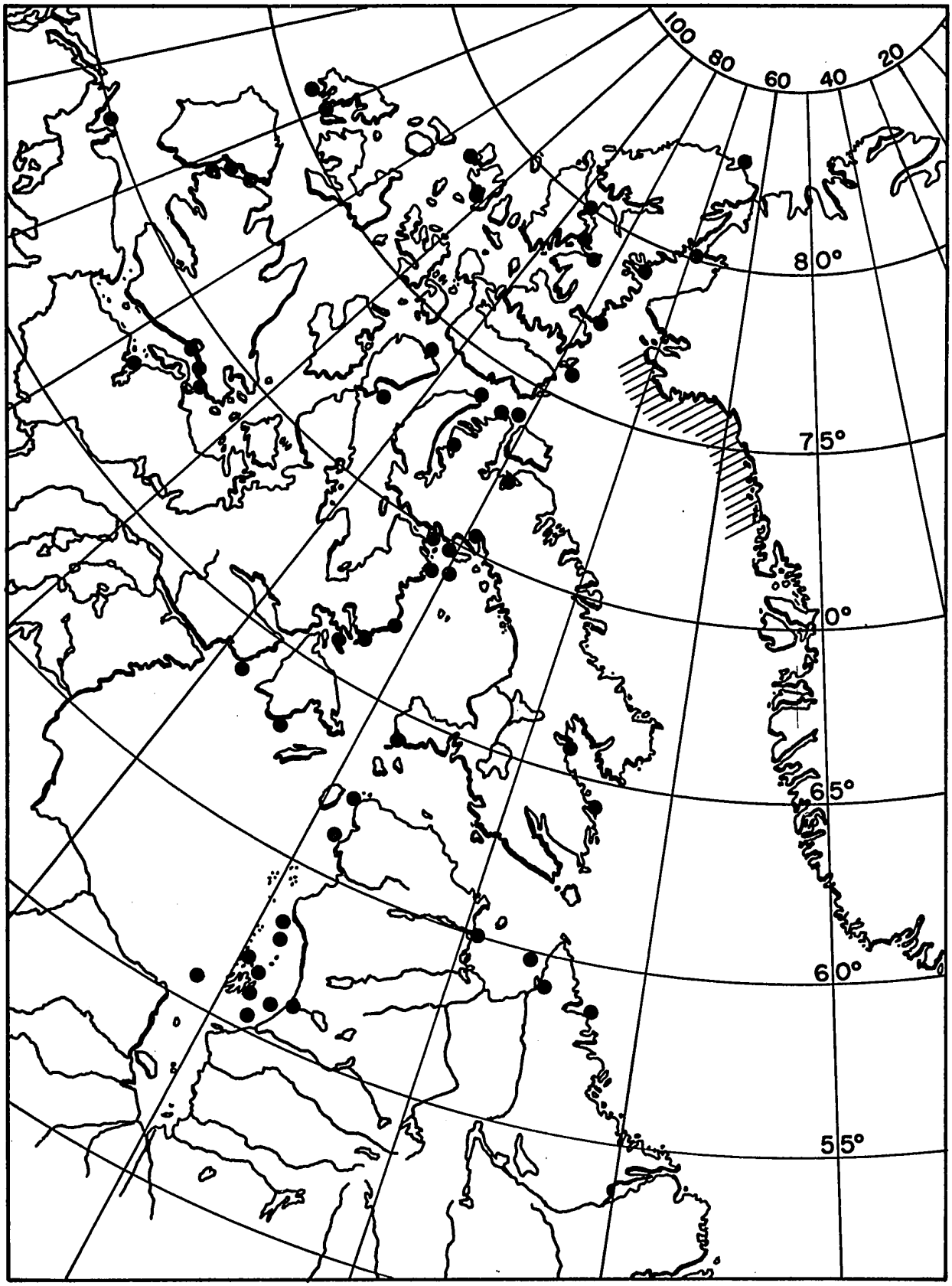


Map No.31

Map No. 32

Distribution of *Astarte warhami* Hancock

in the Canadian Arctic

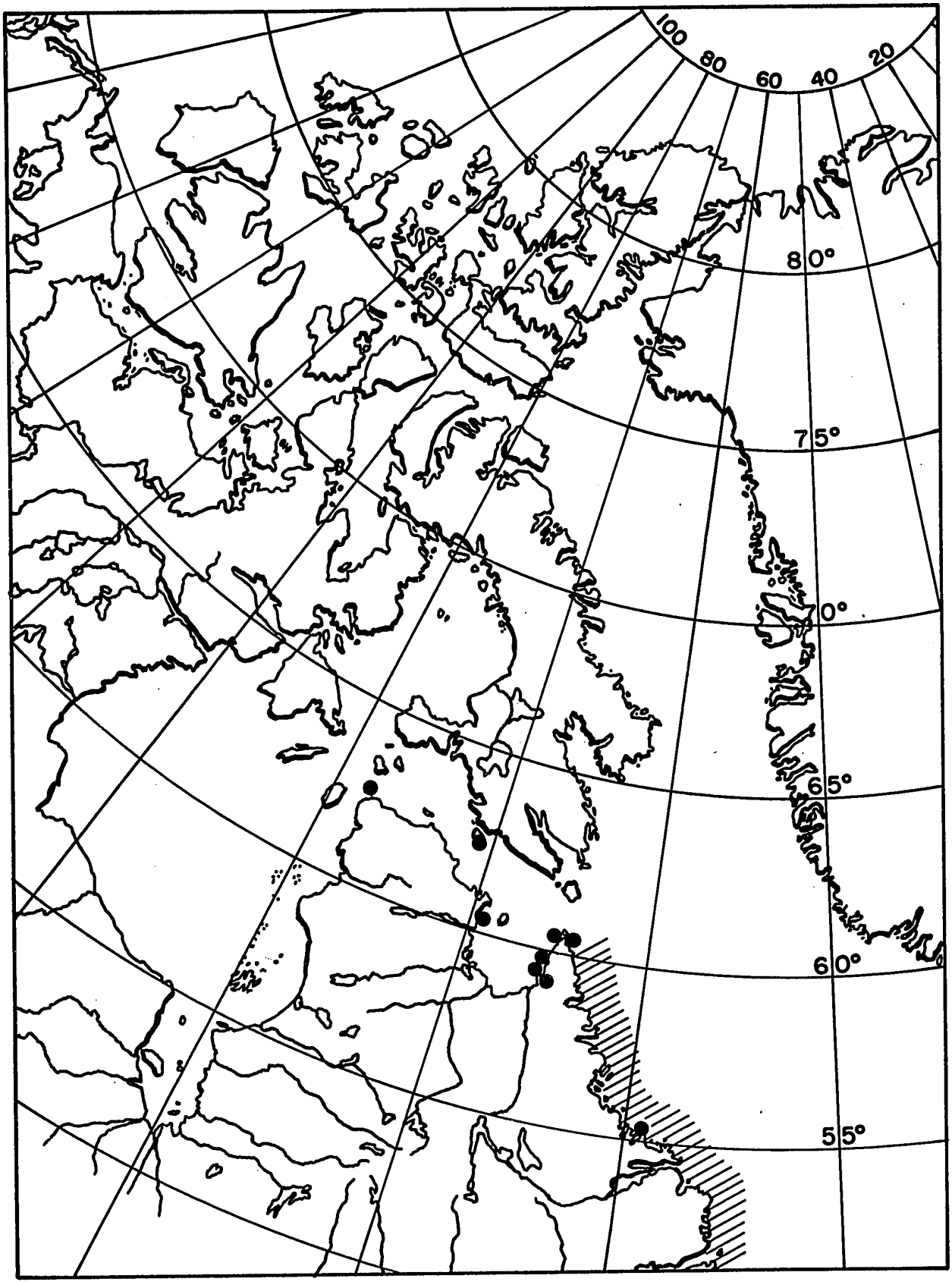


Map No.32

Map No. 33

Distribution of Venericardia borealis (Conrad)

in the Canadian Arctic

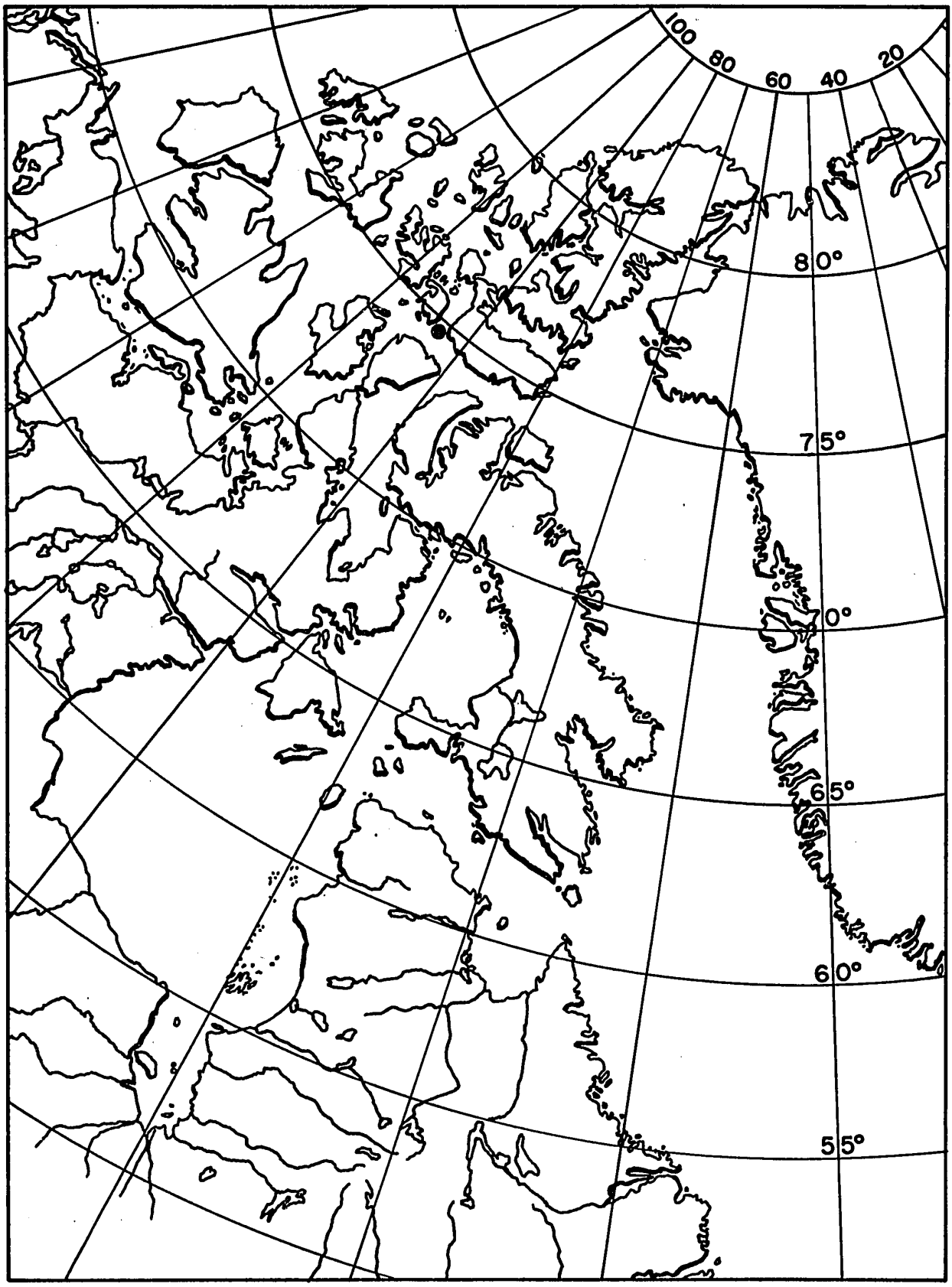


Map No.33

Map No. 34

Distribution of Montacuta substriata (Mont.)

in the Canadian Arctic

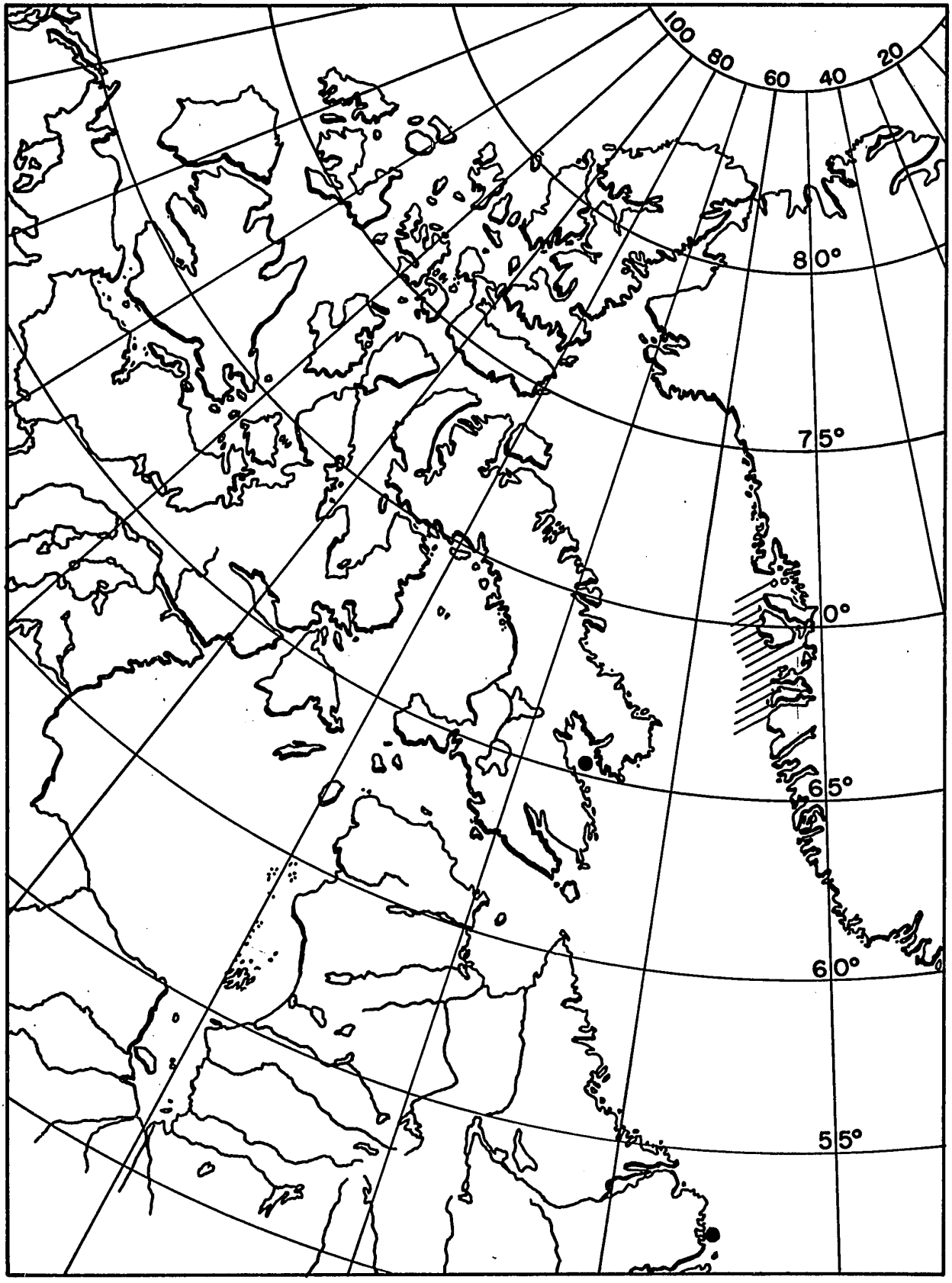


Map No. 34

Map No. 35

Distribution of *Turtonia minuta* (Fabr.)

in the Canadian Arctic

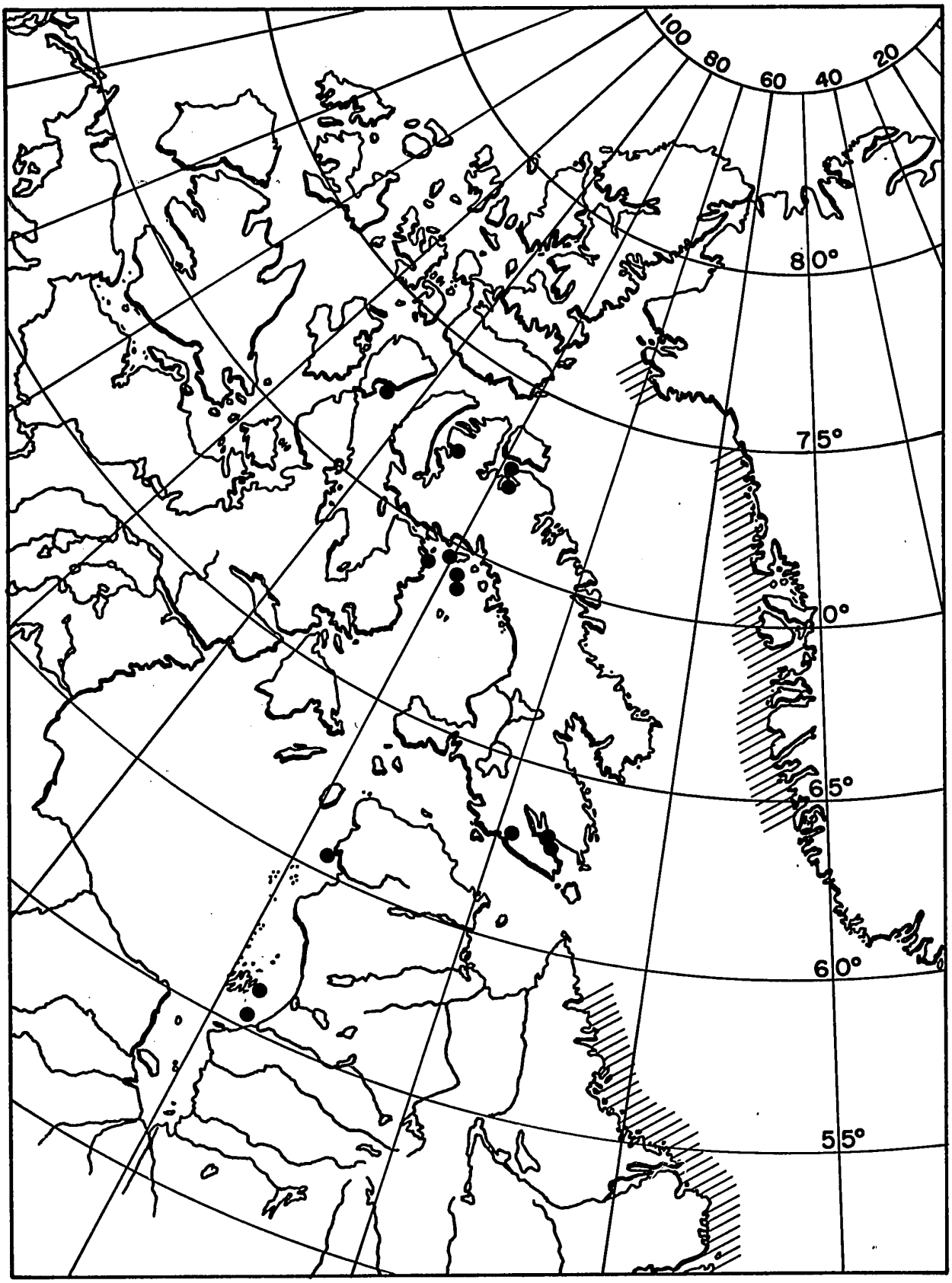


Map No. 35

Map No. 36

Distribution of Axinopsida orbiculata (G.O. Sars)

in the Canadian Arctic

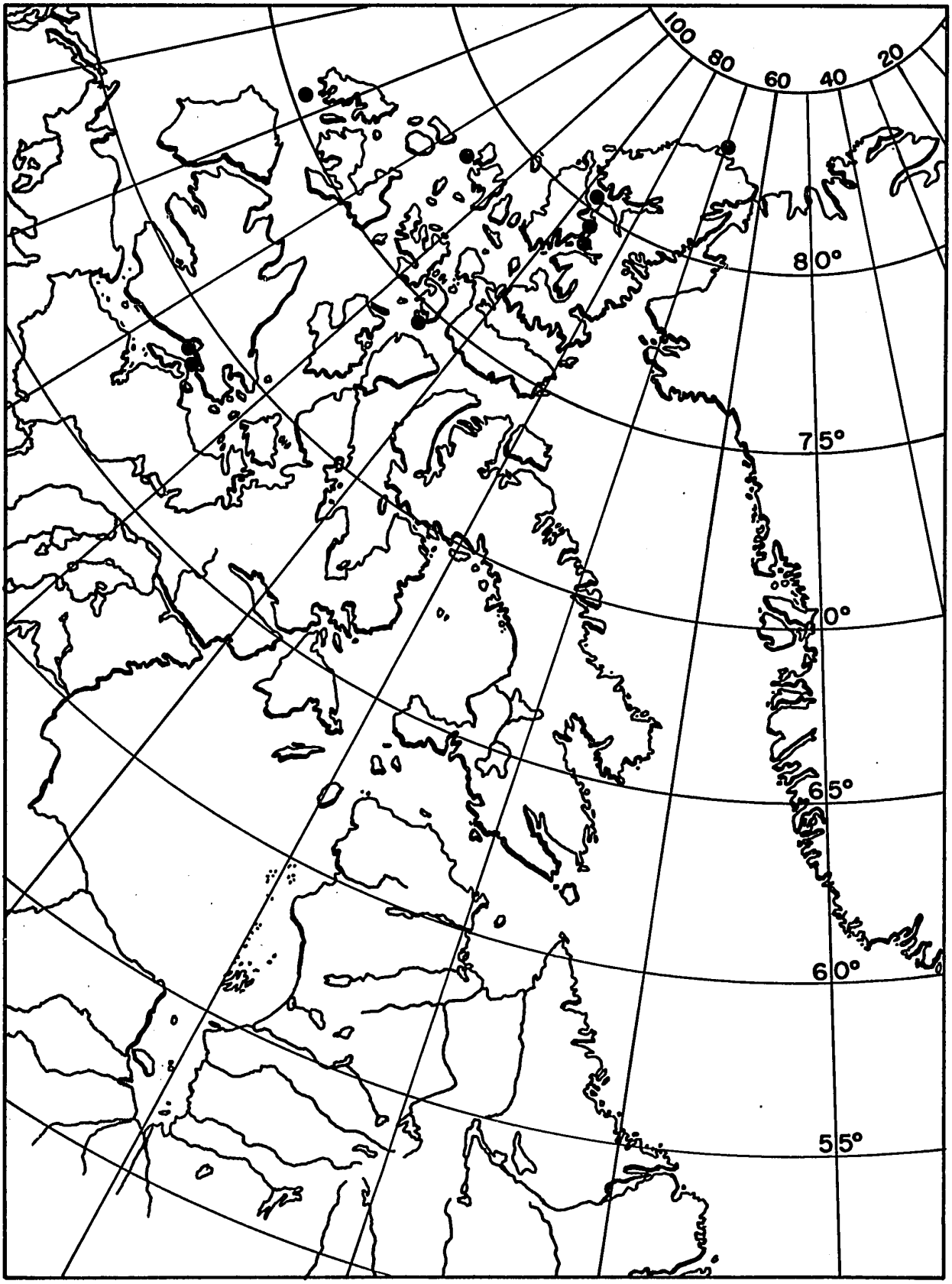


Map No.36

Map No. 37

Distribution of Thyasira dunbari sp. nov.

in the Canadian Arctic

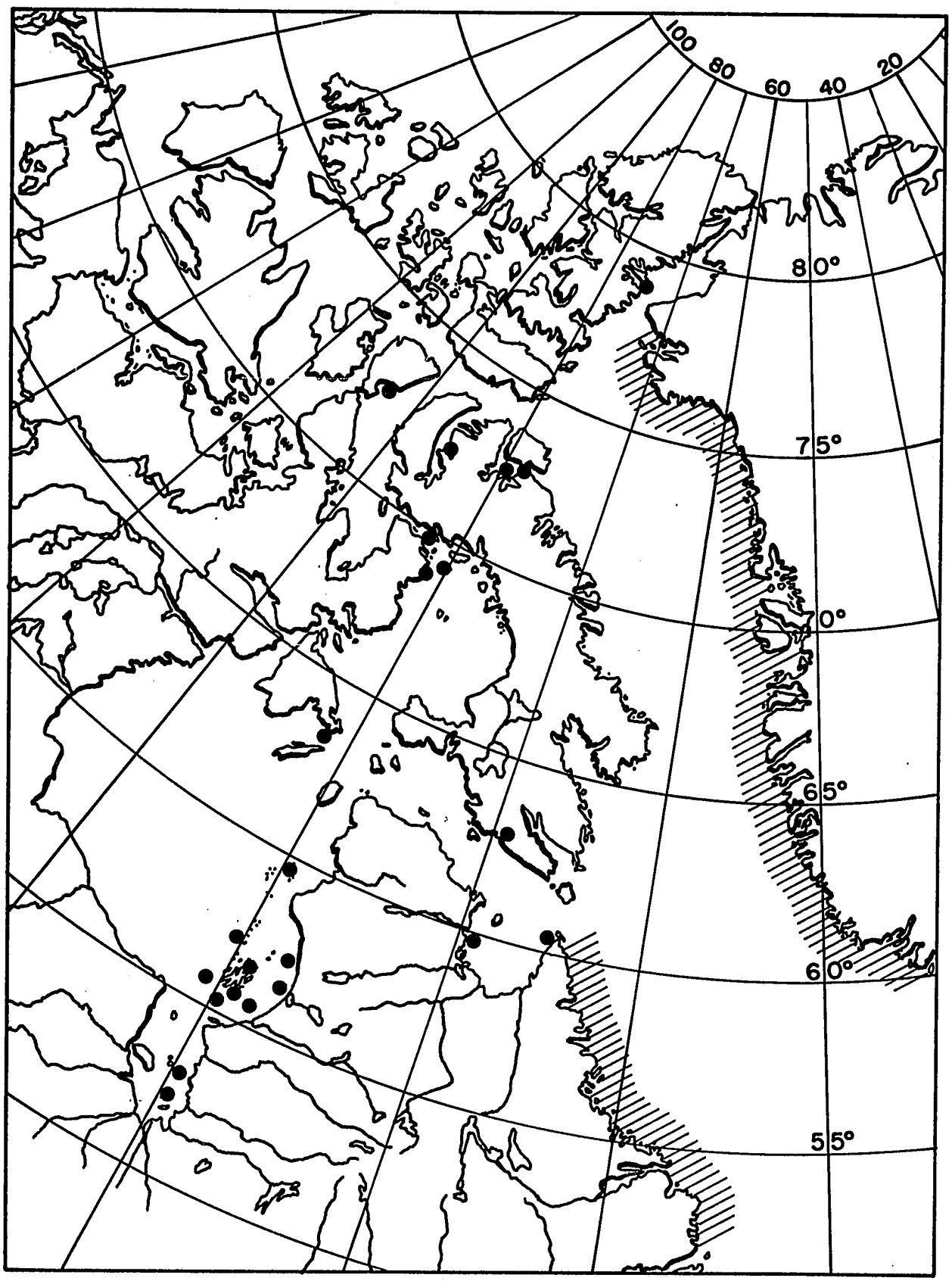


Map No.37

Map No. 38

Distribution of Thyasira gouldi (Phil.)

in the Canadian Arctic

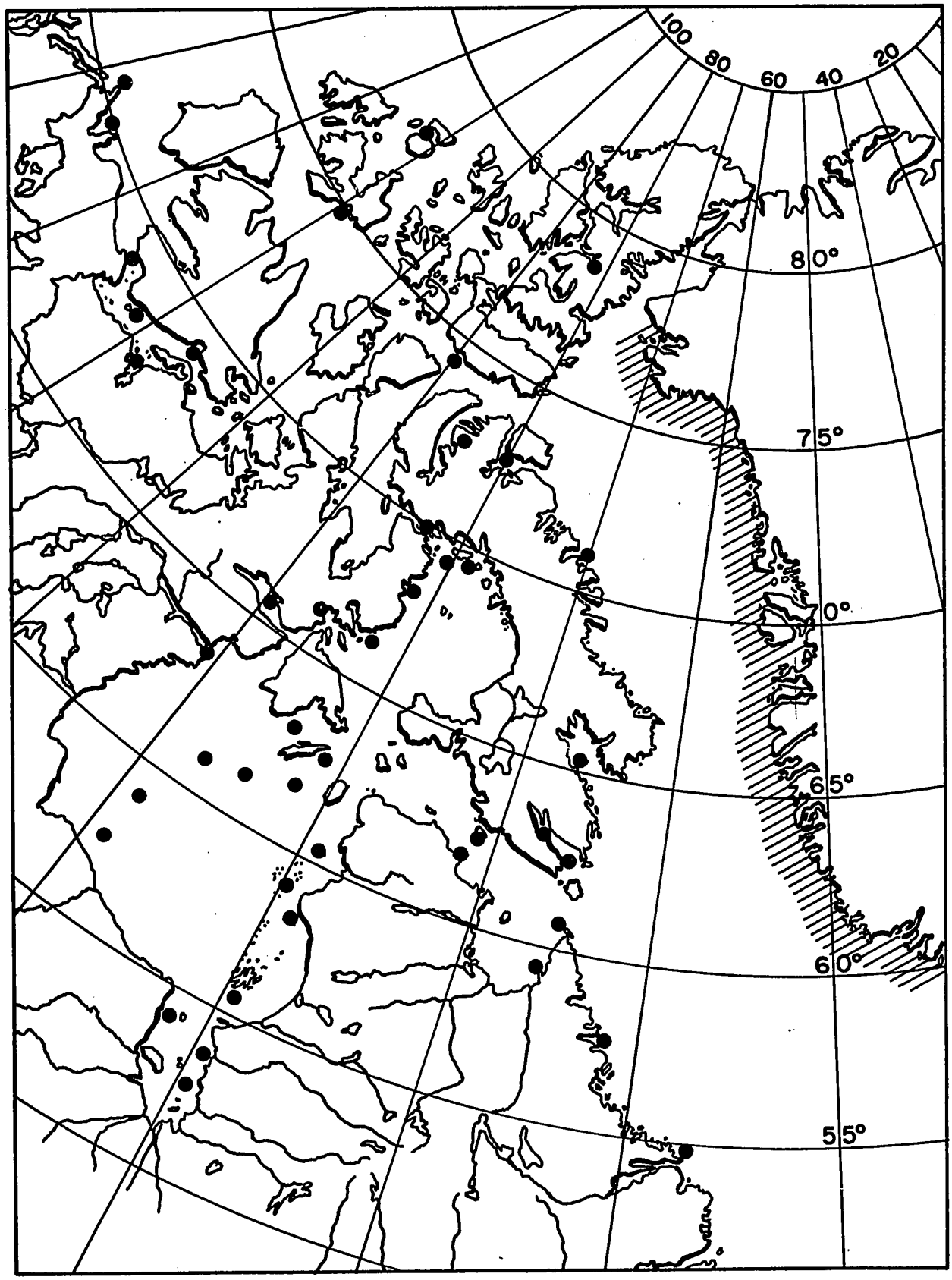


Map No.38

Map No. 39

Distribution of *Clinocardium ciliatum* (Fabr.)

in the Canadian Arctic

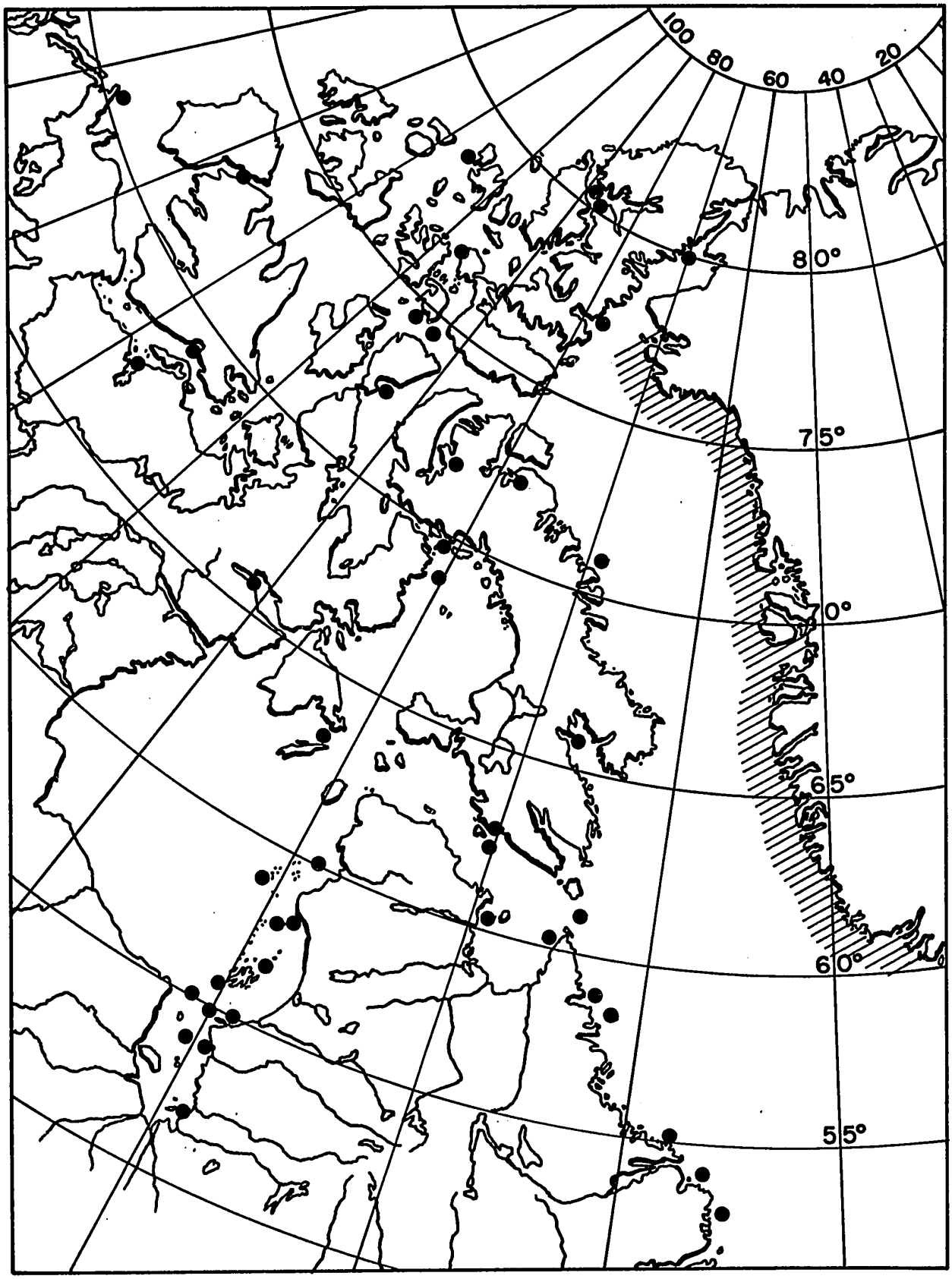


Map No.39

Map No. 40

Distribution of Serripes groenlandicus (Bruggiere)

in the Canadian Arctic

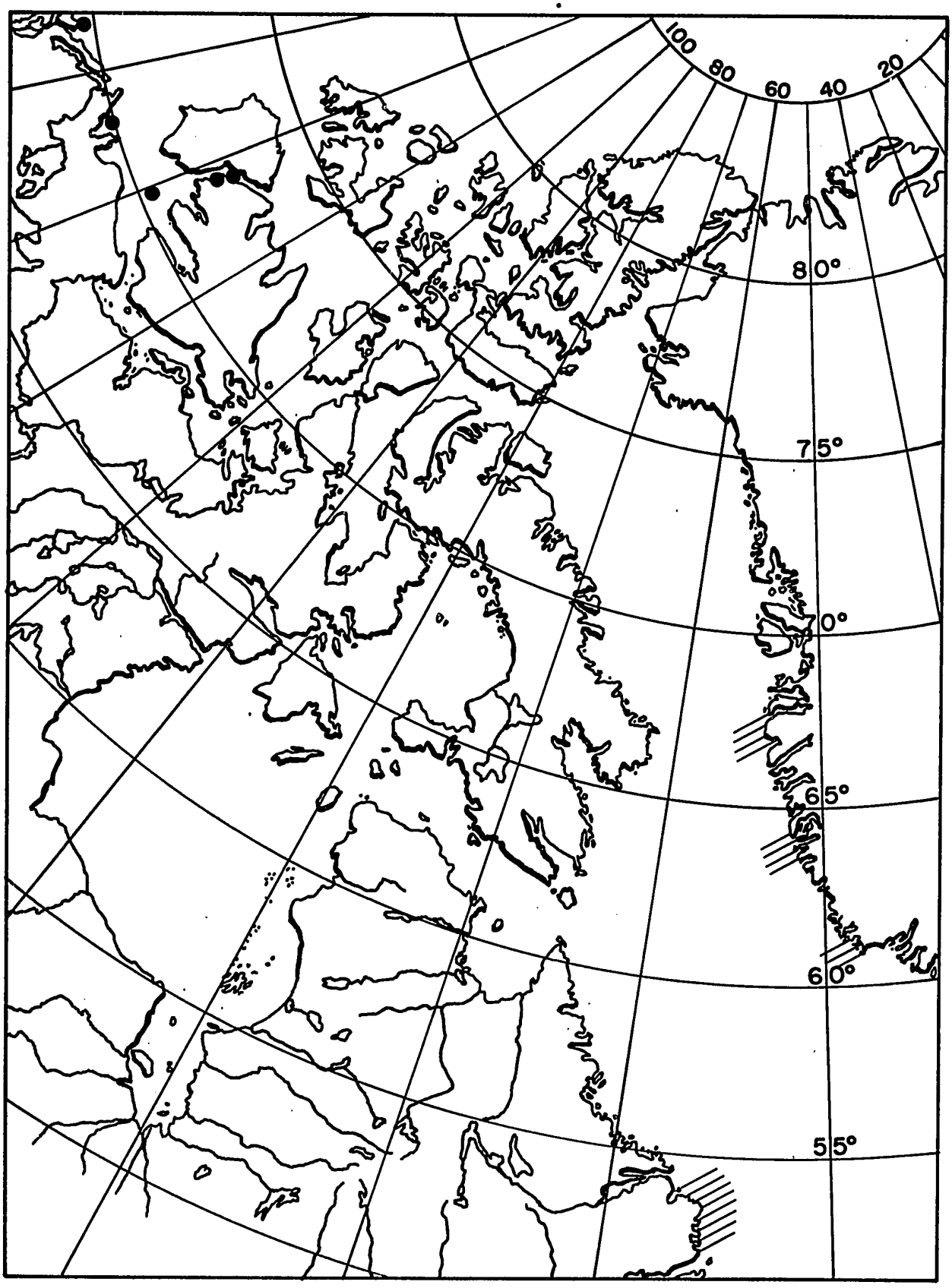


Map No. 40

Map No. 41

Distribution of *Liocyma fluctuosa* (Gould)

in the Canadian Arctic

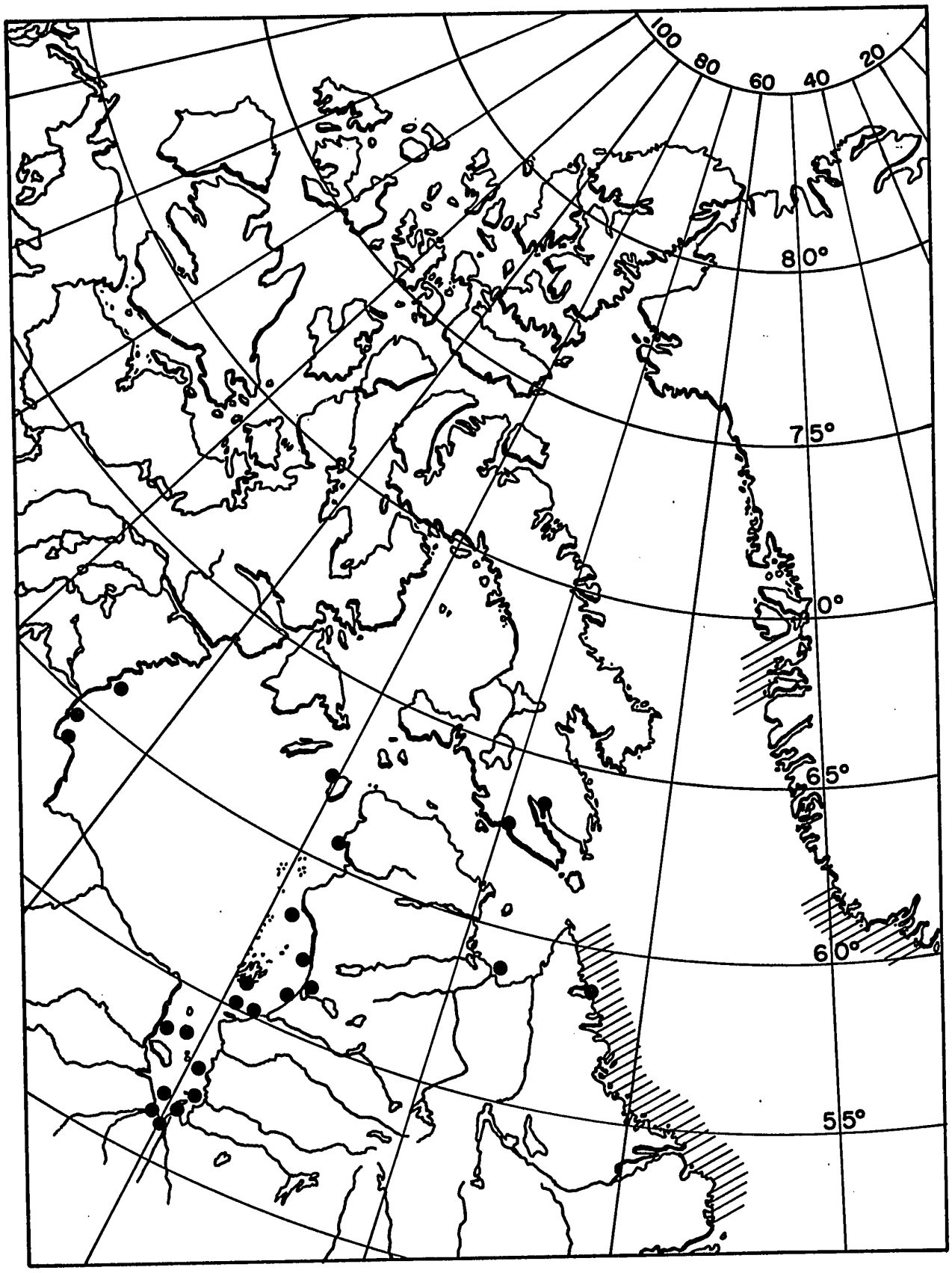


Map No.41

Map No. 42

Distribution of Macoma balthica (Linné)

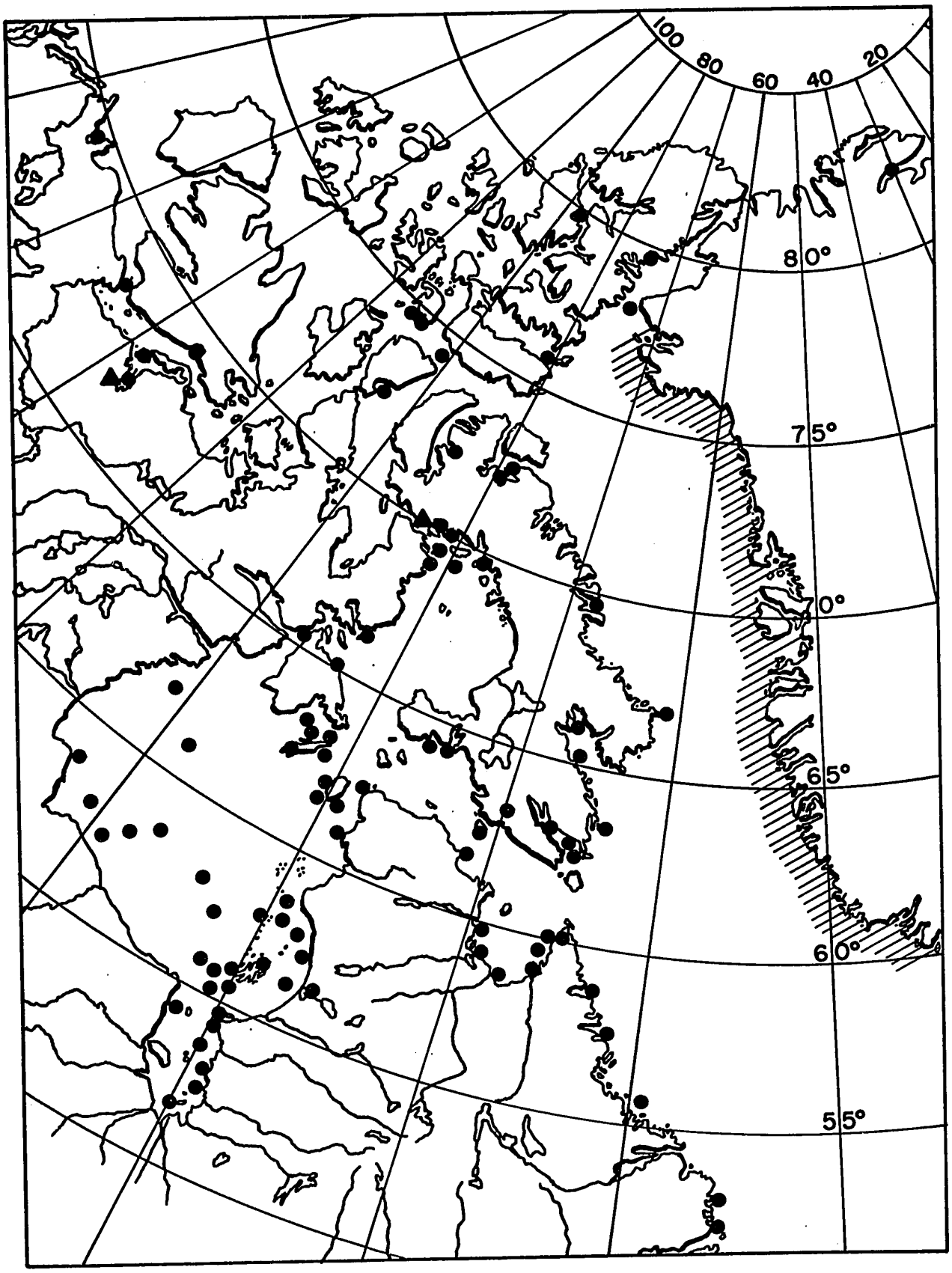
in the Canadian Arctic



Map No. 42

Map No. 43

Distribution of *Macoma calcarea* (Gmelin)
and *M. calcarea* var. *obliqua* Soot-Ryen, trangles,
in the Canadian Arctic

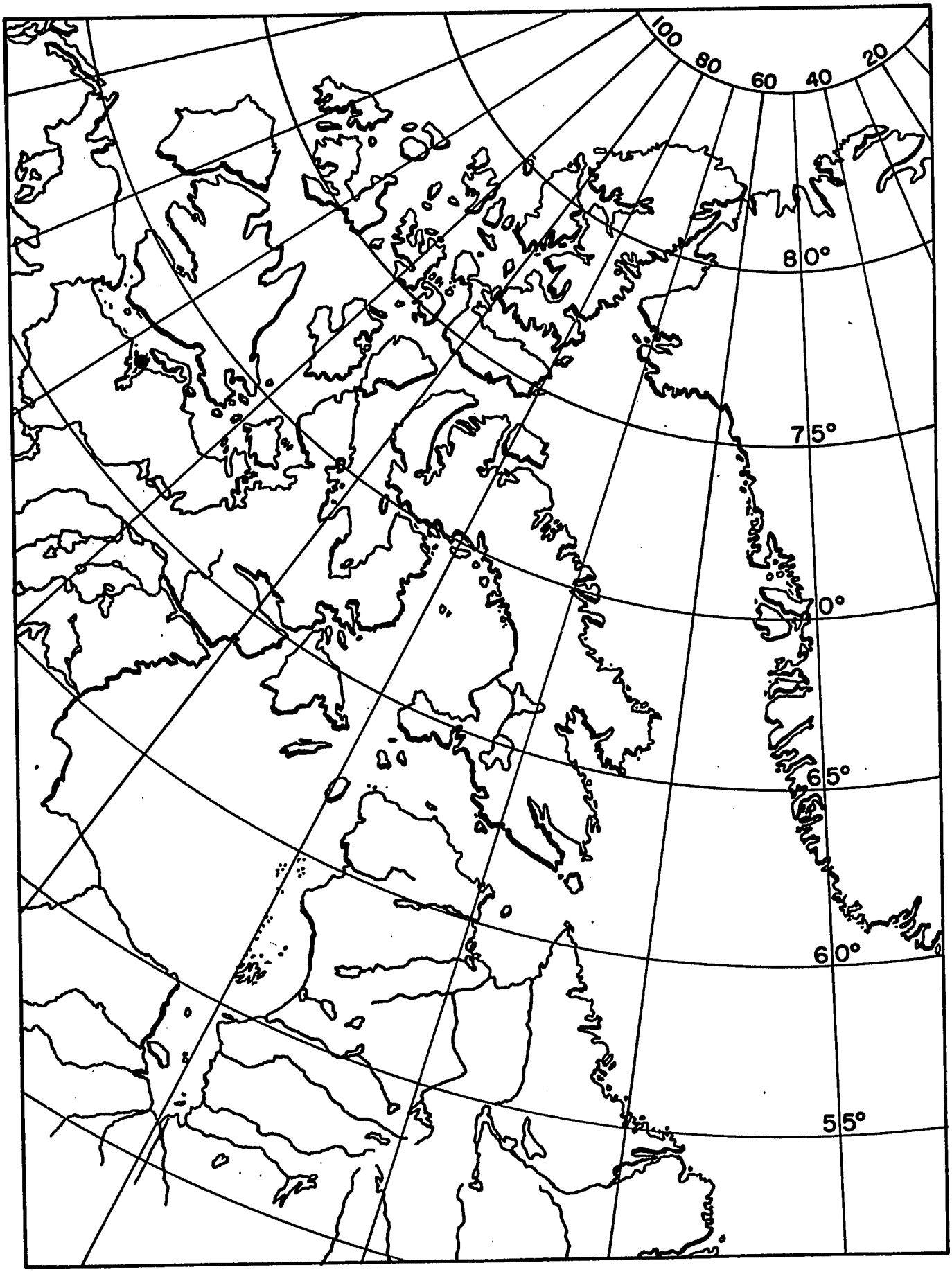


Map No. 43

Map No. 44

Distribution of Macoma inconspicua (Brod. and Sow.)

in the Canadian Arctic

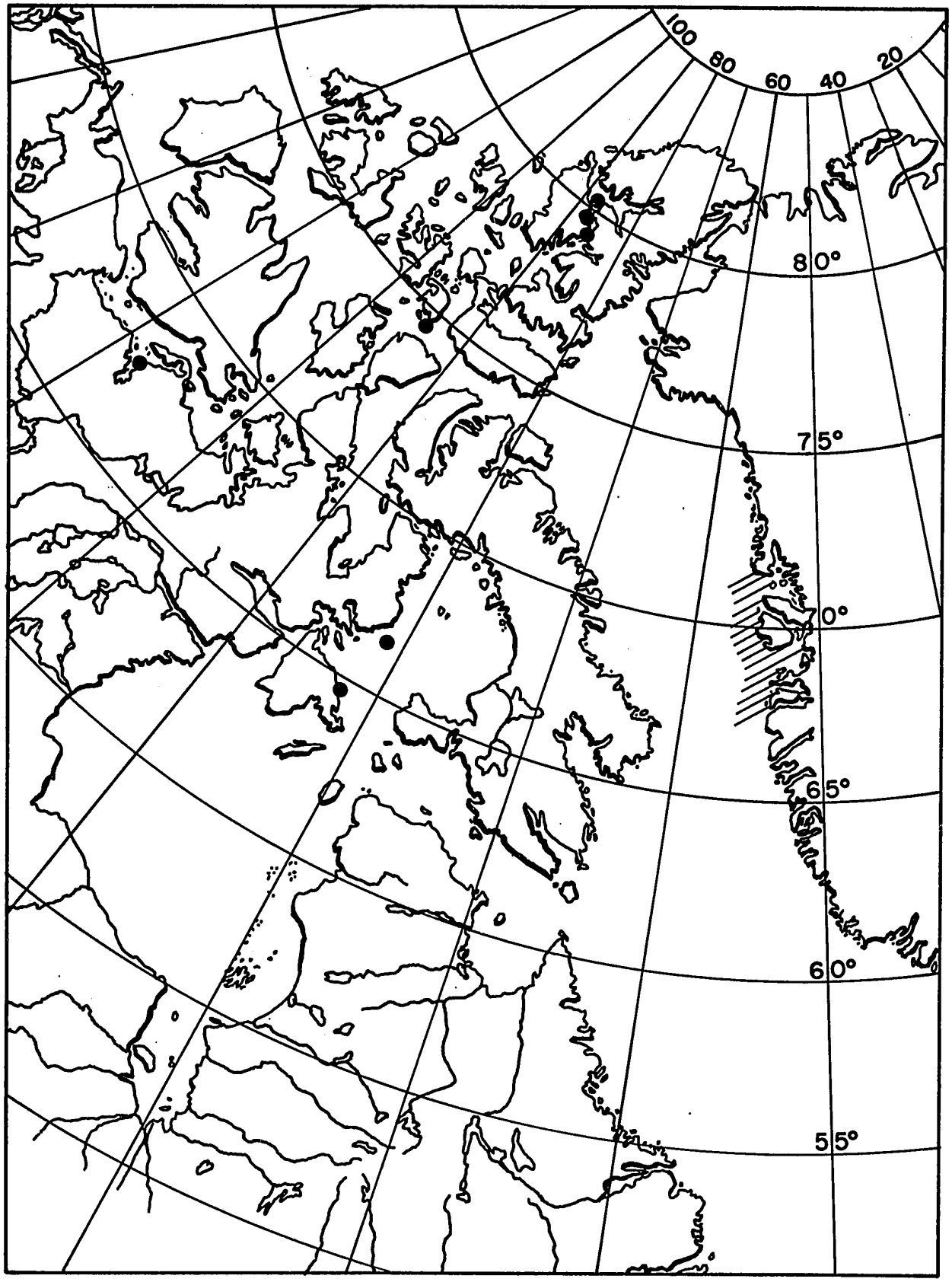


Map No.44

Map No. 45

Distribution of *Macoma loveni* (Steenstrup) Jensen

in the Canadian Arctic

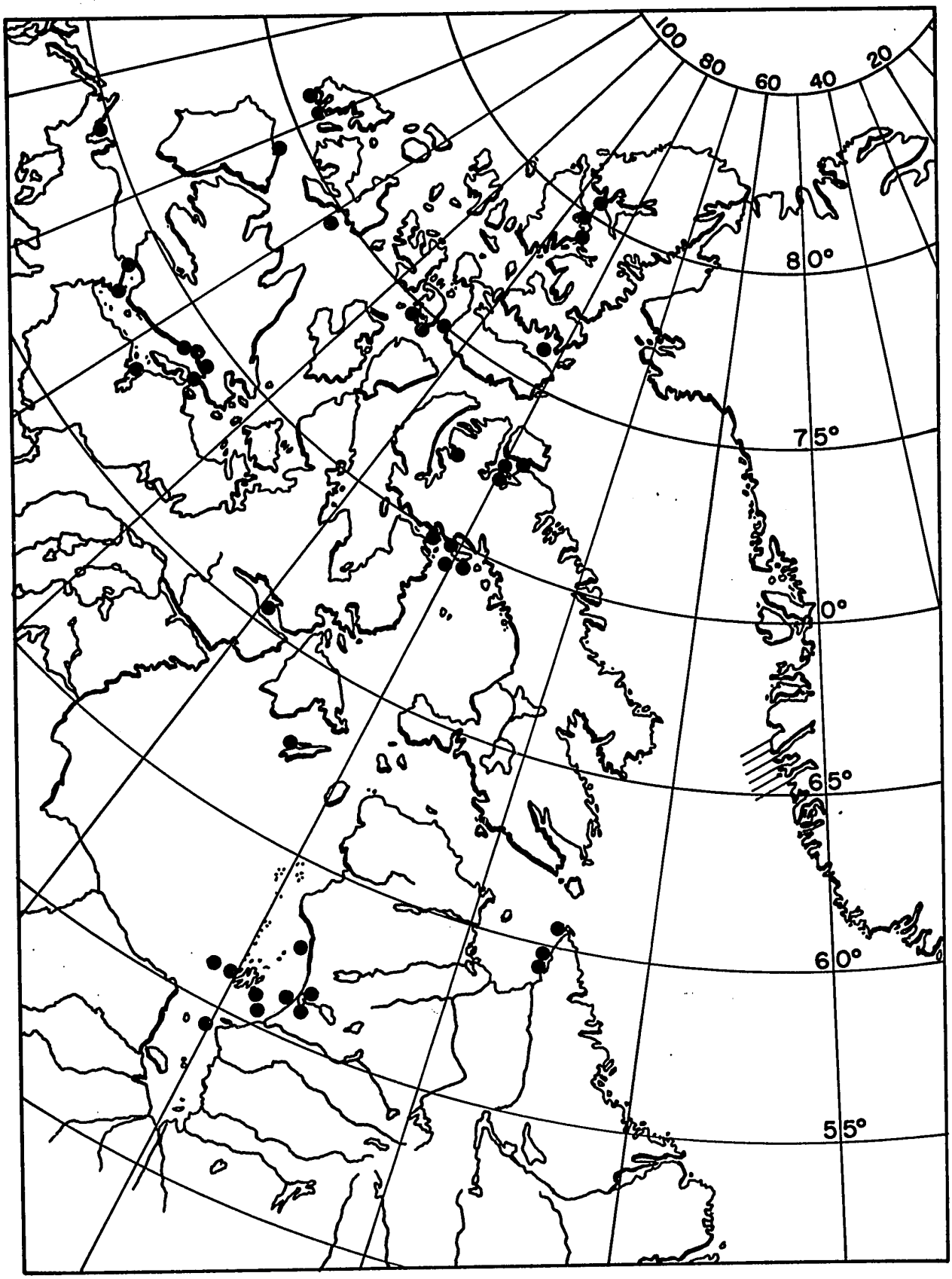


Map No. 45

Map No. 46

Distribution of *Macoma moesta* (Deshayes)

in the Canadian Arctic

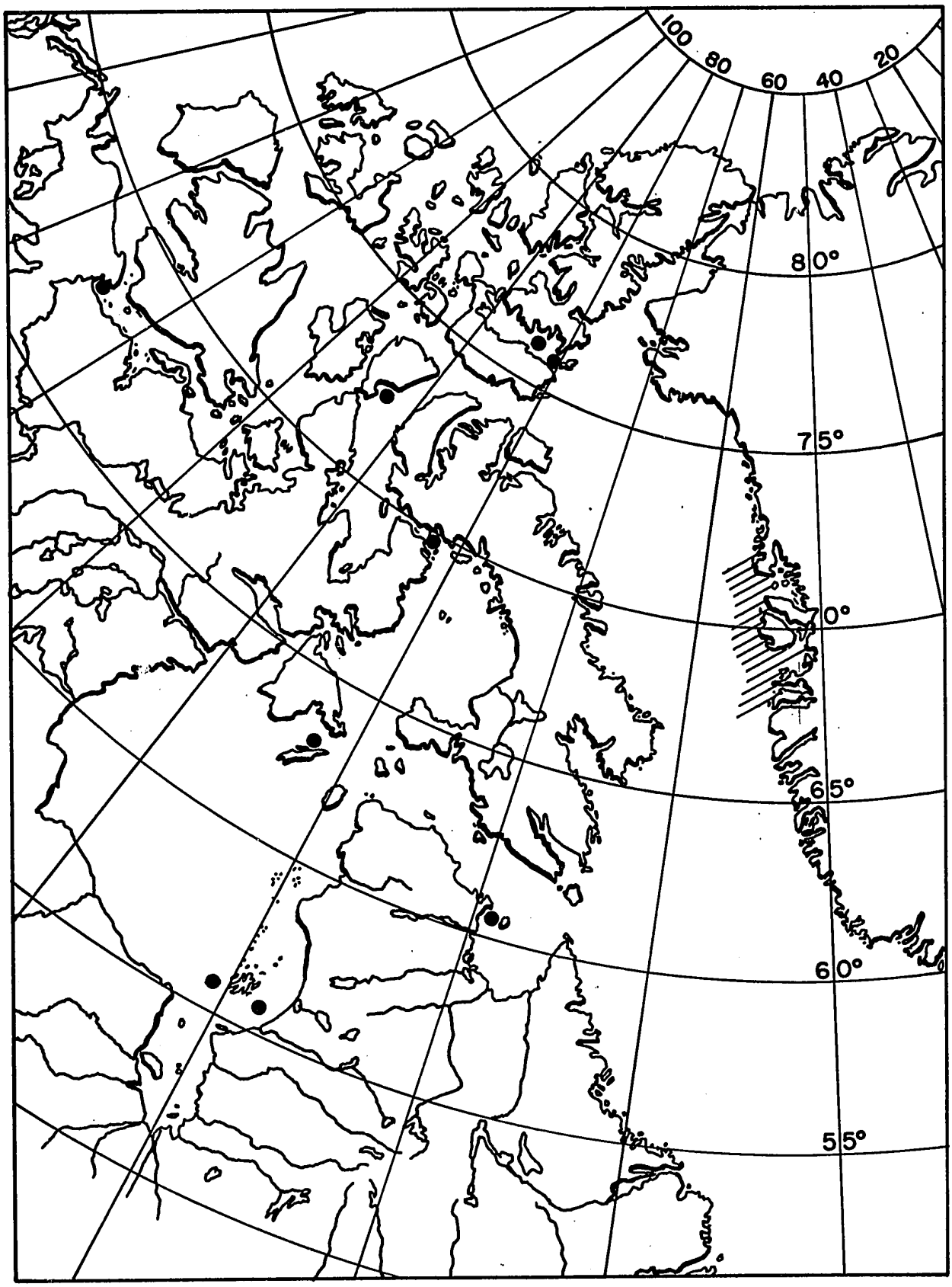


Map No. 46

Map No. 47

Distribution of Macoma torelli (Steenstrup) Jensen

in the Canadian Arctic

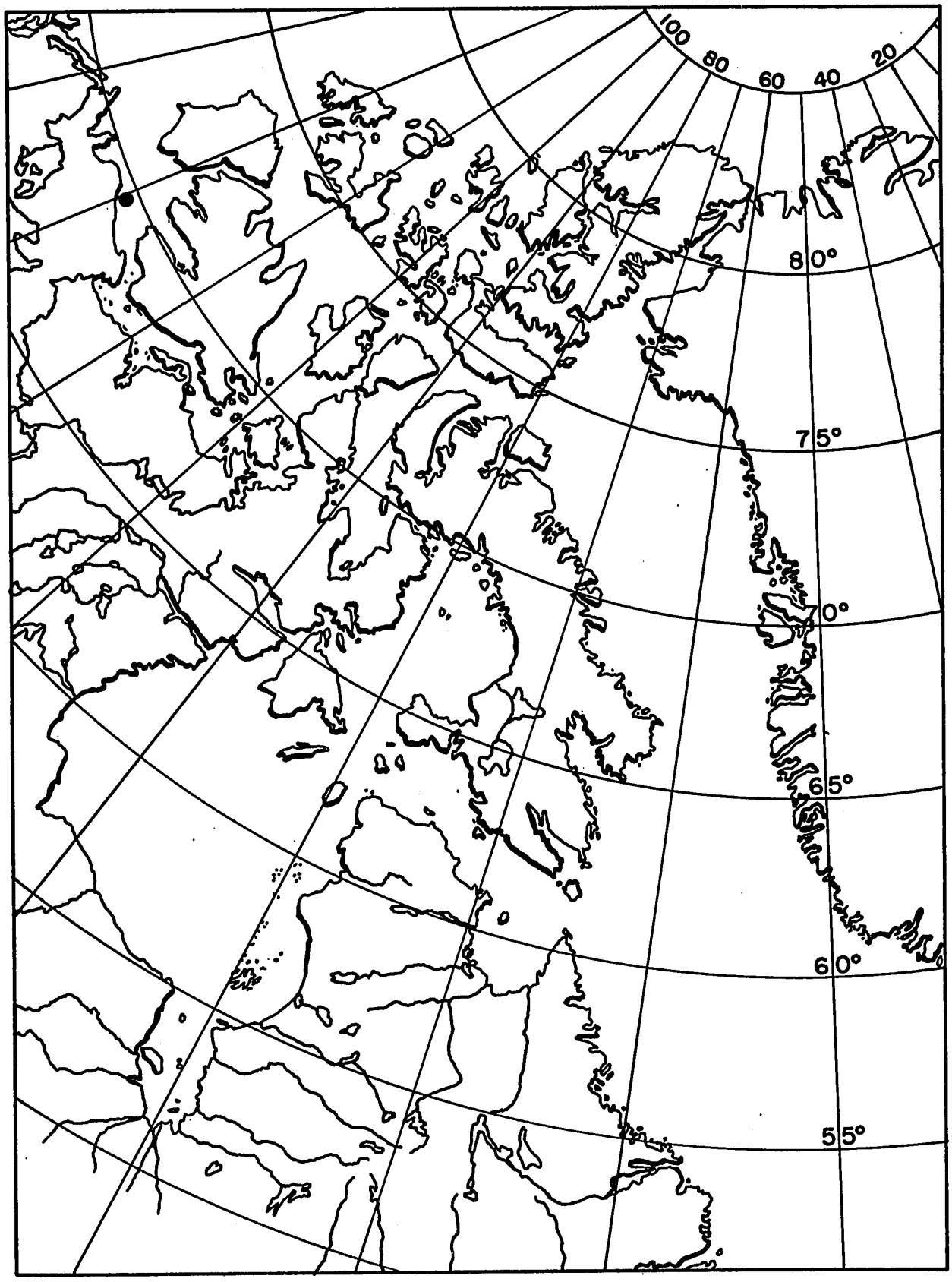


Map No.47

Map No. 48

Distribution of Macoma planiuscula Grant and Gale

in the Canadian Arctic

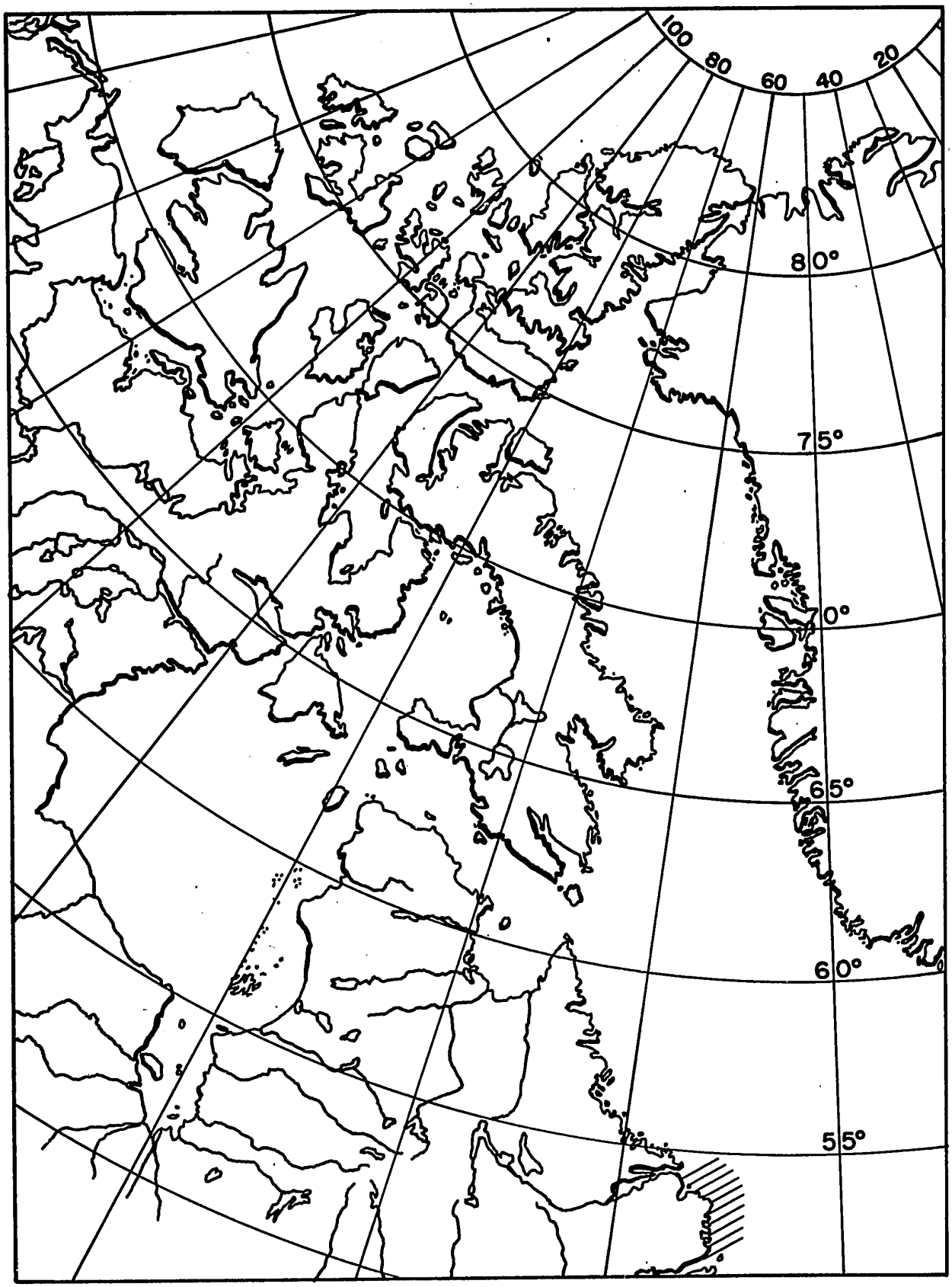


Map No.48

Map No. 49

Distriubtion of Mya arenaria Linne

in the Canadian Arctic

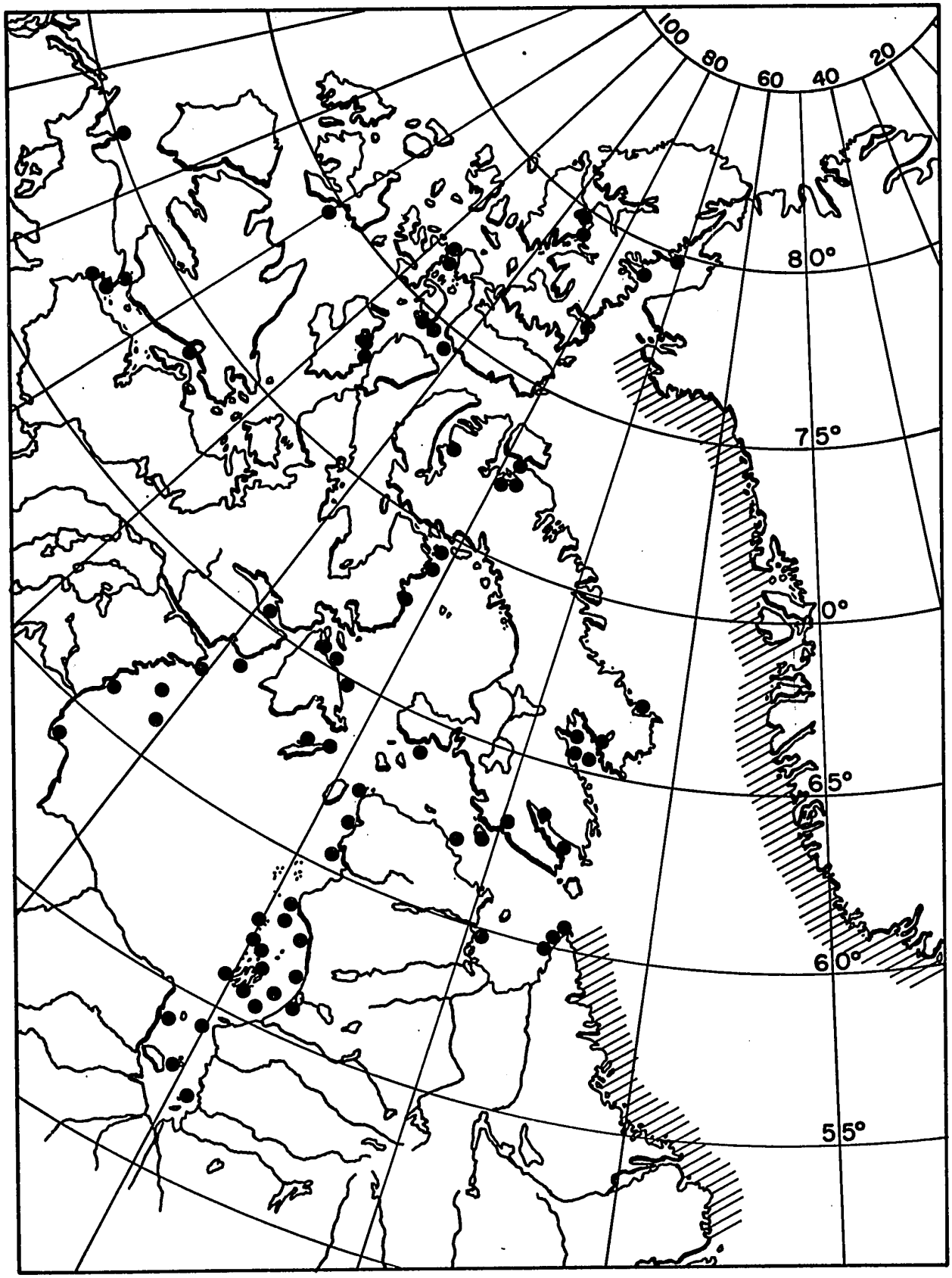


Map No.49

Map No. 50

Distribution of *Mya truncata* Linne

in the Canadian Arctic

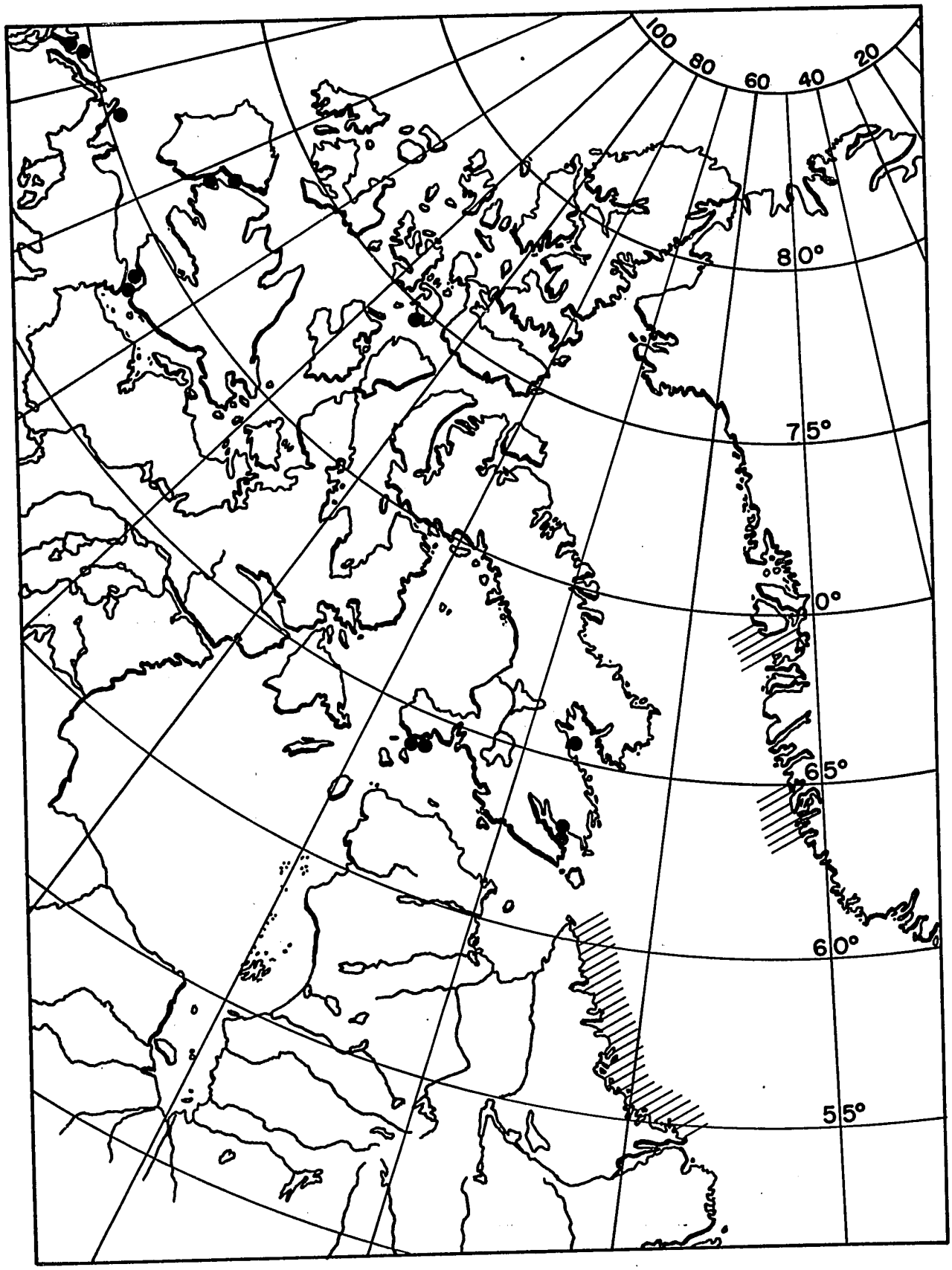


Map No.50

Map No. 51

Distribution of *Cyrtodaria kurriana* Dunker

in the Canadian Arctic

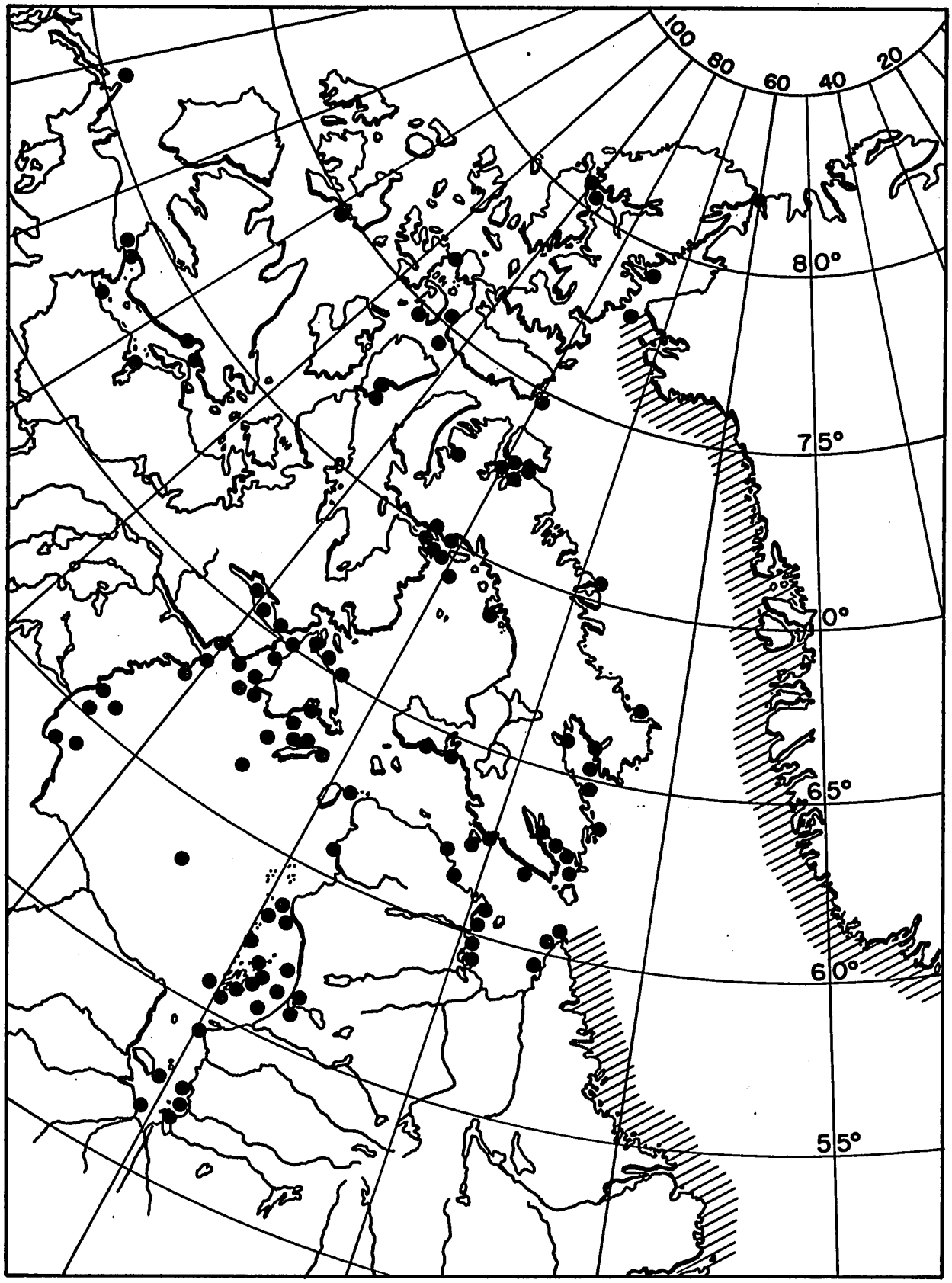


Map No.51

Map No. 52

Distribution of *Hiatella arctic* (Linné)

in the Canadian Arctic

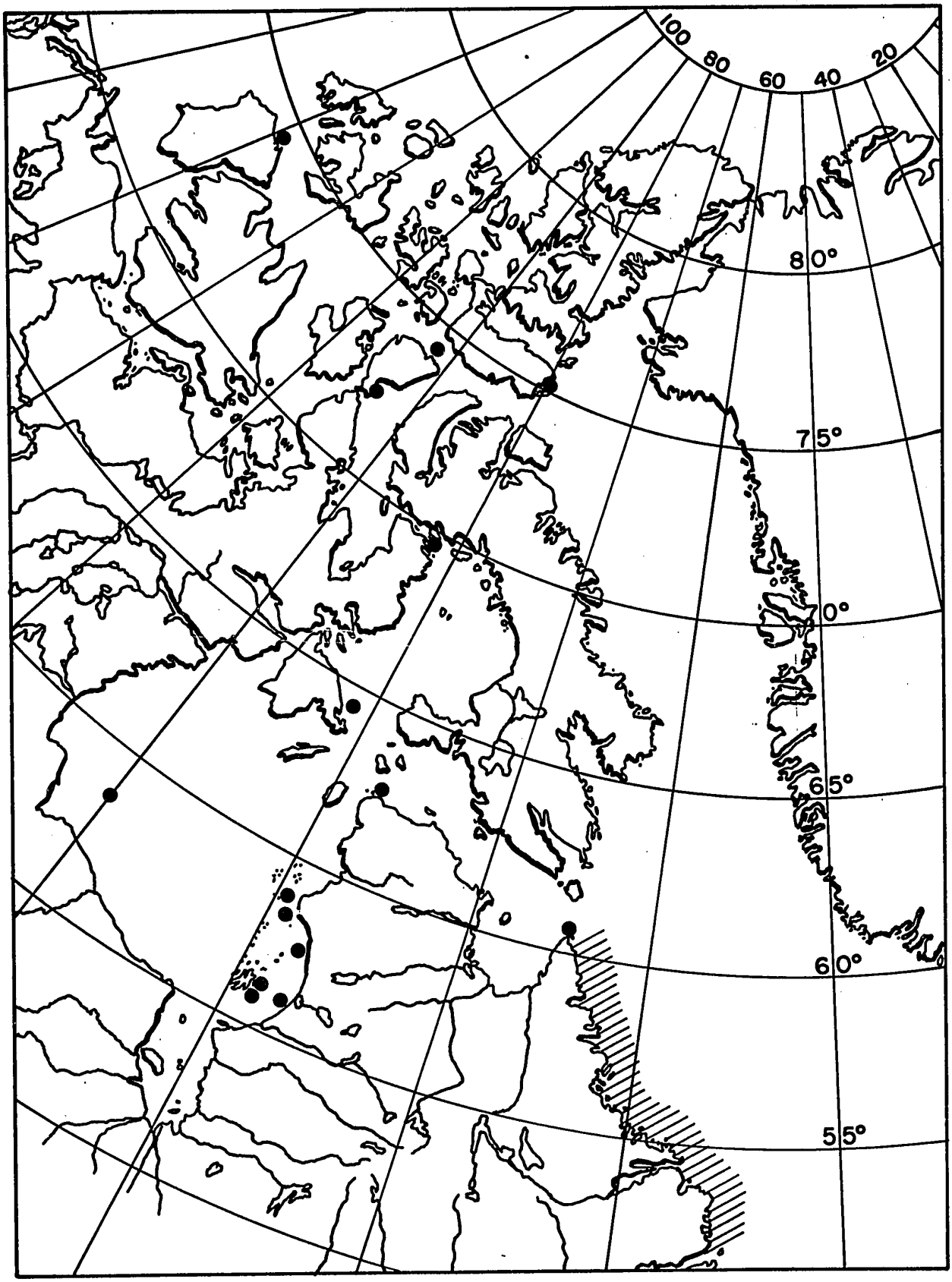


Map No.52

Map No. 53

Distribution of *Pandora glacialis* Leach

in the Canadian Arctic

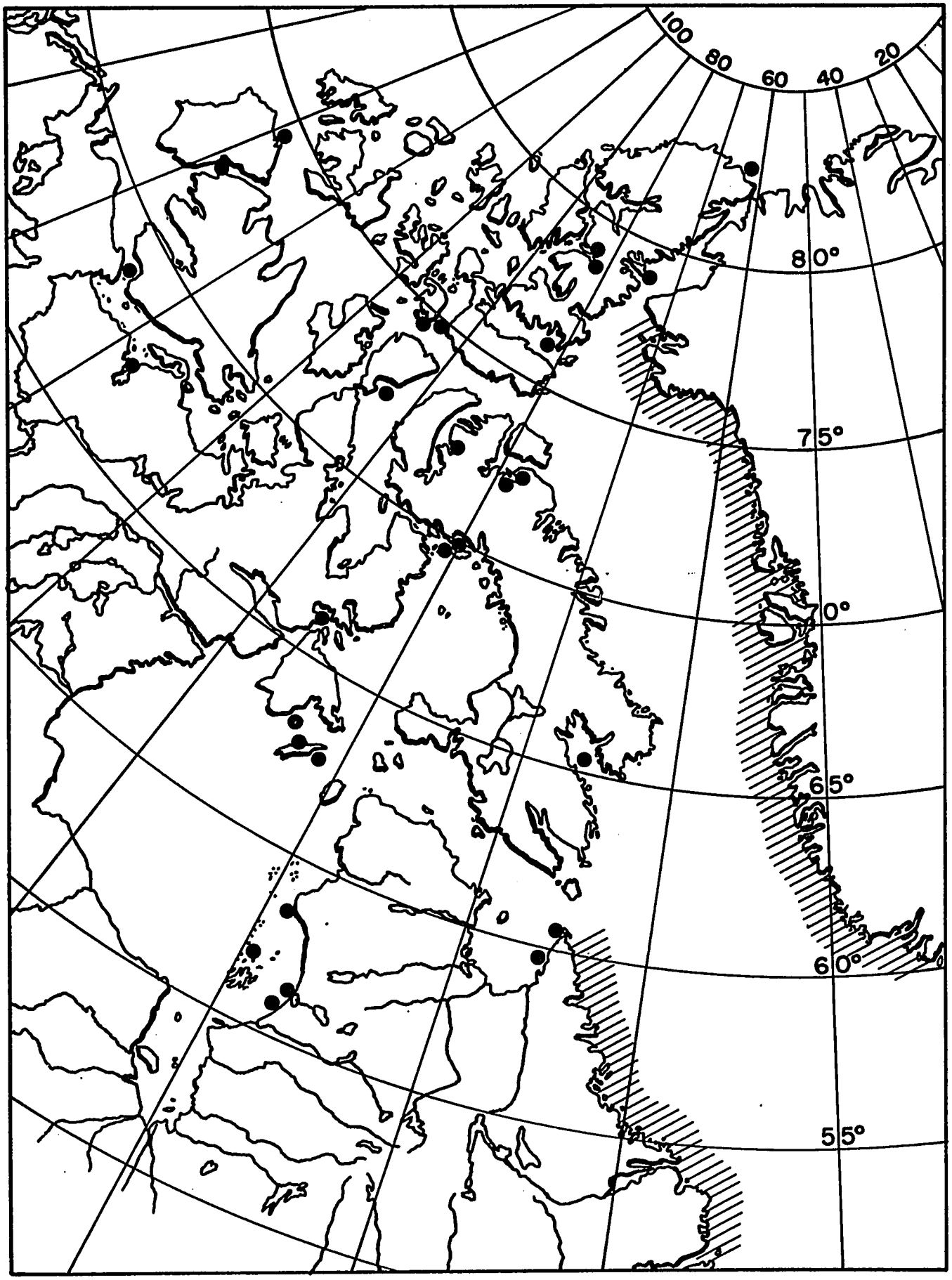


Map No.53

Map No. 54

Distribution of Lyonsia arenosa (Møller)

in the Canadian Arctic



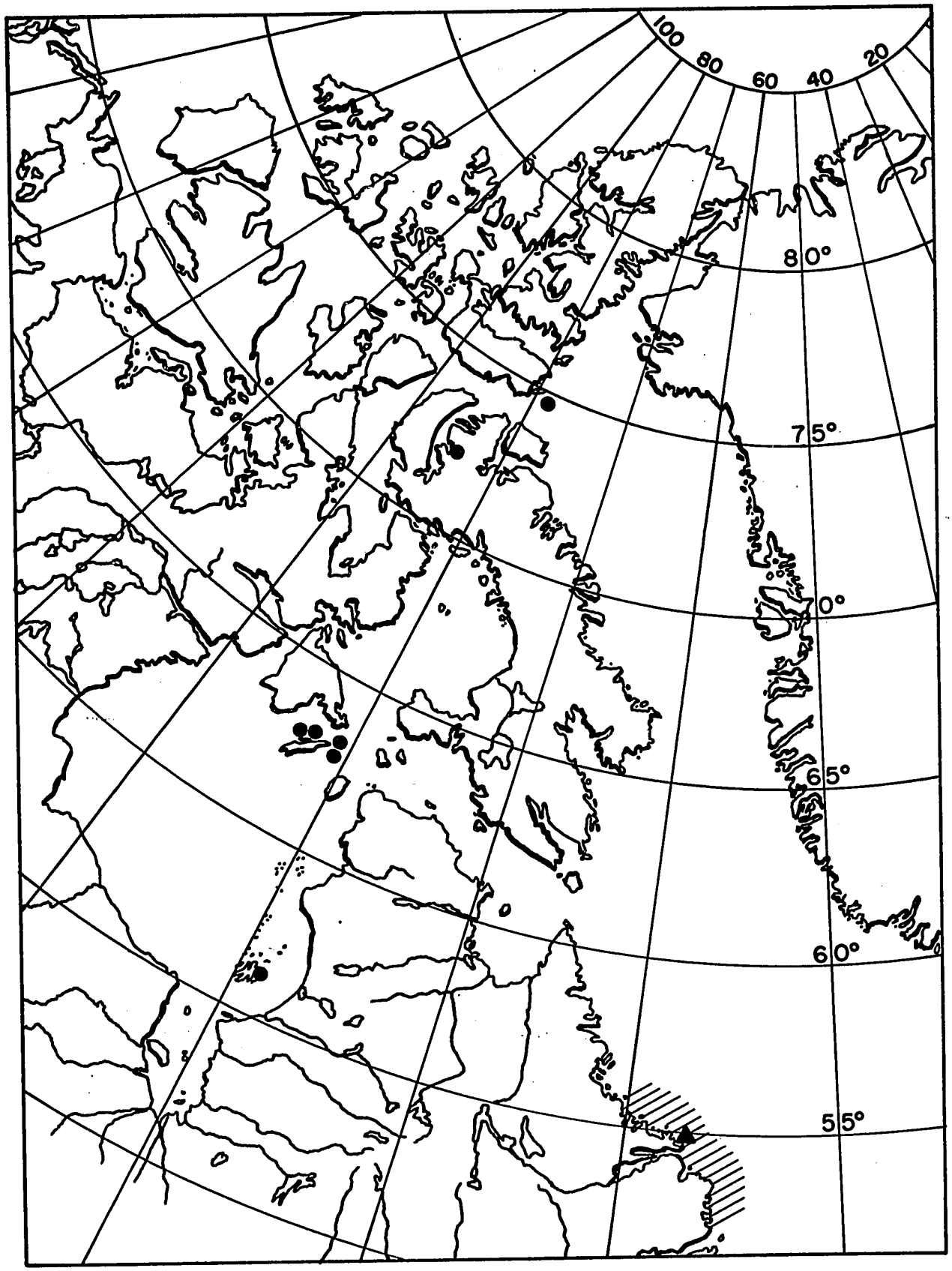
Map No.54

Map No. 55

Distribution of *Periploma abyssorum* (Verrill) Bush

and *P. fragilis* (Totten), triangles,

in the Canadian Arctic

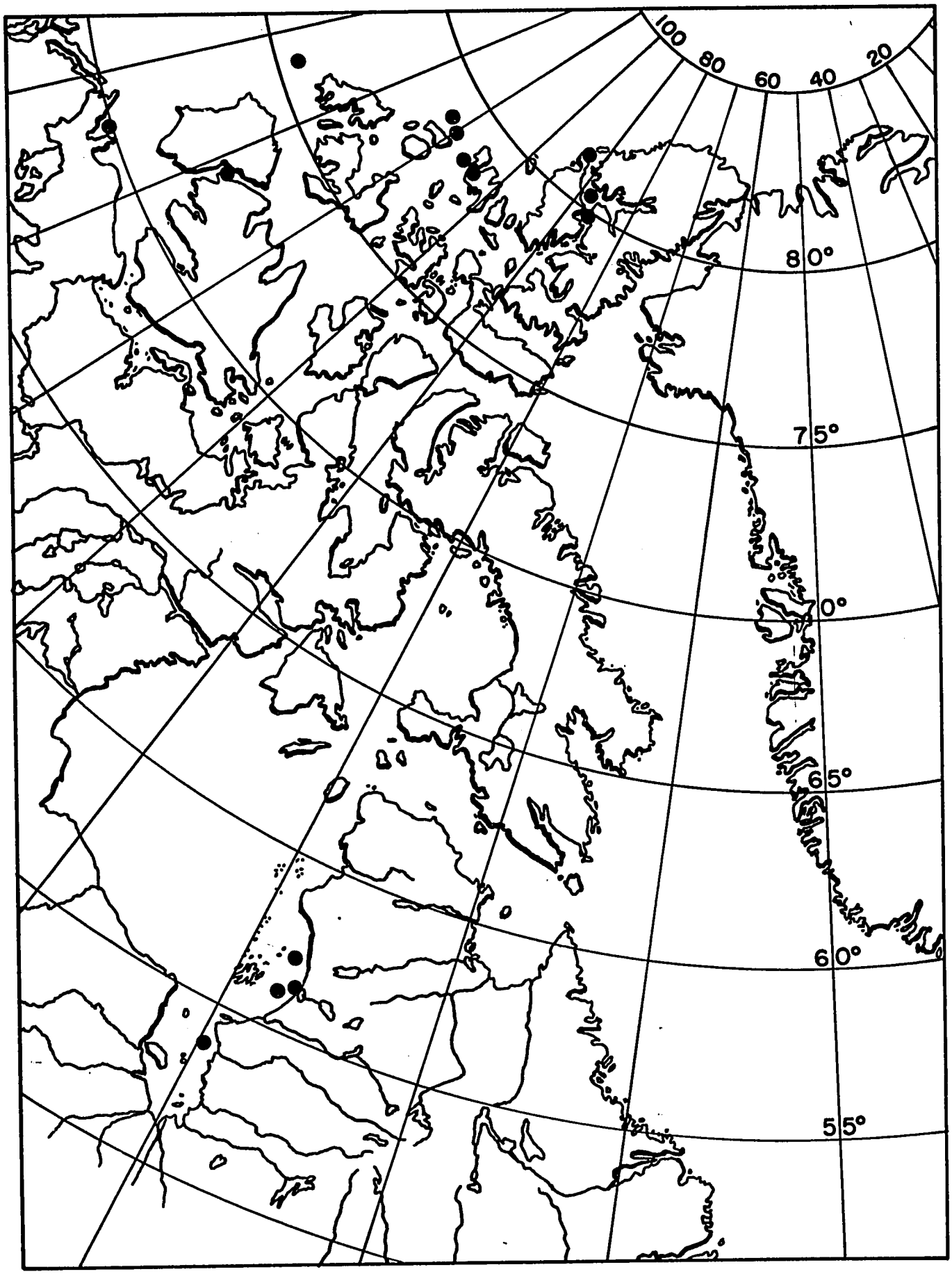


Map No.55

Map No. 56

Distribution of *Thracia devexa* G.O. Sars

in the Canadian Arctic

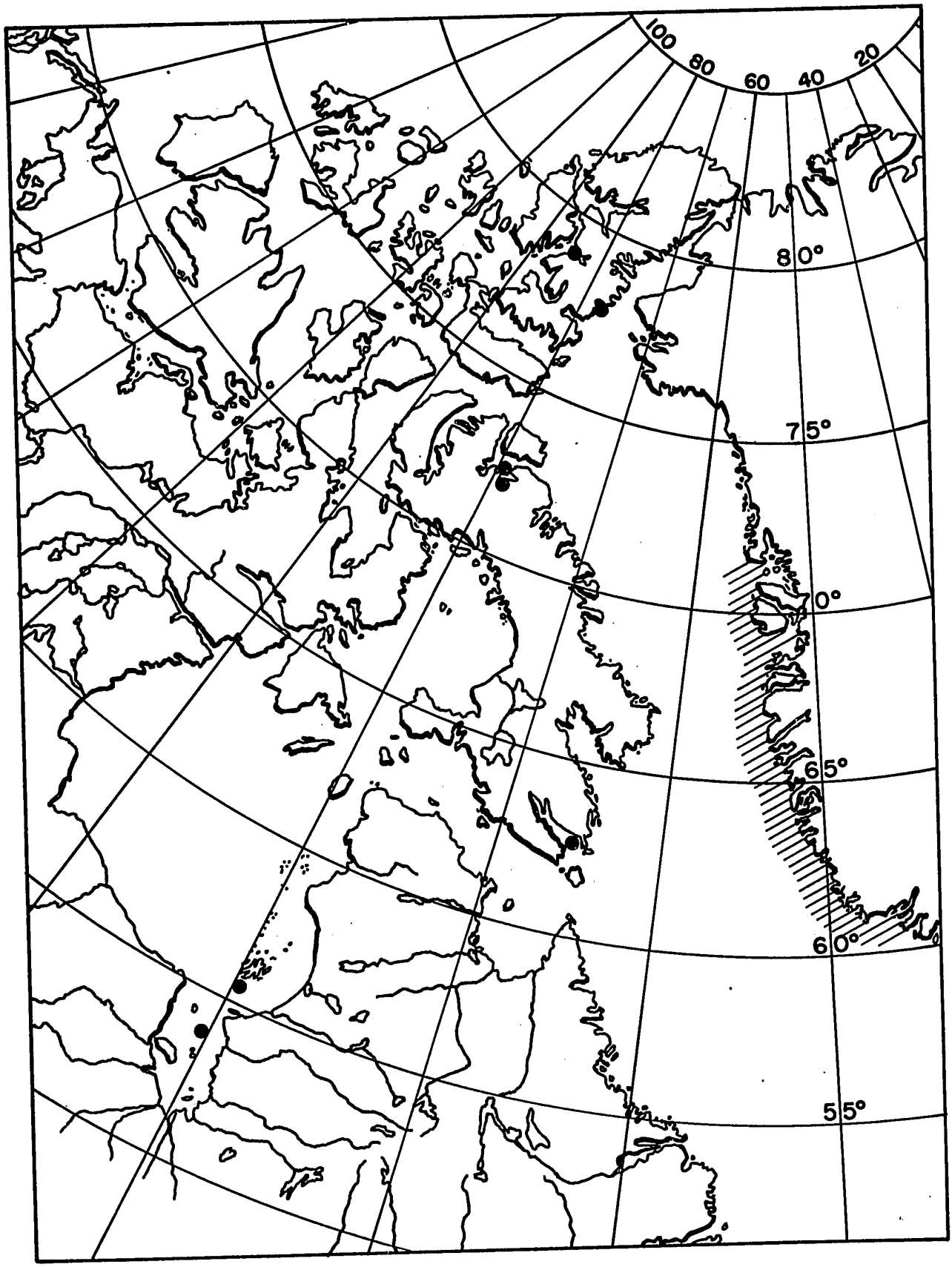


Map No.56

Map No. 57

Distribution of Thracia myopsis (Beck) Møller

in the Canadian Arctic

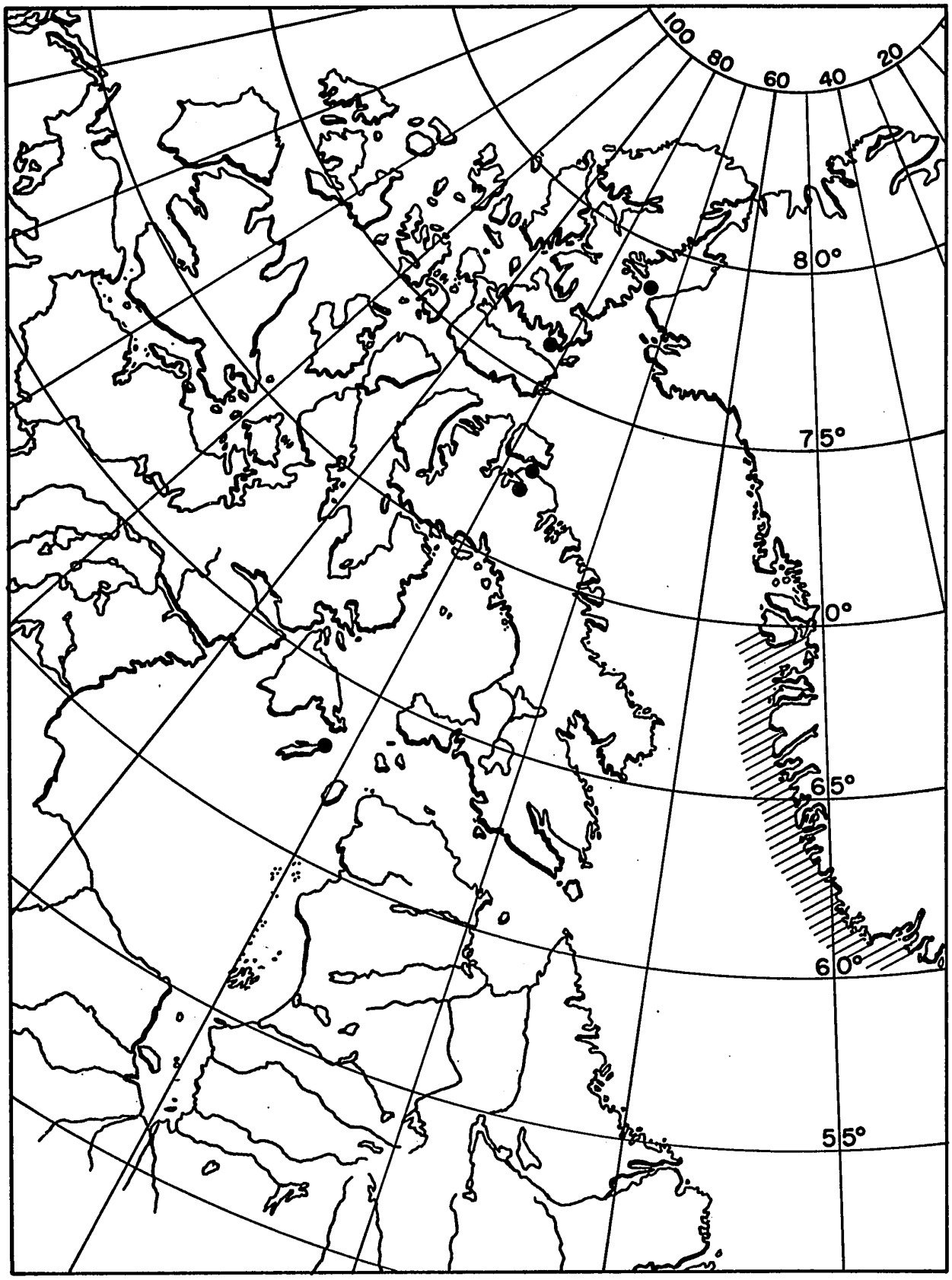


Map No.57

Map No. 58

Distribution of *Thracia septentrionalis* Jeffreys

in the Canadian Arctic

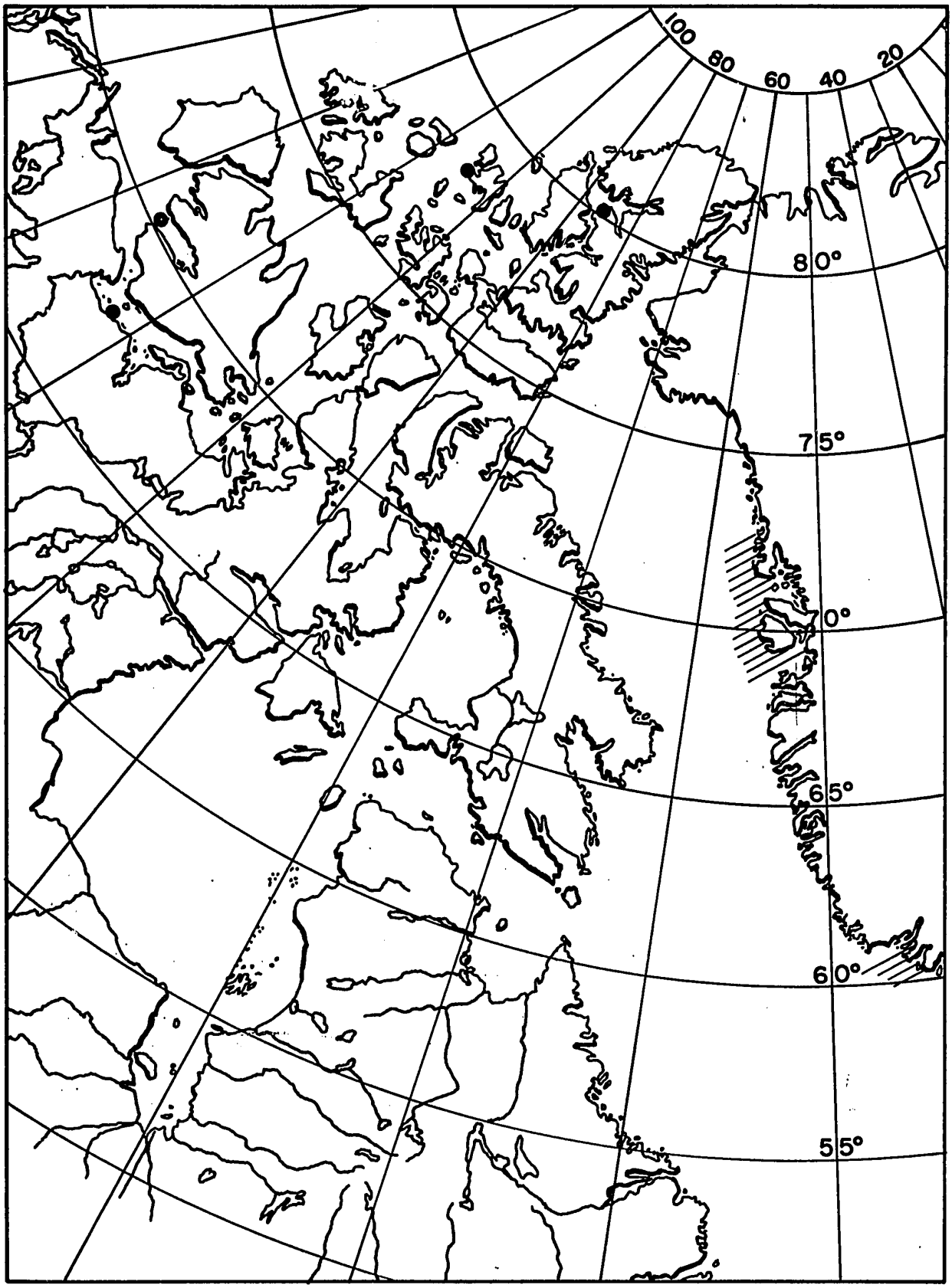


Map No.58

Map No. 59

Distribution of *Cuspidaria arctica* (M. Sars)

in the Canadian Arctic

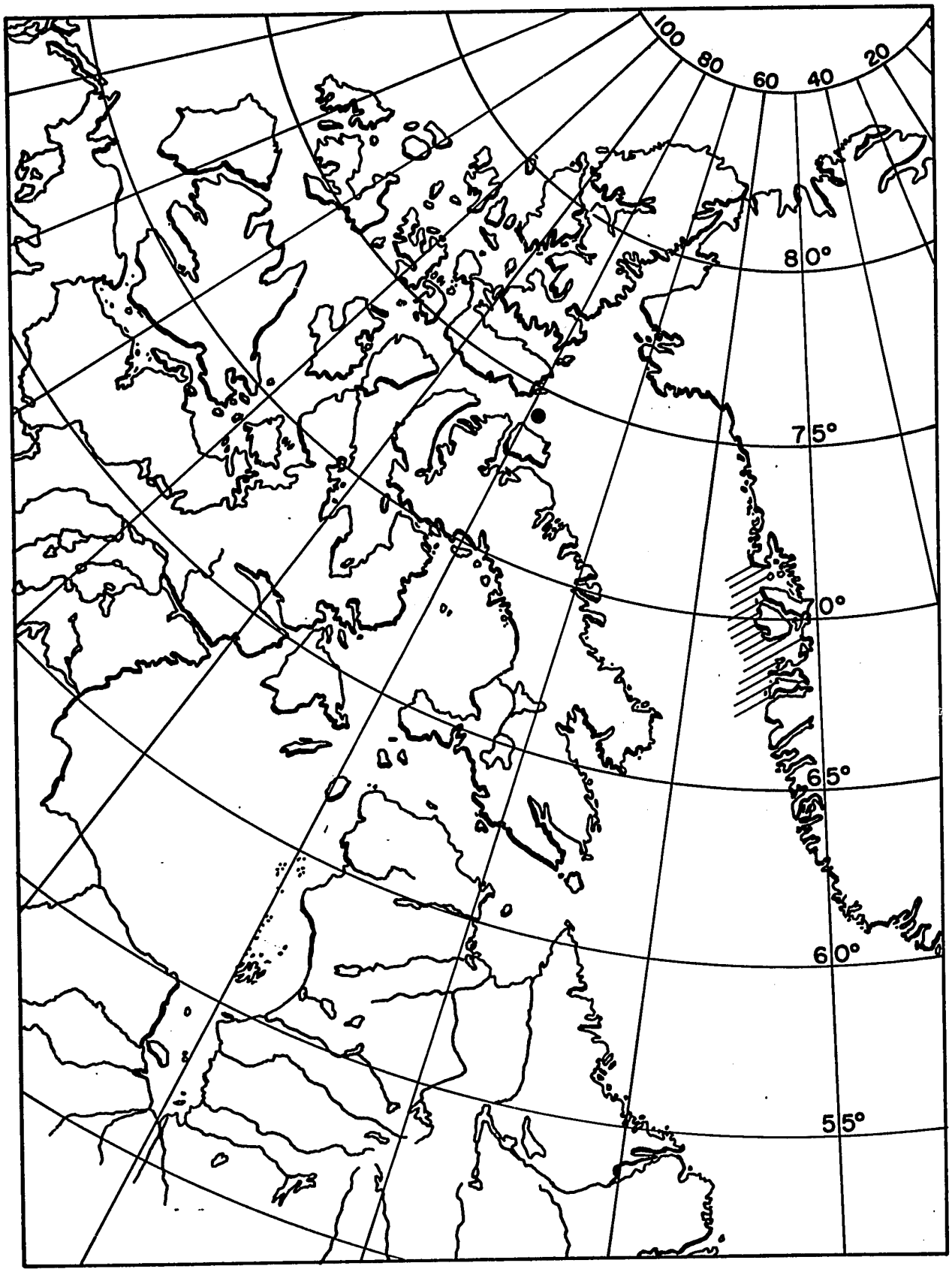


Map No.59

Map No. 60

Distribution of *Cuspidaria glacialis* (G.O. Sars)

in the Canadian Arctic

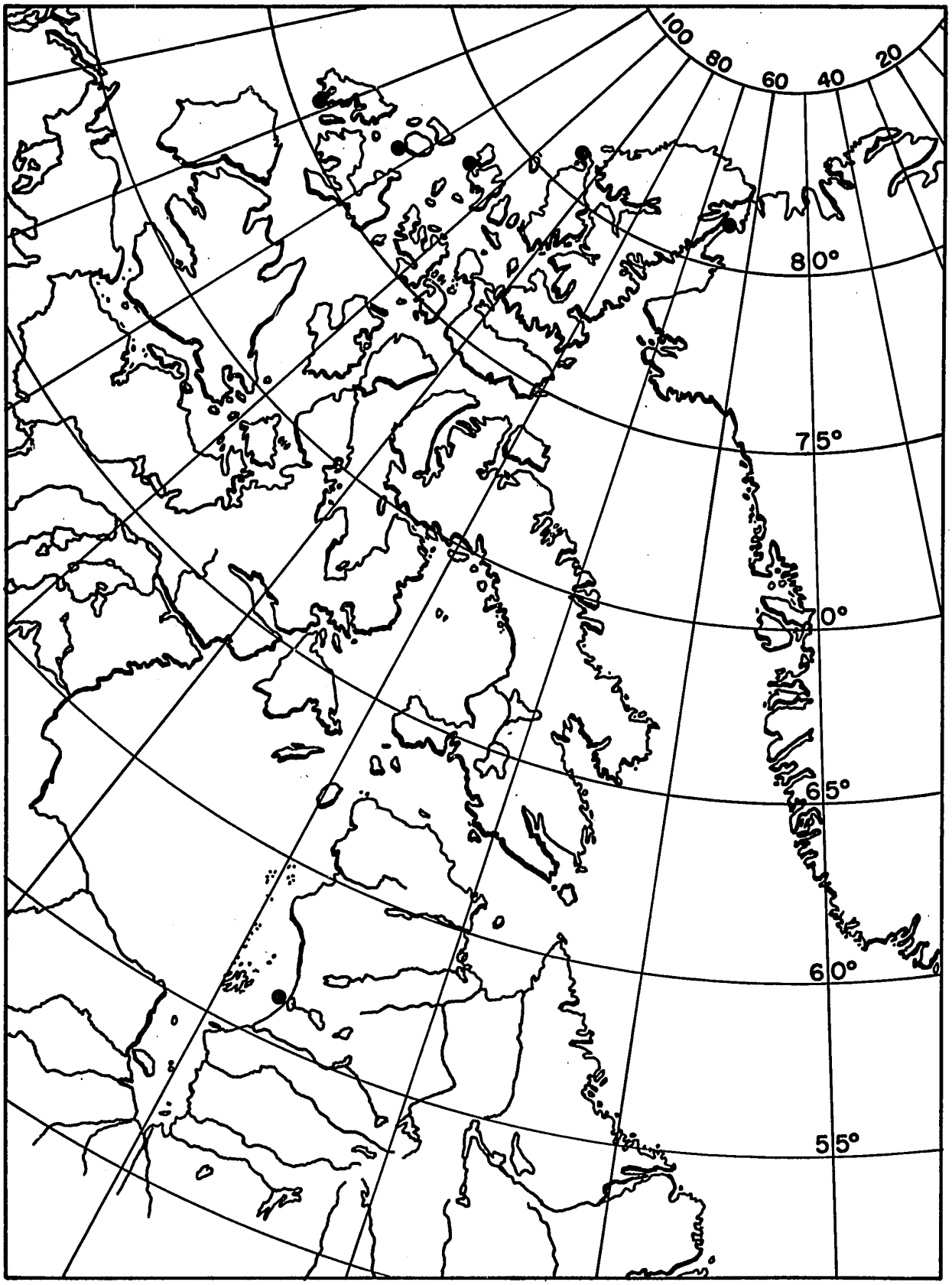


Map No.60

Map No. 61

Distribution of *Cuspidaria subtorta* (G.O. Sars)

in the Canadian Arctic



Map No.61

List of Plates (1-26)
of the marine bivalve molluscs of the Canadian Arctic

Plate No:	Name of species:
1	Nucula belloti Adams
2	Nucula belloti Adams
3	Nuculana pernula (O.F. Müller) " " costigera (Leche)
4	Nuculana pernula buccata (Steenstrup)
5	Yoldia hyperborea (Loven) Torell, hyperborea Ockelmann Yoldiella intermedia (M. Sars) " lenticula (Møller) " frigida (Torell) Arca (Bathyarca) glacialis Gray
6	Portlandia arctica arctica (Gray) " " portlandica (Hitchock)
7	Portlandia arctica siliqua var. inflata (Leach)
8	Portlandia sulcifera (Reeve)
9	Mytilus edulis (Linne) " pellucidus Pennant (= M. edulis L.)
10	Mytilus pellucidus Pennant (= M. edulis L.)
11	Musculus corrugatus (Stimpson)
12	Musculus discors (Linne) " " var. laevigatus (Gray) " " var. substriatus (Gray) " " (Linne) s. str.
13	Musculus niger (Gray)
14	Crenella faba (O.F. Müller) Delectopecten groenlandicus (Sowerby)
15	Astarte borealis var. placenta (Morch) " crenata crebricostata Andrews and Forbes
16	Astarte crenata crenata (Gray)

Plate No:	Name of species:
17	Astarte soror Dall " striata Leach
18	Astarte warhami Hancock
19	Astarte laurentiana Lyell (Pleistocene)
20	Astarte sp. No. 1
21	Astarte sp. No. 2
22	Thyasira dunbari sp. nov.
23	Macoma calcarea f. obliqua Soot-Ryen
24	Macoma inconspicua (Broderip and Sowerby) " loveni (Steenstrup) Jensen " torelli (Steenstrup) Jensen
25	Macoma planiuscula Grant and Gale
26	Lyonsia arenosa (Møller) Cuspidaria subtorta (G.O. Sars) Periploma abyssorum (Verrill) Bush Thracia devexa (G.O. Sars) " myopsis (Beck) Møller

Plate 1. Nucula belloti Adams.

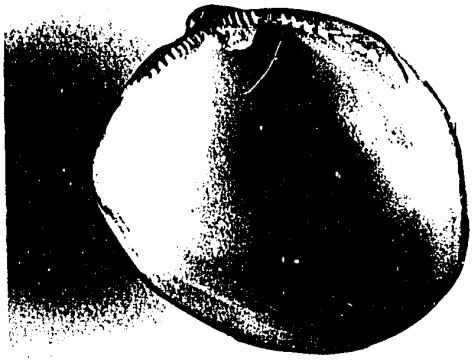
Figs. 1,2. Archipelago, Stn. 17-55, N.M.C.

Dim.: 15.2 x 13.0 x 8.2 mm.

Figs. 3-5. Foxe Basin, Stn. 719, F.R.B.C.

Dim.: 11.8 x 9.8 x 6.5 mm.

1



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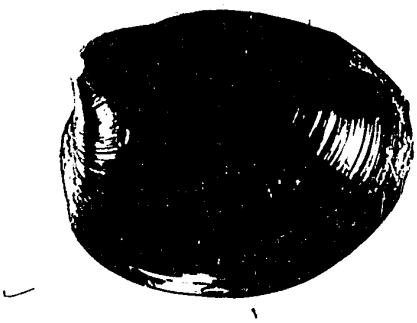

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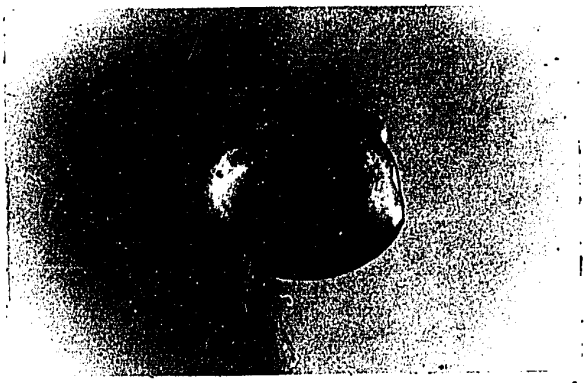

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Plate 1

Plate 2. Nucula belloti Adams.

Figs. 6-8. Hudson Bay, Stn. 59-72. F.R.B.C.

Dim.: 12.5 x 9.8 x 7.0 mm.

6

7

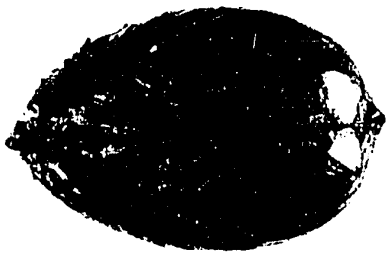

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Plate 2

Plate 3. Nuculana pernula costigera (Leche)

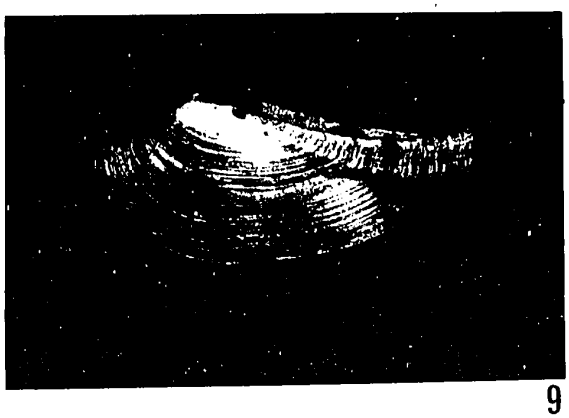
Figs. 9-11. Archipelago, Stn. 10-55, N.M.C.

Dim.: 29.0 x 13.0 x 6.5 mm.

Nuculana pernula buccata (Steenstrup)

Figs. 12-14. Labrador, No. 5470, M.C.Z., coll. Dr. Hayes

Dim.: 15.3 x 9.0 x 6.5 mm.



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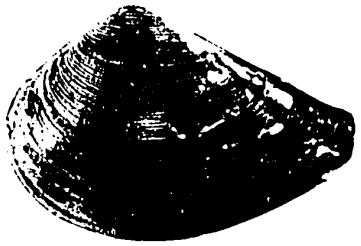

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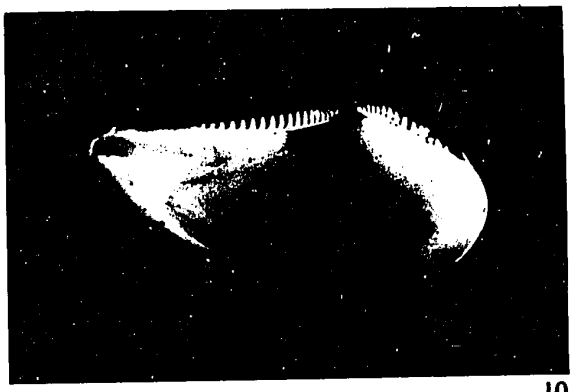

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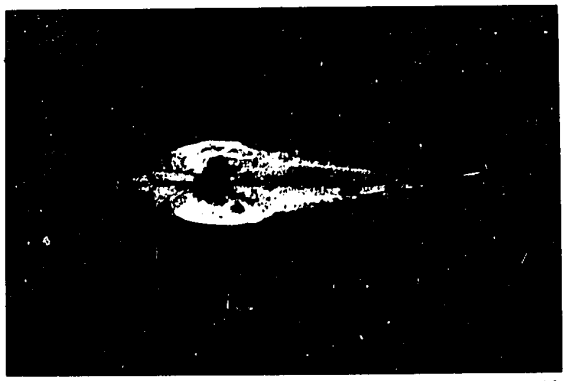

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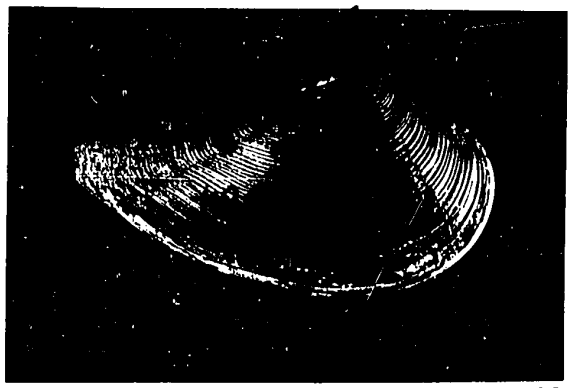
Plate 4. Nuculana pernula buccata (Steenstrup)

Figs. 15-17. Labrador, Mugfjord-Hebron. No.29084 MCZ
Dim.: 28.0 x 16.2 x 9.1 mm.

Fig. 18. Structure of the periostracum on the anterior part of the shell in thr region of the dark ray. (x 30)



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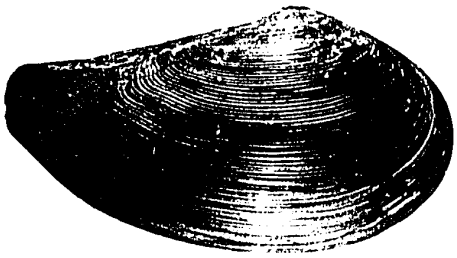

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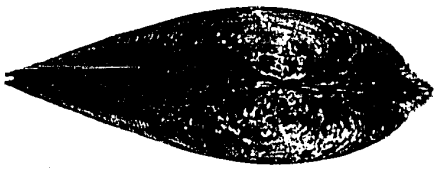


17

Plate 4

Plate 5. Yoldia hyperborea (Loven) Torell

hyperborea Ockelmann.

Fig. 19. Foxe Basin, Stn. 901. F.R.B.C.

Dim.: 30.5 x 17.0 x 9.5 mm.

Fig. 20. Ungava Bay, Stn. 201. F.R.B.C.

Dim.: 19.0 x 15.5 x 17.0 mm.

Yoldiella intermedia (M. Sars)

Fig. 21. Ellesmere Land, Slidre Fjord, Stn. 10-55 NMC

Dim.: 13.0 x 7.5 x 5.7 mm.

Yoldiella frigida (Torell)

Fig. 22. Pr. Patrick Island, Archipelago Stn.13-52 NMC

Dim.: 4.0 x 3.1 x 1.6 mm.

Yoldiella lenticula (Møller)

Fig. 23. Hudson Bay, Stn. 59-72. F.R.B.C.

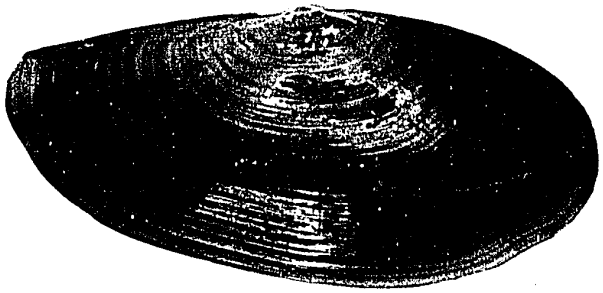
Dim.: 6.6 x 4.2 x 4.0 mm.

Bathyarca glacialis (Gray)

Fig. 24. Ellesmere Land, Slidre Fjord, Stn.10-55 NMC

L. = 9.2 mm.

19



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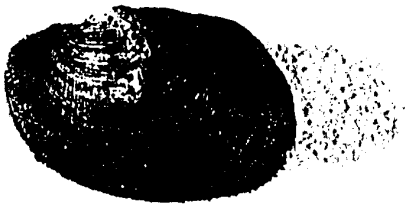


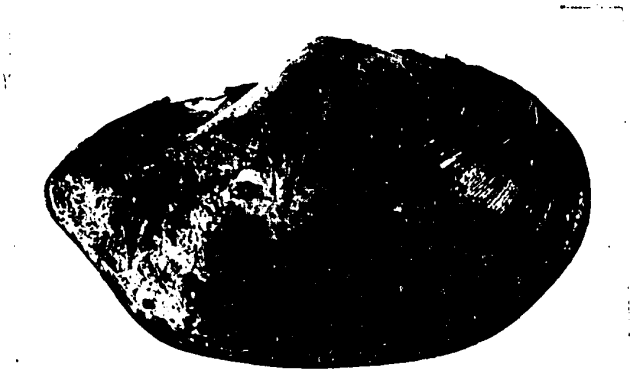
24

Plate 6. *Portlandia arctica* (Gray)

Figs. 25-27. *P. a. arctica* (Gray) Hudson Bay Stn. 59-72 F.R.B.C. Dim.: 19.5 x 12.0 x 8.2 mm.

Figs. 28,29. Same sample. Young specimen Dim.: 13.4 x 9.2 x 6.0 mm.

Fig. 30. *P. a. portlandica* (Hitchcock) James Bay Stn. 59-11. F.R.B.C. Dim.: 14.0 x 7.5 x 5.0 mm.



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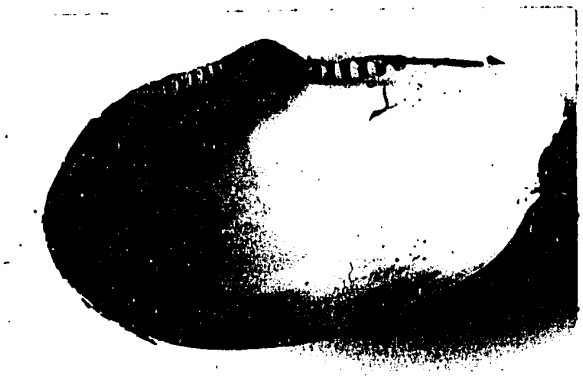

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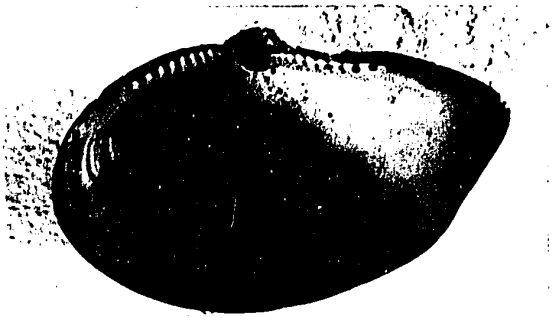

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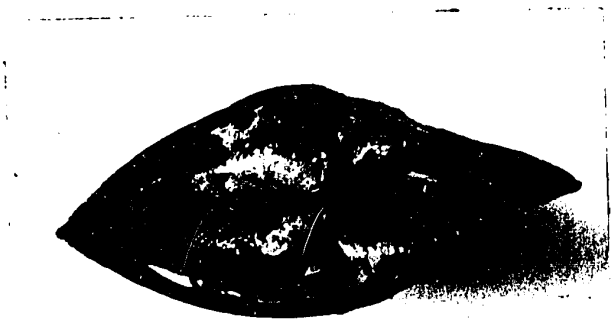


27

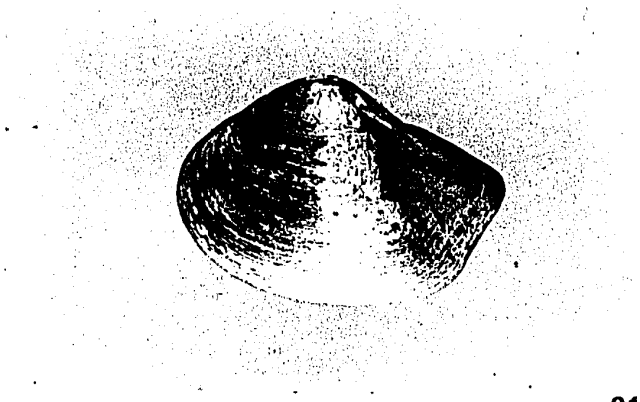
30

Plate 6

Plate 7. Portlandia arctica siliqua (Reeve)
var. inflata Leche

Figs. 31-33. Foxe Basin, Stn. 715. F.R.B.C.

Dim.: 19.2 x 13.5 x 11.8 mm.



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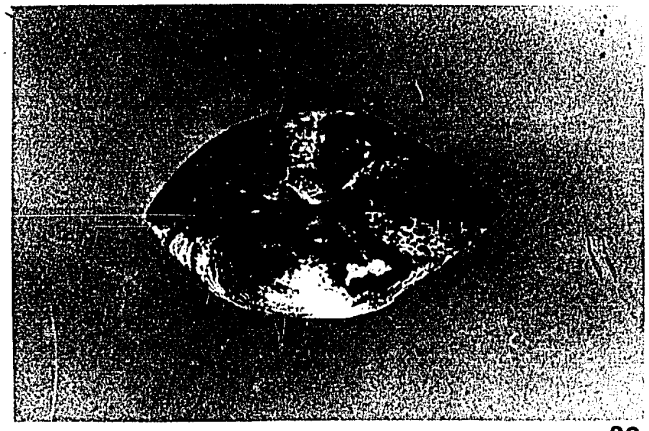

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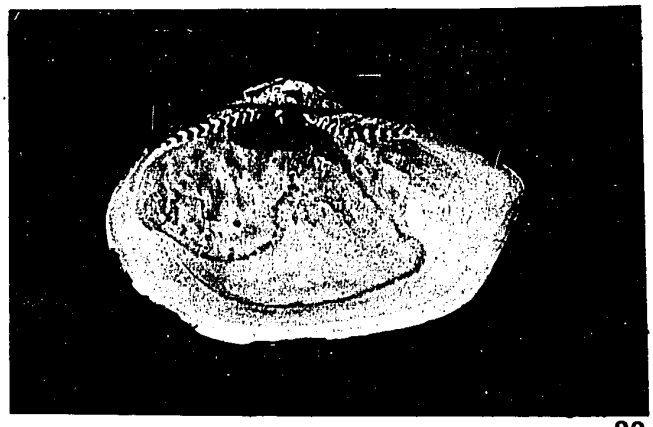
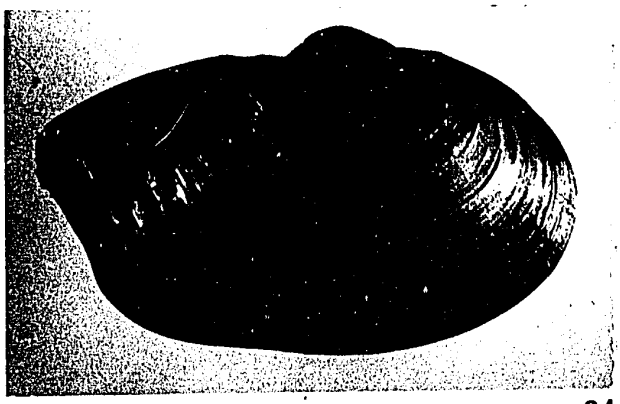


33

Plate 8. Portlandia sulcifera (Reeve)

Figs. 34-37. Isachsen Island, Archipelago. Stn, 14-54
N.M.C. Dim.: 14.5 x 9.2 x 5.0 mm.

Figs. 38,39. Same sample, Young specimen. L. = 10 mm.



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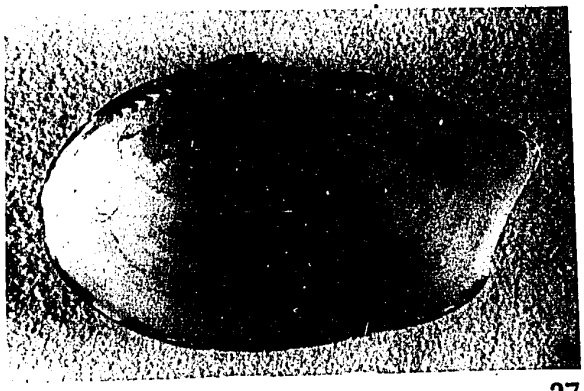

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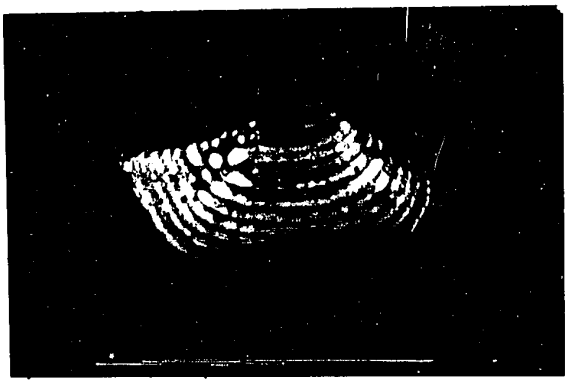

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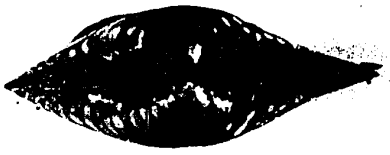


39

Plate 9. Mytilus edulis L.

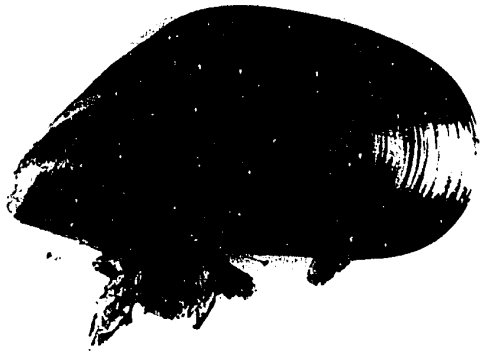
Figs. 40,41. Belcher Islands, Hudson Bay. Stn. 60-5
F.R.B.C. Dim.: 40.0 x 20.5 x 15.5 mm.

Figs 42,43. Belcher Islands. Hudson Bay Stn. 60-9
F.R.B.C. Dim.: 70.0 x 40.0 x 35 mm.

Mytilus pellucidua Pennant
(= M. edulis L.)

Fig. 44 James Bay, Paint Hills, Stn. 1920. N.M.C.
coll. F. Johannsen. Dim.: 37.0 x 17.0 x 11.5 mm.

Fig. 45. James Bay, Stn. 59-10. F.R.B.C.
Dim.: 26.0 x 11.7 x 9.5 mm.



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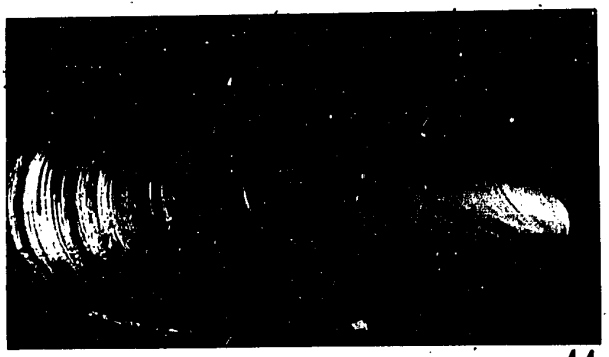

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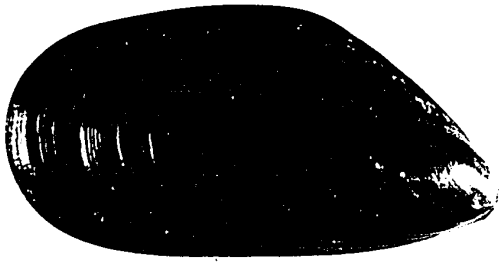

45

Plate 9

Plate 10. *Mytilus pellucidus* Pennant.

(= *M. edulis* L.)

Fig. 46. Hudson Bay, Mouth of Churchill River. coll. F.R.B.C.

Fig. 47. Paint Hills Islands. coll. N.M.C.

Transmitted light. Periostracum intact.

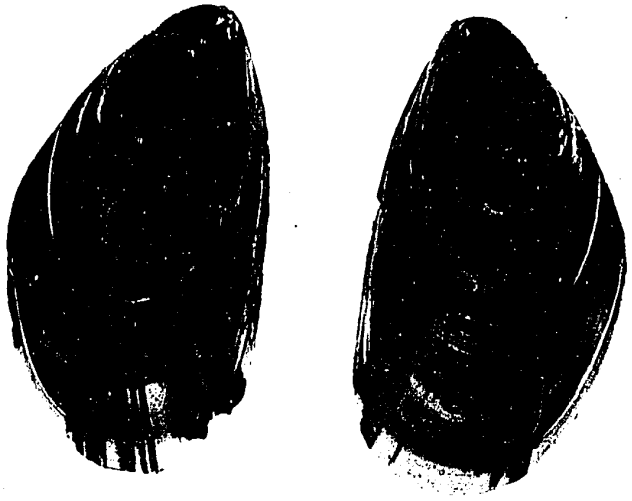

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Plate 11. Musculus corrugatus (Stimpson)

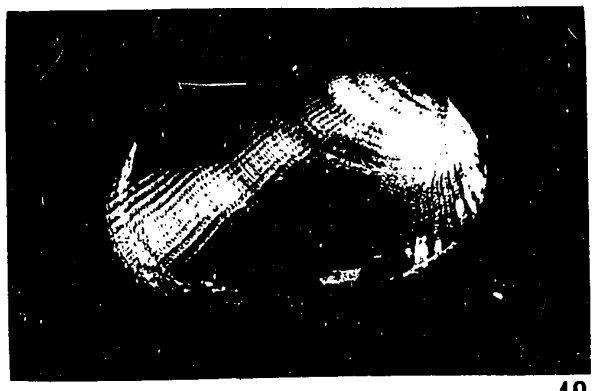
Fig. 48. Ellesmere Land, Parr Inlet. Stn. 10-51
N.M.C. Dim.: 12.0 x 8.1 x 5.5 mm.

Fig. 49. Foxe Basin, Stn. 901. F.R.B.C.
Dim.: L.= 20 mm.

Fig. 50. Foxe Basin Stn. 719. F.R.B.C.
Dim.: L.= 12 mm.

Figs. 51,52. Hudson Bay, Stn. 59-72. F.R.B.C.
Dim.: 6.8 x 5.5 x 4.5 mm.

Fig. 53. James Bay. An older specimen, Stn. 59-6
F.R.B.C. Dim.: 7.7 x 5.7 x 3.8 mm.
Pale translucent shell.



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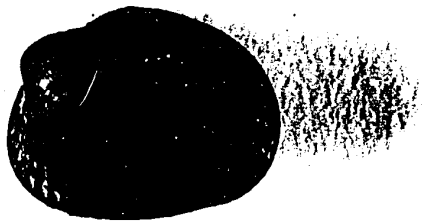

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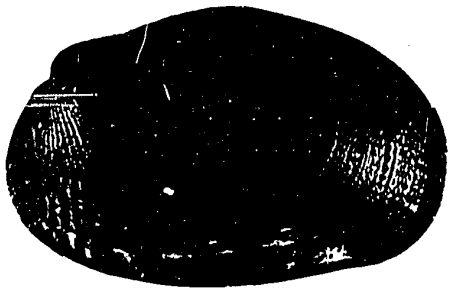

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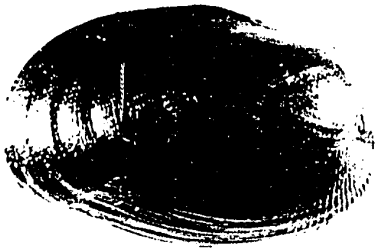

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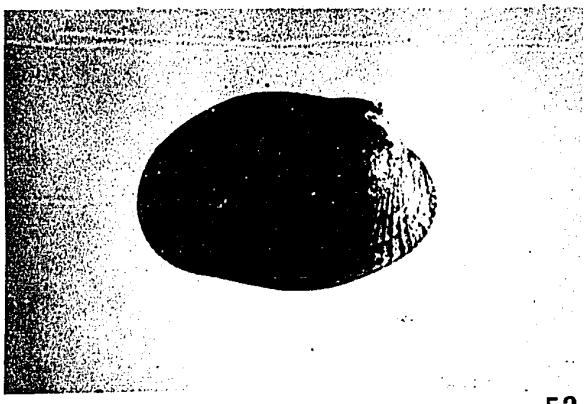


53

Plate 11

Plate 12. Musculus discors (Linne)
var. laevigatus
var. substriatus (Gray) Jensen

Fig. 54. M.d. var. laevigatus Jensen Foxe Basin, Stn. 723. Dim.: 17.0 x 10.5 x 6.8 mm.

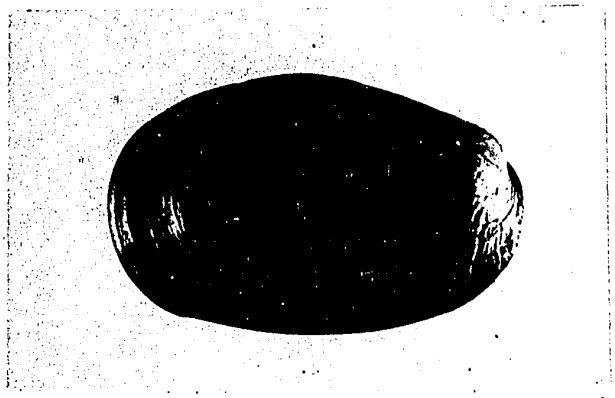
Fig. 55. Same form. James Bay, Stn. 59-4. F.R.B.C. Dim.: 8.0 x 5.0 x 3.2 mm.

Fig. 56. Same form. Frobisher Bay, Stn. 319. F.R.B.C. Dim.: L.= 37 mm.

Fig. 57. M.d. var. substriatus (Gray) Foxe Basin Stn. 818. F.R.B.C. Dim.: 30.5 x 20.0 x 13.8 mm.

Fig. 58. M. discors (Linne) s. str. England, No. 55164 Acad. Nat. Sci. Philadelphia Pa.
Dim.: 15.5 x 10.0 x 6.8 mm.

Fig. 59. M.d. var. substriatus (Gray) Jensen No. 55164 Acad. Nat. Sci. Philadelphia Pa.
Dim.: 9.0 x 5.5 x 3.5 mm.
Shells pale translucent.



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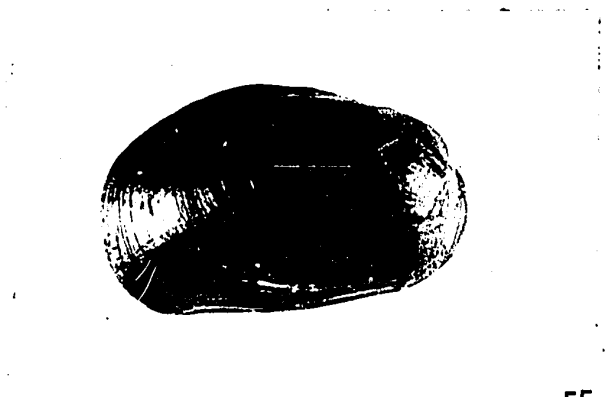

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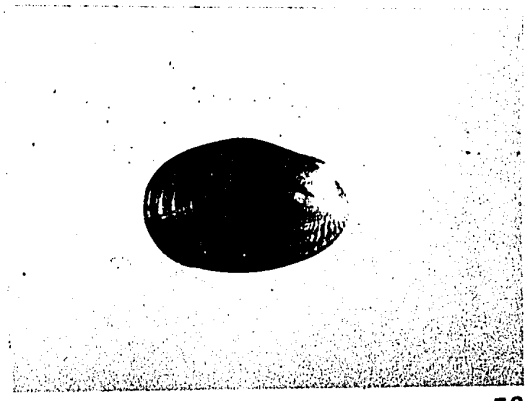

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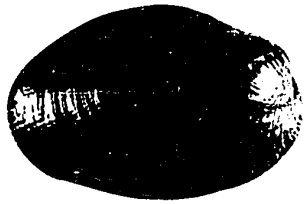

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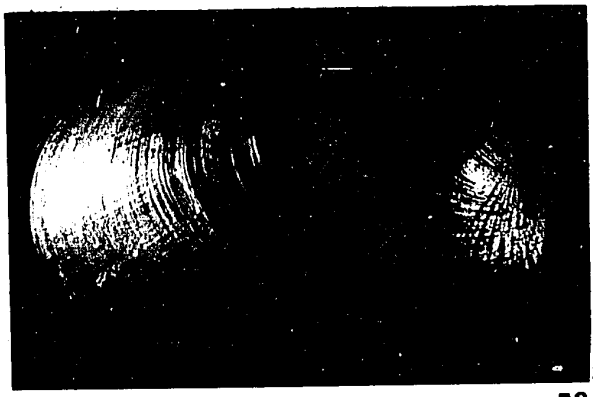

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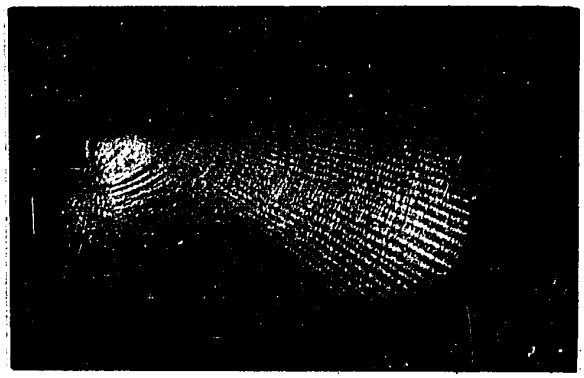

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Plate 12

Plate 13. Musculus niger (Gray)

Figs. 60,61. Ellesmere Land, Stn. 5-55 N.M.C.

Dim.: 24.0 x 13.0 x 9.0 mm. Northern type.

Fig. 62 Ellesmere Land, Parr Inlet. Stn. 10-54 N.M.C.

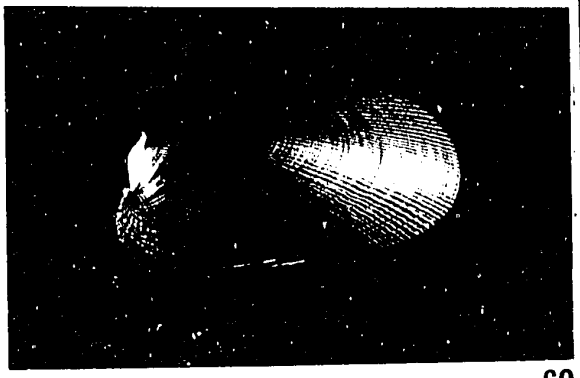
Dim.: 34.0 x 18.5 x 13.0 mm. Northern type.

Fig. 63. Ellesmere Land, Stn. 5-55. N.M.C.

Dim.: 14.0 x 9.2 s 5.5 mm.

Fig.64. Ungava Bay, Stn. 231. F.R.B.C.

Dim.: L.= 80 mm. Southern type.



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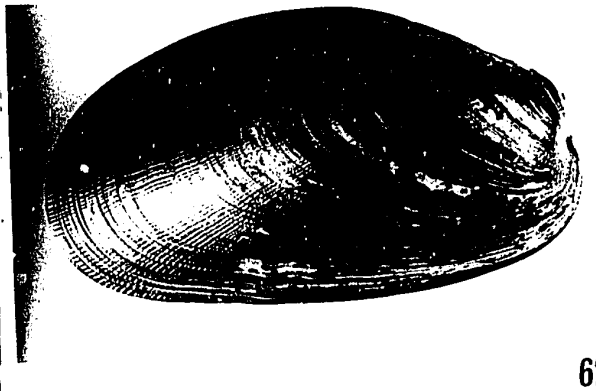

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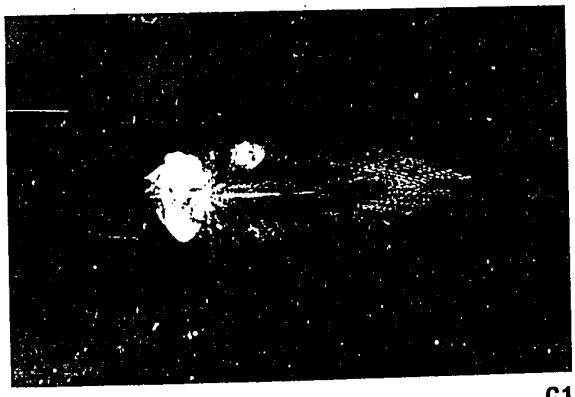

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64

Plate 13

Plate 14. Crenella faba (O.F. Müller)

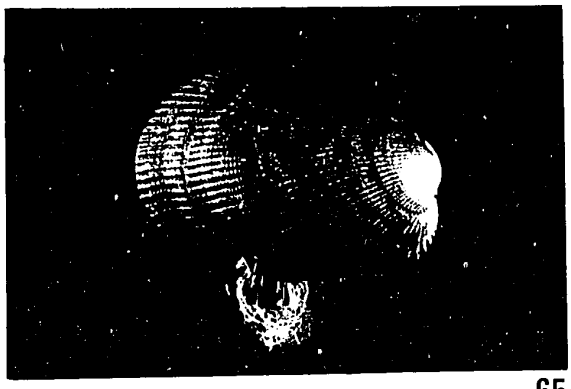
Fig. 65. Foxe Basin, Stn. 828. F.R.B.C.
Dim.: 17.0 x 12.7 x 9.0 mm. The largest specimen, about 5 years old.

Fig. 66 Foxe Basin, Same station. Middle sized specimen of same age. Dim.: 10.0 x 8.0 x 5.0 mm.

Fig. 67. James Bay, Stn. 59-11. F.R.B.C.
Dim.: 5.9 x 4.0 x 2.5 mm. Age as above.

Delectopecten groenlandicus
(Sowerby)

Fig. 68. Prince Patrick Island. Stn. 13-52. N.M.C.
Dim.: L.= 32 mm., H.= 19 mm.



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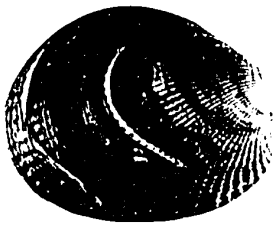

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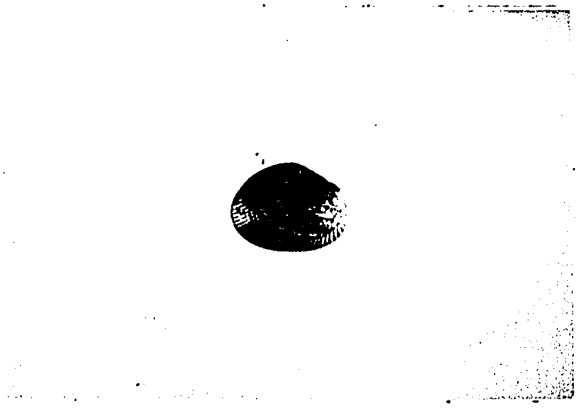

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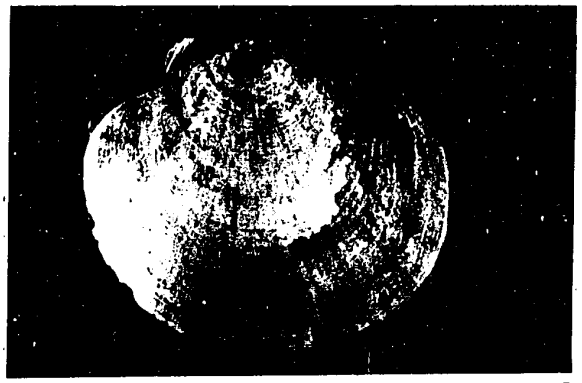


68

Plate 15. *Astarte borealis var. placenta* (Mörch)

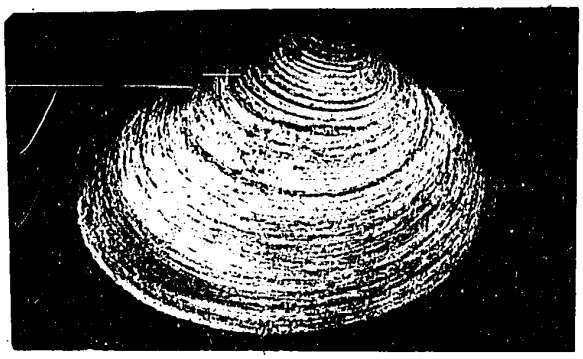
Fig. 69. Pr. Patrick Island, Archipelago, Stn.15-52
N.M.C. Dim.: 31.0 x 23.5 x 8.0 mm.

Fig. 70. Ellesmere Land, Slidre Fjord, Stn. 10-55
N.M.C. Dim.: 28.2 x 19.6 x 8.3 mm.

Astarte crenata (Gray)

Figs. 71,72. *A.c. crebricostata* Andrews and Forbes
Hudson Bay, Stn. 59-15. F.R.B.C.
Dim.: 22.5 x 18.0 x 12.5 mm.

Fig. 73. Same sample, Variation in form.



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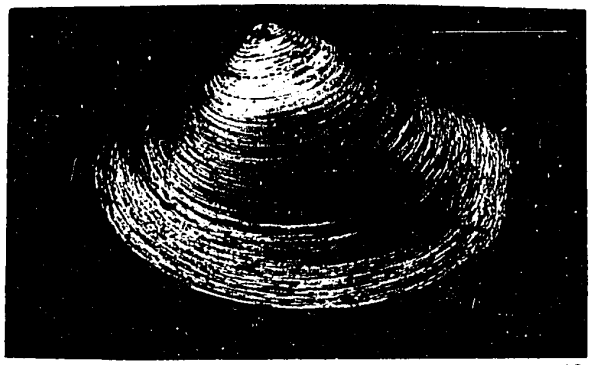

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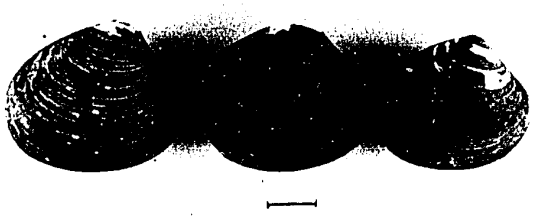
70 A



73

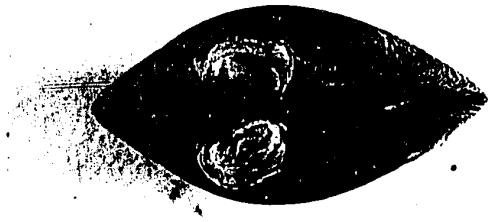
Plate 16. *Astarte crenata crenata* (Gray)

Figs. 74,75. Archipelago, Hershel Island. Stn.103-60. F.R.B.C. Dim.: 23.0 x 18.5 x 11.2 mm.

Figs. 76,77. Hudson Bay, Stn. 59-15. F.R.B.C. Dim.: 19.0 x 17.0 x 10.0 mm.

Figs. 78,79. Hudson Bay. Same sample.

74



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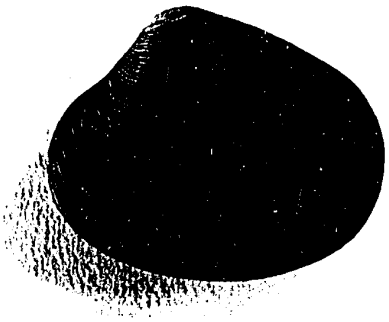

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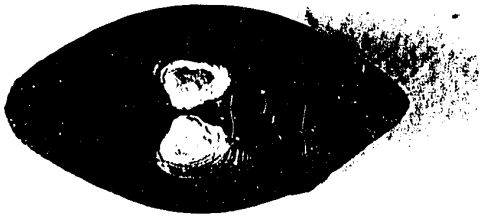

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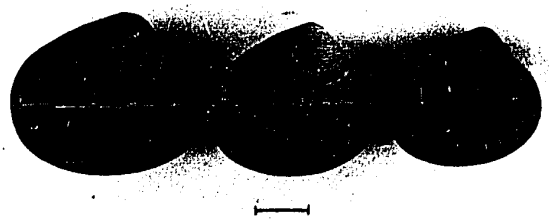

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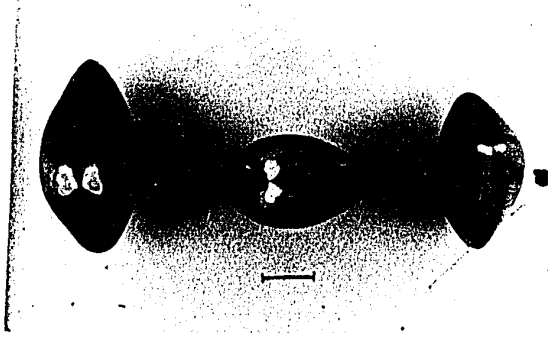


79

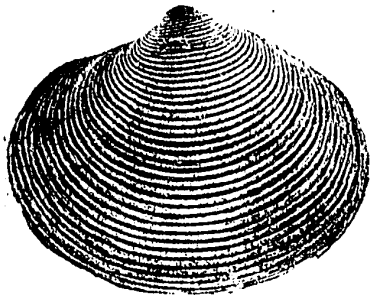
Plate 17. Astarte soror Dall

Figs. 80-82. West Greenland, Disco Bay. No. 109278
U.S.N.M. Dim.: 20.5 x 17.6 x 11.0 mm.

Astarte striata (Leach)

Figs. 83-86. Repulse Bay, Northern Hudson Bay
Stn. 711-55. F.R.B.C. Dim.: 18.0 x 14.0 x 8.1 mm.

80



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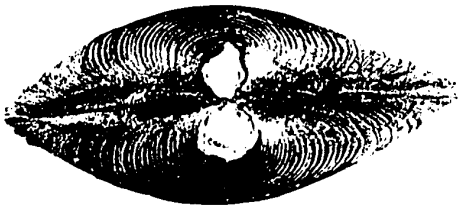

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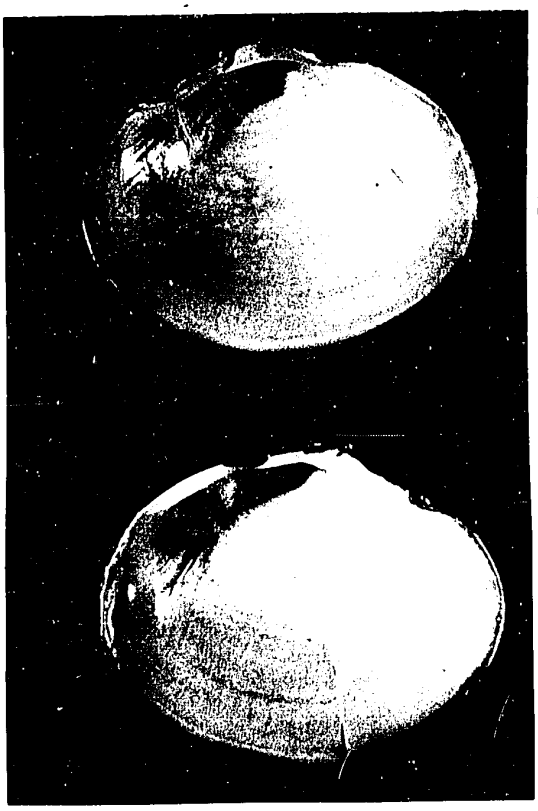

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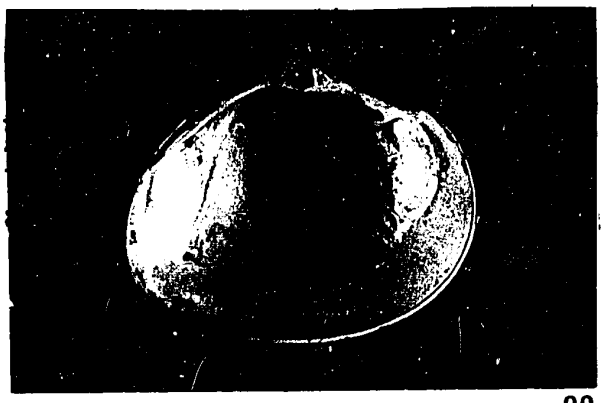


82

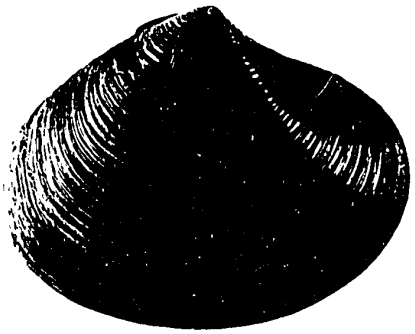
Plate 17

Plate 18. Astarte warhami Hancock

Figs. 87-89. Pr. Patrick Island, Archipelago
Stn. 51-52. N.M.C. Dim.: 19.0 x 14.5 x 6.8 mm.

Figs. 90,91. Same station.
Dim.: 28.0 x 22.0 x 12.0 mm.

Fig. 92 Isachsen Island, Archipelago, Stn. 25-54, N.M.C.
Dim.: L.= 5.0 mm. Young specimen, ribbing peculiar to the species.



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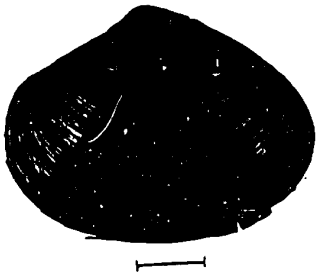

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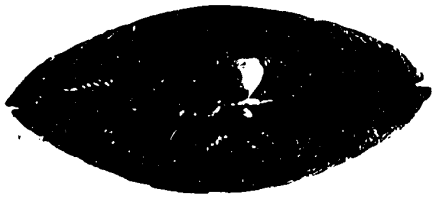

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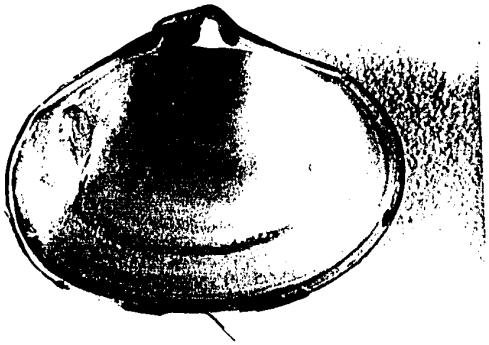

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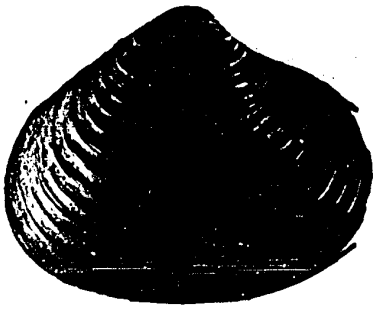


92

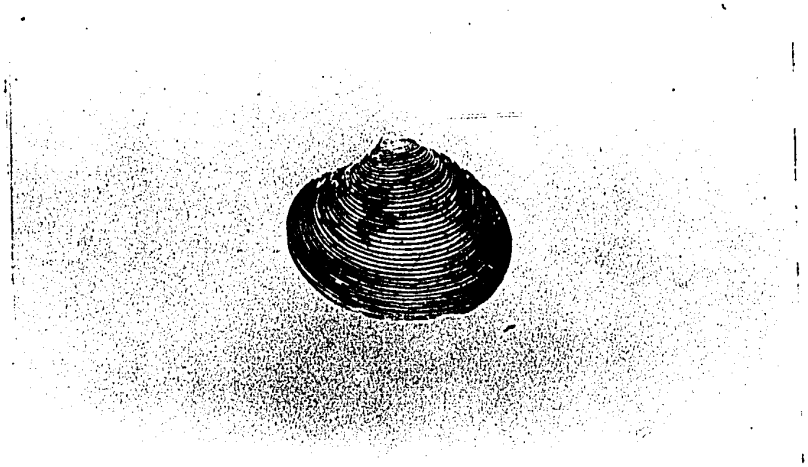
Plate 18

Plate 19. Astarte laurentiana Lyell

(Pleistocene)

Figs. 93,94. Riviere du Loup, Quebec. U.S.N.M.

No. 95750. Dim.: 13.0 x 11.0 x 6.5 mm.



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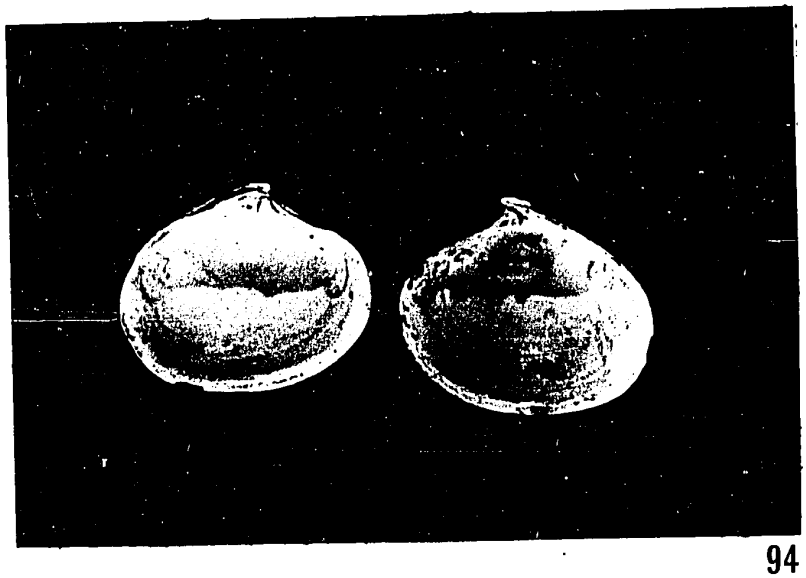
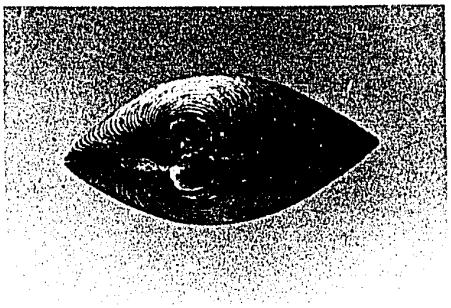


94

Plate 20. Astarte sp. (nov?)

Figs. 95-97. Northern Baffin Bay. East end of Coburg Island. No. 466686. U.S.N.M.

Dim.: 19.0 x 14.0 x 9.0 mm.



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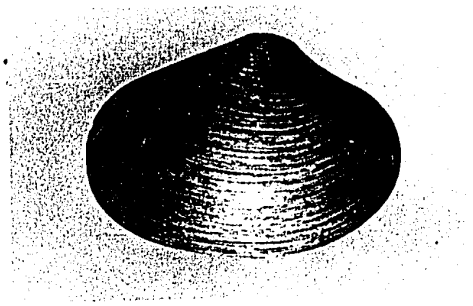


96

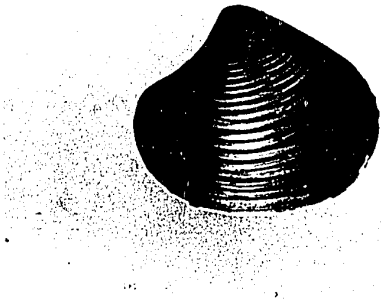
97

Plate 21. Astarte sp. (nov?)

Figs. 98,99. Labrador coast Foxe Harbor.

No. 34372, U.S.N.M.

Dim.: 15.0 x 13.0 x 7 mm.



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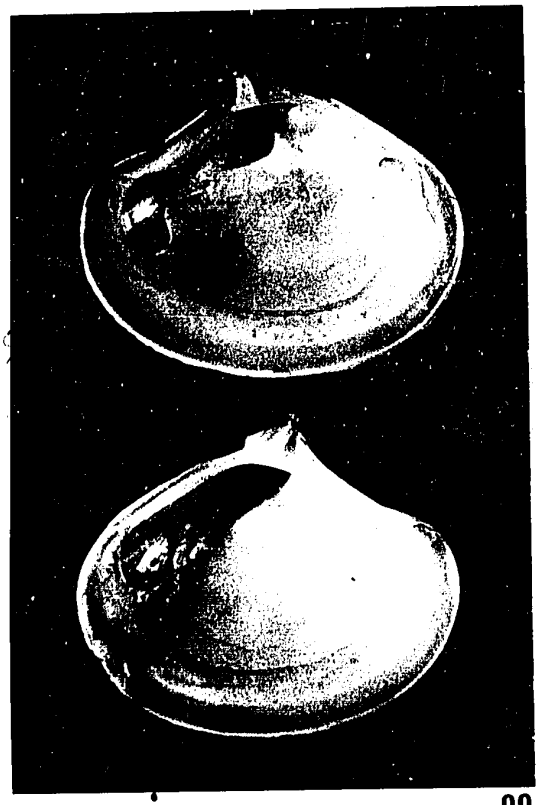


99

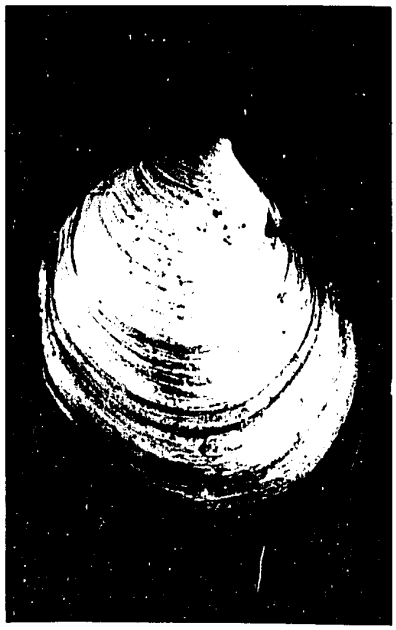
Plate 22. Thyasira dunbari sp. nov.

Type specimen.

Figs. 100-102. Isachsen Island, Hole-in-Fog Stn. 14-54.

N.M.C. Dim.: 7.2 x 6.0 x 4.5 mm.

Fig. 103. Same station. An older specimen.



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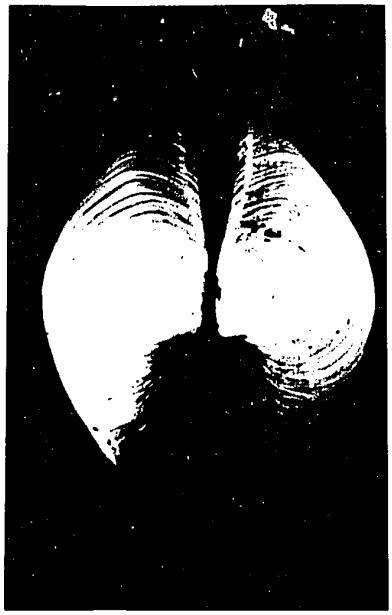

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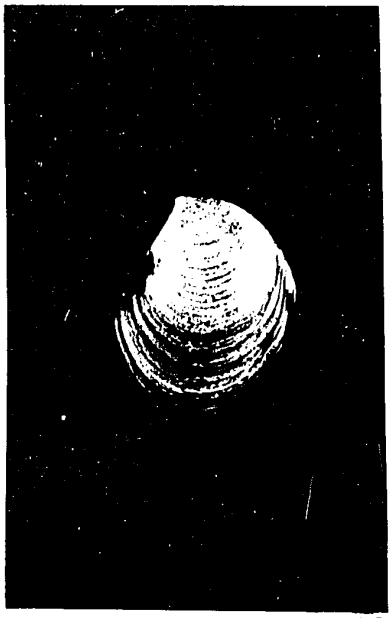


103

Plate 23. Macoma calcarea f. obliqua

Soot-Ryen

Figs. 104-107. Foxe Basin, Stn. 808, F.R.B.C.

Dim.: L.= 31 mm.

104

105

107

106

Plate 24. Macoma inconspicua Brod. & Sow.

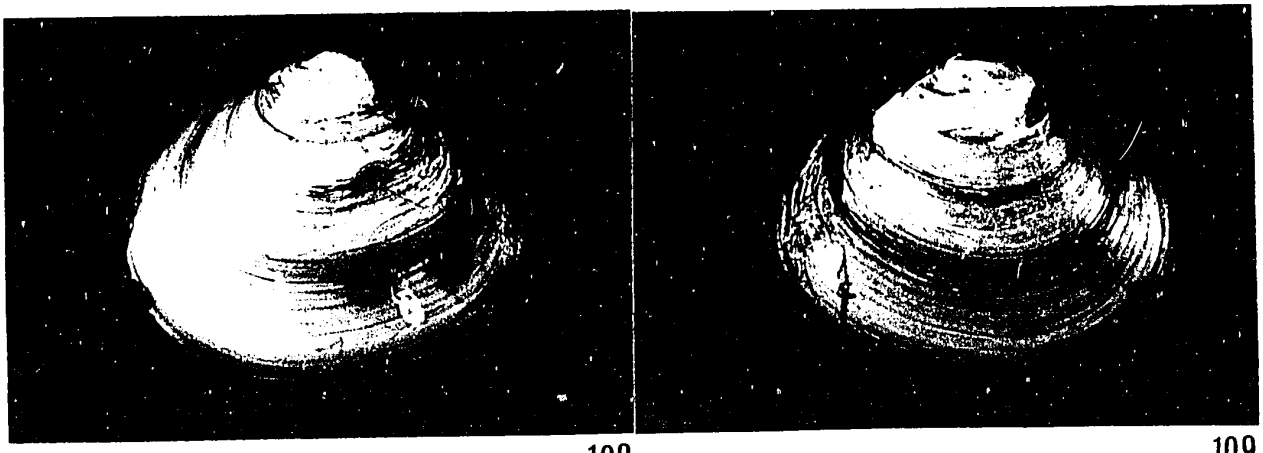
Figs. 108-111. Bathurst Inlet, Coronation Gulf Archipelago. Coll. W. Blake Jr. G.S.C.
Dim.: L.= 10 mm.

Macoma loveni (Steenstrup) Jensen

Fig. 112. Hudson Bay, Stn. 59-45, F.R.B.C.
Dim.: L.= 11 mm.

Macoma torelli (Steenstrup) Jensen

Fig. 113. Hudson Bay. Stn. 613-11, F.R.B.C.
Dim.: L.= 12 mm.



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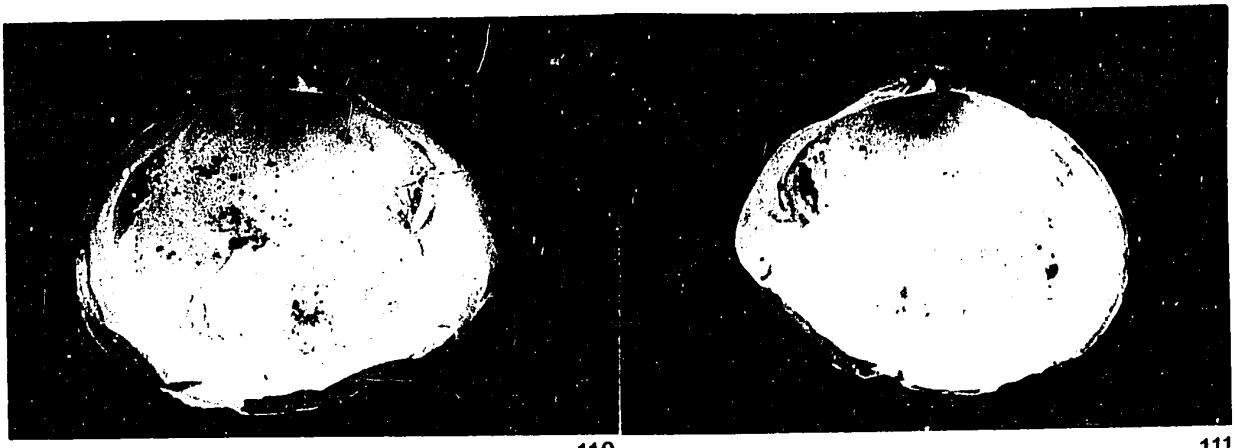

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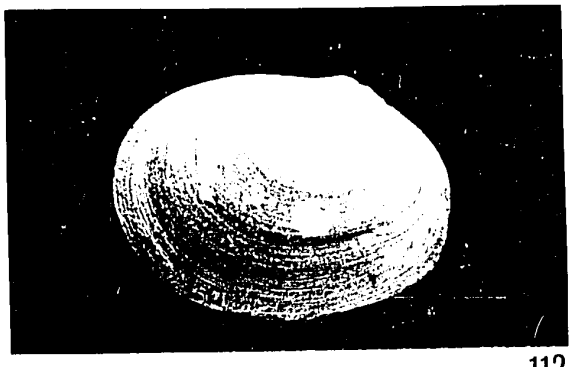


112

113

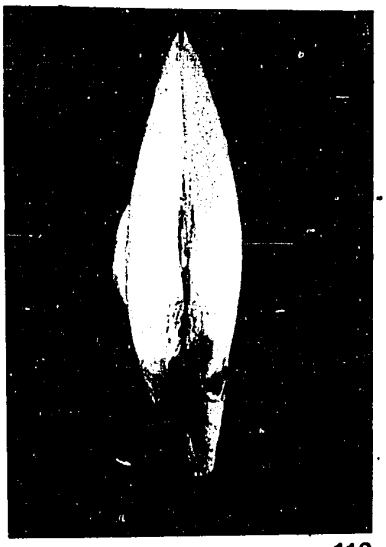
Plate 25. Macoma planiuscula Grant & Gale

Figs. 114-118. Coronation Gulf. Coll. N.M.C.

Dim.: L.= 18 mm.

114

115



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118

Plate 26. Lyonsia arenosa (Møller)

Fig. 119. Slidre Fjord, Stn. 10-55. N.M.C.
Dim.: L.= 19 mm.

Periploma abyssorum Ver. et Bush.

Fig. 120. Evans Strait, Hudson Bay. Stn. 549.
F.R.B.C. Dim.: L.= 23 mm.

Cuspidaria subtorta (G.O. Sars)

Fig. 121,122. Prince Patrick Island, Archipelago
Stn. 13-55. N.M.C. Dim.: L.= 6.0 mm.

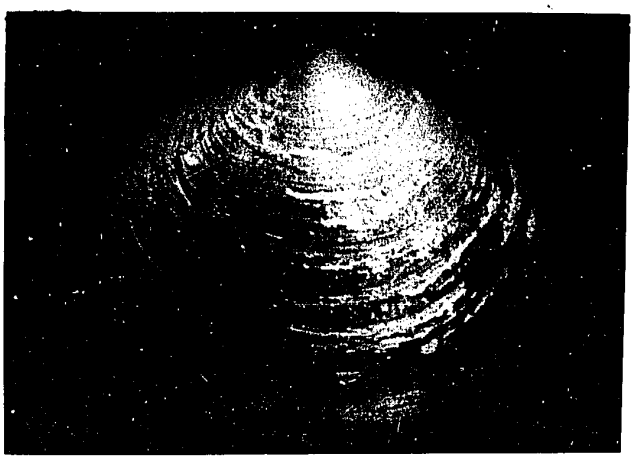
Thracia devexa G.O. Sars

Fig. 123. Isachsen Isl., Archipelago, Stn 25-54. N.M.C.
Dim.: 28.0 x 20.8 x 14.0 mm.

Thracia myopsis (Beck) Møller

Fig. 124. Pr. Patrick Isl. Archipelago Stn.10-52 N.M.C. L=30mm.

119



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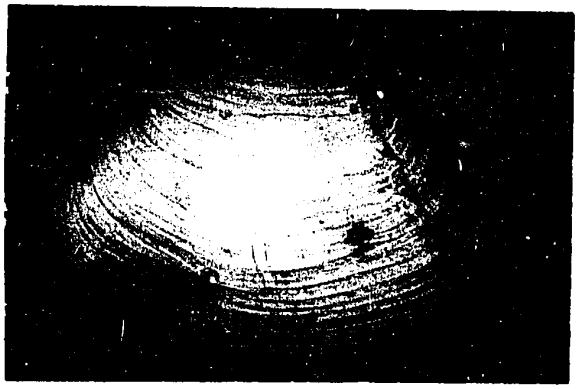

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