REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME IV: BOTANY

PART A:
FRESHWATER ALGAE AND FRESHWATER DIATOMS

By CHARLES W. LOWE

SOUTHERN PARTY—1913-16

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1923

Issued February 20, 1923

Report of the Canadian Arctic Expedition, 1913-18.

VOLUME I: GENERAL INTRODUCTION, NARRATIVE, ETC.

Part A: NORTHERN PARTY, 1913–18. By Vilhjalmur Stefansson.....(*In preparation*)
Part B: SOUTHERN PARTY, 1913–16. By Rudolph Martin Anderson.....(*In preparation*)

VOLUME II: MAMMALS AND BIRDS

Part A: MAMMALS OF WESTERN ARCTIC AMERICA.
By Rudolph Martin Anderson.....(*In preparation*).
Part B: BIRDS OF WESTERN ARCTIC AMERICA.
By R. M. Anderson and P. A. Taverner.....(*In preparation*).

VOLUME III: INSECTS

INTRODUCTION. By C. Gordon Hewitt.....(*Issued December 10, 1920*).
Part A: COLLEMBOLA. By Justus W. Folsom.....(*Issued July 10, 1919*).
Part B: NEUROPTEROID INSECTS. By Nathan Banks.....(*Issued July 11, 1919*).
Part C: DIPTERA.
Crane-flies. By Charles P. Alexander.
Mosquitoes. By Harrison G. Dyar.
Diptera (excluding Tipulidæ and Culicidæ). By J. R. Malloch.....(*Issued July 14, 1919*).
Part D: MALLOPHAGA AND ANOPLURA.
Mallophaga. By A. W. Baker.
Anoplura. By G. F. Ferris and G. H. F. Nuttall.....(*Issued September 12, 1919*).
Part E: COLEOPTERA.
Forest Insects, including Ipidæ, Cerambycidæ, and Buprestidæ. By J. M. Swaine.
Carabidæ and Silphidæ. By H. C. Fall.
Coccinellidæ, Elateridæ, Chrysomelidæ and Rhynchophora (excluding Ipidæ).
By C. W. Leng.
Dytiscidæ. By J. D. Sherman, Jr.....(*Issued December 12, 1919*).
Part F: HEMIPTERA. By Edward P. VanDuzee.....(*Issued July 11, 1919*).
Part G: HYMENOPTERA AND PLANT GALLS.
Sawflies. (Tenthredinoidea). By Alex. D. MacGillivray.
Parasitic Hymenoptera. By Charles T. Brues.
Wasps and Bees. By F. W. L. Sladen.
Plant Galls. By E. Porter Felt.....(*Issued November 3, 1919*).
Part H: SPIDERS, MITES AND MYRIAPODS.
Spiders. By J. H. Emerton.
Mites. By Nathan Banks.
Myriapods. By Ralph V. Chamberlin.....(*Issued July 14, 1919*).
Part I: LEPIDOPTERA. By Arthur Gibson.....(*Issued January 10, 1920*).
Part J: ORTHOPTERA. By E. M. Walker.....(*Issued September 4, 1920*).
Part K: INSECT LIFE ON THE WESTERN ARCTIC COAST OF AMERICA.
By Frits Johansen.....(*Issued November 7, 1921*).
Part L: GENERAL INDEX.....(*Issued December , 1922*).

VOLUME IV: BOTANY

Part A: FRESHWATER ALGAE AND FRESHWATER DIATOMS. By Charles W. Lowe.
.....(*In press*).
Part B: MARINE ALGAE. By F. S. Collins.....(*In preparation*).
Part C: FUNGI. By John Dearness.....(*In press*).
Part D: LICHENS. By G. K. Merrill.....(*In preparation*).
Part E: MOSSES. By R. S. Williams.....(*Issued February 8, 1921*).

VOLUME V: BOTANY

Part A: VASCULAR PLANTS. By James M. Macoun and Theo. Holm.....(*Issued October 14, 1921*).
Part B: CONTRIBUTIONS TO MORPHOLOGY, SYNONYMY, AND GEOGRAPHICAL DISTRIBUTION OF ARCTIC PLANTS. By Theo. Holm.....(*Issued February 10, 1922*).
Part C: GENERAL NOTES ON ARCTIC VEGETATION. By Frits Johansen. (*In preparation*)

VOLUME VI: FISHES, TUNICATES, ETC.

Part A: FISHES. By F. Johansen.....(*In preparation*).
Part B: ASCIDIANS, ETC. By A. G. Huntsman.....(*Issued November 29, 1922*).

VOLUME VII: CRUSTACEA

Part A: DECAPOD CRUSTACEANS. By Mary J. Rathbun.....(*Issued August 18, 1919*).
Part B: SCHIZOPOD CRUSTACEANS. By Waldo L. Schmitt.....(*Issued September 22, 1919*).
Part C: CUMACEA. By W. T. Calman.....(*Issued October 15, 1920*).
Part D: ISOPODA. By P. L. Boone.....(*Issued November 10, 1920*).
Part E: AMPHIPODA. By Clarence R. Shoemaker.....(*Issued September 7, 1920*).
Part F: PYCNOGONIDA. Leon J. Cole.....(*In press, January 3, 1921*).
Part G: EUPHYLLOPODA. By F. Johansen.....(*Issued May 10, 1922*).
Part H: CLADOCERA. By Chancey Juday.....(*Issued June 23, 1920*).
Part I: OSTRACODA. By R. W. Sharpe.....(*In preparation*).
Part J: FRESHWATER COPEPODA. By C. Dwight Marsh.....(*Issued April 21, 1920*).
Part K: MARINE COPEPODA. By A. Willey.....(*Issued June 25, 1920*).
Part L: PARASITIC COPEPODA. By Charles B. Wilson.....(*Issued August 6, 1920*).
Part M: CIRRIPEDIA. By H. A. Pilsbry.....(*In preparation*).
Part N: THE CRUSTACEAN LIFE OF SOME ARCTIC LAGOONS, LAKES AND PONDS.
By F. Johansen.....(*Issued December 30, 1922*).

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I.

The Freshwater Algae of the Canadian Arctic Expedition, 1913-18

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The Freshwater Algae of the Canadian Arctic expedition were collected by Mr. Frits Johansen, the marine biologist who accompanied the Southern Party. The collections were obtained in Alaska, from the arctic regions of the Northwest Territories as far east as Bernard harbour, and from islands near the arctic coast. The algae were collected from as many different situations as possible —exposed rocks, warm streams, still and running water, lakes and tundra ponds.

In such latitudes as those in which these samples of waterlife were obtained, it is almost impossible to make an examination at the time of collection to determine which collections are likely to be of special interest and worth obtaining in considerable quantity, and which are going to turn out poorly. In consequence the collections varied greatly; some bottles containing but little material were rich in both species and numbers, while a few which seemed to be better filled were found to contain only sand particles and unrecognizable decaying organic matter.

The richest collection was secured from an *Hippuris* swamp at Herschel island, Y.T. (Plate II., fig. 2). This is a small island situated a short distance from the mainland in the Beaufort sea, and about halfway between the international boundary at Demarcation point and the mouth of the Mackenzie river. The swamp, which is about half a mile from the sea, at an elevation of approximately 200 feet, is a widened portion of one of the many creeks intersecting the island. The fact that the island is much visited by waterbirds may account to a large extent for the variety of algal species found there.

The low temperature in these northern latitudes makes it necessary to preserve all collections in alcohol almost immediately after they have been gathered. Alcohol, as is well known, is by no means a good fixing agent for algae and, as a consequence, the algae in the collections, for the most part, were poorly fixed. The protoplasmic contents of the cells were found to be much contracted and the walls of many of the desmids collapsed. Some of the desmids had even lost their original shapes, owing to the fact that portions of their walls had become inverted. In many of the Myxophyceae the alcohol had altered the colour of the sheath and of the contents.

The Examination of Material from Brackish Ponds.

The examination of material from brackish waters was of special interest, revealing a green algal flora almost entirely freshwater in character. In samples collected from a brackish pond at Teller, Alaska, there were not only many species of algae but each species was represented by numerous individual plants. I therefore inquired of Mr. Johansen as to the pond's salinity, its nearness to the ocean, and as to its supplies of fresh water from melting snow. Mr. Johansen kindly furnished me with the following information.

There were two kinds of brackish ponds examined by the expedition: (1) very shallow lagoon ponds, from a few inches up to one foot in depth, in actual connection with the sea, at least at high tide, and (2) brackish ponds containing water all the year round, situated farther inland than the lagoons

or at a sufficiently high elevation to be out of the reach of the sea, although to this they plainly owe their origin. Some of the larger lakes were quite fresh and probably of glacial origin, but others, which must at one time have had connection with the sea, probably contained some salt or brackish water in their deeper parts although their surface water was quite fresh.

The shallow lagoon ponds owe their water content partly to melted snow but principally to the influx at high tide. The sandy or gravelly beach surrounding them is saturated with sea water; and the more shallow and smaller of them completely dry out by the end of summer. The presence of salt in the lagoon ponds is thus easily accounted for. The ponds are frozen solid for nine months of the year and thaw in summer at the same time as the ice along the seashore.

Of especial interest are two brackish ponds which belong to the second type mentioned above, viz.: (1) a tundra pond between a large lake and the sea at Teller, Alaska (Port Clarence bay), and (2) a more open pond situated at the end of the bay at Bernard harbour, N.W.T.

The tundra pond represents a remnant of the outlet which in earlier times at high tide connected the large lake nearby with Grantley harbour (Port Clarence bay). The bed of this outlet, except for a deep hole which is now the tundra pond, filled with sand and in the course of time became overgrown with a swamp vegetation. The locality was visited by the expedition for two weeks in August, 1913, and the pond was then quite free of ice. Its brackish nature was determined simply by tasting the water. In the collections from the pond, excluding diatoms, there were 14 species of freshwater algae.

The large lake, referred to in the previous paragraph, represents a former lagoon connected with Grantley harbour. Its surface and marginal waters were tested and found to be quite fresh, although its deeper parts were probably brackish. Marine diatoms were found in the deposits from the bottom of this lake.

The brackish pond at Bernard harbour is situated out of reach of the sea at an elevation of about 10 feet and about 25 yards inland from high-tide marks on the beach, and on a gravel flat. The pond proper is represented by a deeper hole, which is 3 to 4 feet deep in the middle and rises rather abruptly to a broad belt of shallow marginal water not exceeding one foot in depth. The bottom of the hole contains mud which smells strongly of sulphuretted hydrogen. The bottom of the shallower margin is composed of light brown mud and stones with many green thread algae (*Enteromorpha crinita* and *E. intestinalis*). When the melting of the pond begins, water is formed on the surface and the shallow marginal water becomes ice-free, whilst the deeper part (over 1 foot) is solid ice (May 5, 1916). By the middle of June (1916) the pond was completely ice-free and had considerably increased its expanse owing to the inflow of fresh water produced from the snow which had melted on the tundra slopes behind. The pond still overflowed into a nearby bay of the sea by means of a small creek. Toward the second week of July (1915), owing to evaporation, the horizontal expanse of the pond had diminished, and all that remained of the overflow were a few small waterholes in the creek bed. A month later, this evaporation had progressed still further and the pond was practically limited to the deeper hole in the centre, the rest being flats and swamps with a *Carex subspathacea* vegetation. At the end of September (1915), the ice had become more than 1 foot thick. At this time, therefore, the marginal water was completely frozen. The temperature of the water beneath the ice was found to be 30·2° F. at 2 p.m. September 23, 1915 (atmospheric temperature 26·8° F.).

It is an interesting fact that, in spite of the limited size of these two ponds (Teller, Alaska, and Bernard harbour) and of the great influx of melting fresh water in the early summer, the water in the ponds keeps distinctly brackish. Mr. Johansen gives the following reasons for this: (1) the ponds actually represent bays of the sea, isolated by an elevation of the beach line in comparatively recent times, so that the surrounding soil is impregnated more or less with saline matter; and (2) in the spring a large volume of melting water spreads out over

the surface of the ponds and occupies the shallower parts of them, and it is this fresh water which evaporates in the summer, thus leaving the deeper and more concentrated saline layers as practically the only water to freeze at the close of the summer. Like all water areas in the north, the first free water on the ice in the spring owes its origin to melted snow from the surrounding slopes and not to the melting of the pond ice. The pond ice melts later under the combined

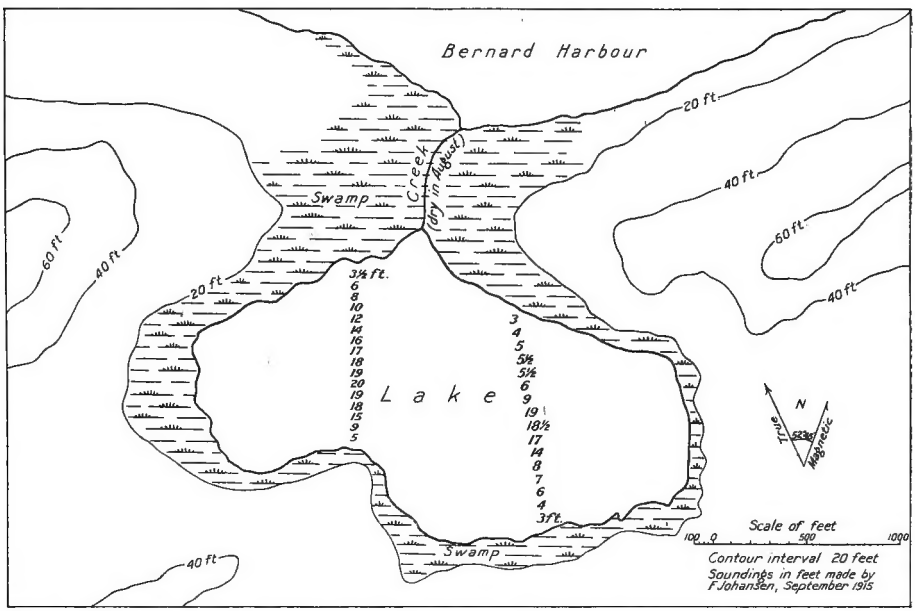

Fig. 1. Map of part of Bernard harbour, Northwest Territories, showing the big lake and its outlet to the sea. Survey by K. G. Chipman and J. R. Cox.

action of the sun's rays and the erosion of the overlying fresh water. In the brackish ponds under consideration there is little or no circulation of the water except during the influx of the freshly melted water from outside sources, but during May and early June, when this influx occurs, the deeper part which contains the more saline and heavier water is one mass of ice and its subsequent melting is a gradual process. By the time the conditions are favourable (no ice) for a thorough mixing of the water layers in the pond, there is no influx of freshly melted water and, therefore, no circulation in the pond. Consequently, the heavier and more saline layers continue to be the deeper layers during the summer, whilst the lighter and freshwater surface layers are subject to rapid evaporation. The fresh water having evaporated during the summer, the first ice formed at the beginning of the winter is brackish. The deeper and more saline water freezes only as the temperature lowers with the advance of winter.

The brackish ponds just described both have an algal flora which, excluding diatoms, is decidedly freshwater in character. The diatoms, which are plentiful, include both freshwater and marine forms. Certain species of *Pediastrum* and *Cosmarium* are very numerous in both ponds. These genera are typically freshwater, marine or brackish forms being unknown.

From the condition of the specimens examined, I have no hesitation in stating that most of them were in a healthy condition when collected. Only a few individuals from bottom deposits gave the impression that they must have been dead before they were preserved. Healthy specimens were collected from water which was distinctly brackish when tasted. The freshwater algae found in these ponds are listed below:

LIST OF FRESHWATER ALGAE FOUND IN BRACKISH PONDS.

Teller, Alaska.	Bernard harbour, N.W.T.
Chroococcus turgidus	
Eudorina elegans	
Pediastrum Boryanum	*Pediastrum Boryanum*
	Pediastrum integrum
	Enteromorpha intestinalis
	Ulothrix variabilis
Microspora sp? (fragments)	
Spirogyra inflata ? (no spores)	
	Closterium striolatum
Cosmarium granatum	*Cosmarium granatum*
Cosmarium punctulatum	*Cosmarium punctulatum*
Cosmarium humile var. *striolatum*	
Cosmarium radiosum (one only)	
Staurastrum punctulatum	
Oedogonium sp? (fragments)	*Oedogonium* sp? (fragments)
Bulbochaete sp?	
Ophiocytium majus	

In addition to these numerous diatoms were found including *Epithemia turgida, E. gibba, E. Sorex,* species of *Cymbella, Eunotia, Navicula,* etc.

After a consideration of the local climatic and geographic factors, I think that the explanation of the presence of these distinctly freshwater plants in water which is brackish to the taste is that the ponds contain two distinct floras which flourish at different times during the short summer season—a freshwater flora of green algae and freshwater diatoms which flourish in the earlier part of the season, and a marine diatomaceous flora which flourishes in the latter part of the season.

The freshwater flora becomes active with the advent of summer. The fresh water, melted on the slopes further inland, probably flowing through bogs or pools of fresh water, would bring freshwater algae to the brackish ponds where the surface ice would be beginning to melt. The resting stages of algae, left near the margin of the pond by evaporation the previous year, would begin active life again as fast as the rising water covered them. These plants, and those brought in by the influx of fresh water, would flourish during the earlier part of the summer. By the middle of June, when all the ice of the pond had melted, a brackish or marine flora would become active and remain so until arrested by the approach of winter.

The evaporation of the surface waters would leave many freshwater algae stranded, whilst others would cease activity under the influence of the slowly increasing salinity of the water. The stranded plants, in most instances, would assume or form some resting state which would enable them to survive the adverse conditions of winter and take up active life again the following year.

Many of these typical freshwater forms must be subjected to some extent to brackish conditions and yet they survive. Probably many can exist in slightly brackish water, with a slightly retarded metabolism, as long as the season lasts. As the salinity increases, some may be induced to develop spores and rest until the influx of fresh water the following summer. Judging by the number of individuals, I think that certain species, *e.g., Pediastrum Boryanum* and *Cosmarium punctulatum,* can adapt themselves to a nearly normal existence even in parts of these ponds where the water is distinctly brackish. Experimental observations under natural conditions would be of great value, if carried out; but, unfortunately, laboratories cannot be established readily in arctic swamps.

Calcareous Deposits formed by Algae.

Amongst the material collected were a number of pebbles from a warm creek, a tributary to the Sadlerochit river, northern Alaska. The water of this creek came from some warm (sulphur?) springs further inland. The samples collected were pebbles of various sizes with a greenish incrustation upon the exposed surfaces. An examination of the incrustation showed it to be a deposit of calcium carbonate in which were embedded some blue-green algae and diatoms. Calcareous and silicious sinters with algae embedded in them are not uncommon in the waters of hot springs and geysers; and the embedded algae are almost exclusively members of the Myxophyceae. It is not surprising, therefore, that the blue-green algae were found upon the Alaska pebbles. Here *Calothrix parietina* was the prevailing species, but there were a few small colonies of a *Gloeocapsa* which could not be determined specifically, and a number of diatoms, mostly *Epithemia turgida* and *E. gibba*. There is no doubt that blue-green algae are responsible for the precipitation of the calcium carbonate which is retained in their gelatinous sheaths. However, to elucidate the precipitation a careful analysis of the water and of the deposit, as well as culture experiments made upon the algae under different conditions, would be needed.

The collections of freshwater algae made by the Canadian Arctic expedition add considerably to our knowledge of the distribution of species. There are a number of records new to this continent or to arctic regions. Some species recorded here, such as *Hyalotheca mucosa*, are well known in the warmer temperate and subtropical regions, yet, as these new observations show, they are able to thrive in some localities within the arctic circle. *Cosmarium Cucurbita* var. *attenuatum* hitherto has been recorded only from England, Germany, and the West Indies, and *Cosmarium subexcavatum* var. *ordinatum* only from Switzerland and England, yet these and some others with very limited distribution elsewhere have been found in the collections I have examined. A number of species, including many species of *Micrasterias*, known from Alaska and Greenland, were not present in the material submitted to me. This seems remarkable. However, up to the present time very little attention has been paid to the freshwater algae of the Dominion either in arctic regions or in more temperate parts. Further work may show that many species, rare or apparently absent in our flora, are more generally distributed than hitherto supposed.

The following is a list of all species of Myxophyceae and Chlorophyceae found by the expedition. Accompanying this list are six columns which indicate the distribution of these algae as known from records made in Alaska, arctic Canada visited by the expedition, Greenland, the Faeroe islands, the United States of America exclusive of Alaska, and Canada exclusive of the arctic. The column for Canada exclusive of the arctic contains many new records made by myself. These I hope to discuss in another communication.

The following symbols are employed:

- **+**: new record.
- +: previously recorded.
- –: not recorded.
- ⋕: an original record for Canada exclusive of the arctic not hitherto published.
- t: identical in form with original type.
- v: a variety of the species.
- f: a form of the species.
- ⋕v: a variety of the species hitherto not recorded for Canada.

	Alaska.	Arctic Canada visited by the expedition.	Greenland.	Faeroes.	United States exclusive of Alaska.	Canada exclusive of the arctic.
MYXOPHYCEAE.						
Coccogoneae.						
Chroococcus limneticus	+	+	−	+	+	#
" *macrococcus*	+	+	+	+	−	−
" *pallidus*	−	+	−	−	+	−
" *turgidus*	+	+	+	+	+	+
Gloeocapsa magma	+	−	+	+	+	+
" *rupestris*	+	+	+	−	+	−
Aphanocapsa elachista	−	+	−	−	−	#
Aphanothece saxicolor	−	+	−	+	+	−
Microcystis aeruginosa	−	+	−	−	+	#
Gomphosphaeria aponina	−	+	−	−	+	−
Coelosphaerium Kützingianum	+	+	−	+	+	+
Merismopedia glauca	−	+	−	+	+	+
" *tenuissima*	−	+	−	+	−	+
Hormogoneae.						
Oscillatoria tenuis	+	+	+	+	+	−
Nostoc commune	+	+	+	+	+	+
" *sphaericum*	+	+	−	−	+	−
Anabaena cotenula	+	+	−	−	+	−
" *variabilis*	+	+	+	+	+	−
Scytonema crustaceum	−	+	−	−	+	−
" *mirabile*	+	−	−	+	+	−
Tolypothrix lanata	+	−	−	−	+	−
" *tenuis*	+	−	−	+	+	−
Hapalosiphon fontinalis	+	−	−	−	+	−
Stigonema informe	+	−	−	−	+	−
" *lubricum*	−	+	−	−	−	−
" *ocellatum*	+	−	−	+	+	−
Calothrix parietina	+	−	+	−	+	−
Rivularia borealis	+	−	+	−	−	−
CHLOROPHYCEAE.						
Gonium pectorale	−	+	−	+	+	+
Eudorina elegans	+	+	−	+	+	#
Volvox aureus	−	+	−	−	+	−
Gloeocystis infusionum	−	+	−	−	−	−
Oocystis solitaria	+	+	+	+	+	−
Nephrocytium obesum	−	+	−	−	−	−
Tetraëdron enorme	−	+	−	+	+	−
Selenastrum acuminatum	+	−	−	−	−	−?
Scenedesmus denticulatus	+	−	+	+	+	−
" *obliquus*	+	+	−	+	+	−
" *quadricauda*	+	+	+	+	+	#
Crucigenia rectangularis	−	+	+	+	+	−
Coelastrum microporum	−	+	−	+	+	#
" *reticulatum*	−	+	−	−	+	#
Pediastrum Boryanum	+	+	+	+	+	#
" " var. *granulatum*	−	+	−	+	+	−
" *glanduliferum*	+	+	−	−	−	#
" *integrum*	−	+	−	−	−	−
" *Tetras*	+	+	−	+	+	#
Vaucheria terrestris	−	+	+	−	+	−
Cladophora fracta	+	+	−	+	+	−
Rhizoclonium hieroglyphicum	−	−	−	+	+	−
" " var. *tortuosum*	+	−	−	−	−	−
Enteromorpha crinita	+	+	−	−	+	+

	Alaska.	Arctic Canada visited by the expedition.	Greenland.	Faeroes.	United States exclusive of Alaska.	Canada exclusive of the arctic.
CHLOROPHYCEAE—Continued.						
Enteromorpha intestinalis	+	+	+	−	+	#
Prasicla crispa	+	+	+	+	+	−
Schizogonium murale	+	+	−	−	+	−
Ulothrix tenerrima	+	+	−	−	+	−
" *variabilis*	+	+	+	−	+	−
Microspora stagnorum	+	+	+	+	+	−
Draparnaldia glomerata	−	+	−	+	+	−
Zygnema stellinum	−	+	+	+	+	−
Spirogyra inflata	+	+	−	+	+	−
" *insignis*	−	+	−	−	+	−
Cylindrocystis crassa	+	+	−	−	+	−
Penium cruciferum	+	−	−	−	+	−
" *margaritaceum*	+	−	+	+	+	−
" *spirostriolatum*	−	+	−	−	+	−
Closterium Cornu	+	+	−	f	+	−
" *Dianae*	+	+	+	+	+	−
" *didymoctocum*	−	−	−	+	+	−
" " var. *striatum*	−	+	−	−	−	−
" *Jenneri*	f	+	+	+	+	−
" *moniliferum*	+	−	−	+	+	#
" *parvulum*	+	−	+	−	+	−
" *rostratum*	−	+	+	+	+	−
" *setaceum*	+	−	−	−	+	−
" *striolatum*	+	+	+	+	+	−
" *Venus*	+	+	+	+	+	−
Pleurotaenium Trabeculo f. *clavata*	+	−	−	−	+	−
" *truncatum*	+	−	+	−	+	−
Euastrum ansatum	+	+	+	+	+	−
" *bidentatum*	+	+	+	−	+	−
" *binale*	+	+	−	+	+	−
" *denticulatum*	+	−	+	−	+	−
" *dubium*	+	+	−	−	−	−
" *elegans*	+	+	+	+	+	−
" *oblongum*	+	−	+	+	+	−
" *occidentale*	+	−	−	−	+	+
Micrasterias apiculata	−	−	−	−	+	−
" " var. *brachyptera*	−	+	−	−	−	−
Cosmarium asphaerosporum	−	−	−	−	+	−
" " var. *strigosum*	+	−	−	−	−	−
" *binum*	−	+	−	−	+	−
" *Botrytis*	+	+	+	+	+	#
" *conspersum*	+	+	+	−	+	−
" *contractum* var. *ellipsoideum*	t	+	−	+	t	−
" *costatum*	+	+	+	−	+	−
" *crenatum*	+	−	+	+	+	−
" *Cucumis*	+	−	+	+	−	−
" *Cucurbita* var. *attenuatum*	−	+	t	t	t	−
" *cyclicum* var. *Nordstedtianum*	−	+	t	t	t	−
" *globosum*	+	−	+	−	+	−
" *granatum*	+	+	+	+	+	−
" *Hammeri*	+	+	+	−	+	−
" *Holmiense* var. *integrum*	+	+	+	−	+	−
" *humile* var. *striatum*	+	+	−	+	+	−
" *impressulum*	+	+	+	+	+	−
" *inconspicuum*	−	+	−	−	−	−
" *margaritatum*	+	+	+	+	+	−
" *ochthodes*	+	+	+	+	+	−
" *Pokornyanum*	+	+	+	−	+	−
" *punctulatum*	+	+	+	+	+	−
" " var. *subpunctulatum*	+	−	−	+	−	−

	Alaska.	Arctic Canada visited by the expedition.	Greenland.	Faeroes.	United States exclusive of Alaska.	Canada exclusive of the arctic.
CHLOROPHYCEAE—Concluded.						
Cosmarium pygmaeum	−	+	+	+	+	−
" *quadratum*	−	+	+	+	+	−
" *radiosum*	+	−	−	−	+	−
" *rectangulare*	+	+	+	−	+	−
" *reniforme*	−	+	−	+	−	−
" *speciosum*	−	−	+	+	+	−
" " var. *biforme*	−	+	+	+	−	−
" *Stefanssonii*	−	+	−	−	−	−
" *subcostatum*	−	+	+	+	+	−
" *subcrenatum*	+	+	+	+	+	−
" *Subcucumis*	−	+	−	−	−	−
" *subexcavatum*	−	+	+	−	−	−
" " var. *ordinatum*	−	+	−	−	−	−
" *subtumidum* var. *Klebsii*	+	+	t	t	t	#
" *tetraophthalmum*	−	+	+	+	+	−
" *trachyplevrum*	+	−	−	−	+	−
" *Turpinii*	+	+	+	−	+	#
" *undulatum*	+	+	+	+	+	−
Xanthidium antilopaeum	+	+	−	+	+	−
" *cristatum* var. *bituberculatum*	−	+	−	−	−	−
" *fasciculatum*	−	+	+	+	+	−
Arthrodesmus Incus var. *Ralfsii* forma *subhexagona*	−	+	−	t	−	−
Staurastrum Avicula	+	−	−	+	+	−
" *Brébissonii*	+	−	−	−	+	−
" *brevispinum*	−	+	+	−	+	#
" " var. *inerme*	+	−	−	−	+	−
" *denticulatum*	+	−	−	+	−	−
" *furcigerum*	+	+	−	+	+	−
" *hexacerum*	+	+	−	+	+	−
" *Holmii*	+	+	−	−	−	−
" *lunatum*	+	−	−	−	−	−
" " var. *planctonicum*	−	+	−	−	−	−
" *megacanthum*	−	+	−	+	+	−
" *muricatum*	+	−	−	+	+	−
" *muticum*	+	+	+	+	+	−
" *orbiculare*	+	−	−	+	+	−
" *pachyrhynchum*	−	+	+	−	+	−
" *paradoxum*	+	+	−	+	+	+
" *polymorphum*	+	+	−	+	+	−
" *polytrichum*	−	+	−	+	−	−
" *punctulatum*	+	+	+	+	+	−
" *Reinschii*	−	+	−	−	−	−
" *setigerum*	−	+	−	−	+	#
" *vestitum*	−	+	−	−	+	−
Sphaerozosma excavatum	+	+	−	+	+	−
Spondylosium planum	+	−	−	−	+	+
Hyalotheca dissiliens	−	+	−	−	+	−
" *mucosa*	+	+	−	−	+	−
Bulbochaete sp.	+	+	+	+	+	+
Oedogonium nodulosum	−	+	−	−	v	−
" *paludosum* var. *americanum*	−	+	−	−	+	−
Botryococcus Braunii	+	+	−	+	+	#
Ophiocytium majus	+	+	−	+	+	−
Tribonema bombycina	−	−	+	+	−	−
" " var. *tenuis*	+	+	+	−	+	−

A glance at the table shows at once how little is known of Canadian Freshwater Algae. Many of the species are recorded as being found in Canada for the first time. My work has been handicapped to some extent by imperfect library facilities. Certain papers dealing with the arctic flora, which I wished to consult, I was unable to obtain. Hence it is possible that a few records have been omitted from the table.

There are recorded in the detailed account which follows: 28 species of Myxophyceae from 17 genera; 137 species of Chlorophyceae representing 41 genera (*Cosmarium* 38 species, *Staurastrum* 22 species); and Phaeophyceae and Rhodophyceae with 1 genus and 1 species from each group, making a total of 60 genera and 167 species. There are two new varieties, one new species, and one species transferred from the genus *Cosmarium* to the genus *Staurastrum*.

In concluding the general part of this report I wish to express my indebtedness to Professor A. H. Reginald Buller for encouragement and many useful suggestions; to Dr. Theodor Holm for the Latin descriptions of new varieties and species; to Professor W. A. Setchell for identification of *Scytonema crustaceum* Ag.; to Mr. Frits Johansen for much information regarding the collecting of the material and the localities from which the samples were taken, and for the loan of various publications; and, especially, to the late Professor G. S. West of Birmingham, England, not only for valuable help and advice during the earlier stages of the investigations recorded here, but also for the training and stimulating influence which I received from him during a number of years which I was privileged to spend in his laboratory. Professor West was particularly interested in arctic freshwater algae and was desirous of promoting the investigation of Canadian algae in general. His untimely death in the summer of 1919 was a great loss to the botanical world in general, and especially to Canada, whose freshwaters are still practically unexplored.

The following works were consulted regarding the distribution and for other purposes:—

Börgesen—Freshwater Algae of the Faeroes.

Börgesen and Ostenfeld—The Phytoplankton of the Faeroes.

Collins—The Green Algae of North America.

Cooke—British Desmids.

Cooke—British Freshwater Algae.

Ralfs—The British Desmidieae.

Saunders—The Freshwater Algae of the Harriman Alaska Expedition.

Tilden—Minnesota Algae (Myxophyceae).

West—British Desmidiaceae.

Wolle—Desmids of the United States.

Wolle—Freshwater Algae of the United States.

Also "Meddelelser om Grönland," various volumes, and a large number of small works by W. West, G. S. West, Börgesen and other workers.

List of Species.

MYXOPHYCEAE.

COCCOGONEAE.

CHROOCOCCACEAE.

Chroococcus Näg.

Chroococcus limneticus Lemm.

This typical plankton organism was not common in any one particular collection although it occurred in samples from various localities. The cells were all a little below average size. It was found in material from a tundra pond, Collinson point, in the plankton of the big lake at Bernard harbour, on a gelatinous mass (an *Ophrydium* sp? Protozoa) from the lake at Bernard harbour, and amongst stones from the river bed at the same place.

Chroococcus macrococcus (Kütz.) Raben.

This was found along with *Nostoc commune* Vauch. and other algae from the bottom of a dried tundra pond near Bernard harbour, and in a tundra pond at Collinson point. Common.

Chroococcus pallidus Näg.

This alga has not been previously recorded from arctic waters and in North America has only been found in Lake Erie. A few small yellowish gelatinous masses of this species, each mass composed of 4 or 8 cells, were found in the bottle containing the *Ophrydium* from the lake at Bernard harbour.

Chroococcus turgidus (Kütz.) Näg.

This is perhaps the commonest species of this genus in arctic regions. It was found in the tundra collections, the bottom deposits, and the plankton at Bernard harbour. It occurred also at Herschel island, and in the brackish pond as well as the freshwater lake at Teller.

Gloeocapsa Kütz.

Gloeocapsa magma (Bréb.) Kütz.

Although this species occurs fairly frequently in arctic regions, I only found it in material from the lagoon lake at Teller. It was not so darkly coloured as usual, but this may have been due to long standing in alcohol after being collected.

Gloeocapsa rupestris Kütz.

This occurred in the dry tundra pond along with *Nostoc commune* at Bernard harbour, and in the lagoon lake at Teller.

Aphanocapsa Näg.

Aphanocapsa elachista W. and G. S. West

This plant is identical with some plants taken from Lake Winnipeg, Manitoba, and from the Lake of the Woods, Ontario; and it was identified by the late Professor G. S. West as this species. It has not been previously recorded in arctic regions and is not common in North America. It occurred in small quantity in some mud from Bernard harbour and in one sample of plankton (September 26, 1916) from the big lake at Bernard harbour.

Aphanothece Näg.

Aphanothece saxicolor Näg.

Only one small irregular mass of this species was observed, cells 1·5μ wide and 2½ times as long. It was found in the big lake, Bernard harbour, August, 1915. It has not been recorded previously for the arctic regions of America.

Microcystis Kütz.

Microcystis aeruginosa Kütz. [*Clathrocystis aeruginosa* (Kütz.) Henfry]

This typical plankton alga is common in the United States of America but has not previously been found in arctic regions. It is not uncommon in some Canadian lakes. It was found by the expedition in the plankton of the big lake at Bernard harbour and in the second bay east of Bernard harbour and at Herschel island.

Gomphosphaeria Kütz.

Gomphosphaeria aponina Kütz. (Plate IV, fig. 18)

A few pale blue-green colonies of this species were found in the plankton of the big lake at Bernard harbour, July, 1916. It has not been previously recorded from arctic America.

Coelosphaerium Kütz.

Coelosphaerium Kützingianum Näg.

This species was observed on various occasions in the plankton from Bernard harbour and once in some tundra material from Demarcation point, Alaska. This is also a first record for the American arctic regions.

Merismopedia Meyen.

Merismopedia glauca (Ehrenb.) Näg.

This was observed in material from the pond near the second bay east of Bernard harbour, June, 1915, and in material from Herschel island, July, 1916.

Merismopedia tenuissima Lemm.

Although this species was never plentiful, it was observed in different plankton collections from the lake at Bernard harbour and at Herschel island. No previous records have been made for the last two species for arctic America.

OSCILLATORIACEAE.

Oscillatoria Vauch.

Oscillatoria tenuis Agardh

This species is well known from all arctic regions and occurred at Collinson point, Pihumalerksiak island, and Bernard harbour.

Hormogoneae.

NOSTOCACEAE.

Nostoc Vauch.

Nostoc commune Vauch.

This was very plentiful at the bottom of tundra ponds and in many other places at Teller. It was also found at Collinson point and at Bernard harbour, as well as in the stomach of a fish taken June 20, 1915, at Bernard harbour.

Nostoc sphaericum Vauch.

This species was not by any means abundant and only occurred in a few samples from Bernard harbour.

Anabaena Bory.

Anabaena catenula (Kütz.) Bornet and Flahaut

This species was found only in the material from the *Hippuris* swamp, Herschel island. It was not common.

Anabaena variabilis Kütz.

This species occurred in the lake at Teller, and in the big lake at Bernard harbour. It was fairly frequent.

SCYTONEMACEAE.

Scytonema Agardh.

Scytonema crustaceum Ag.

This plant was found in small fragments with *Nostoc commune* in a tundra pond at Bernard harbour. This, I believe, is the first arctic record.

Scytonema mirabile (Dillw.) Bornet

Occasional fragments of this alga were found in a collection of plankton and bottom deposits from Teller.

Tolypothrix Kütz.

Tolypothrix lanata (Des.) Wartmann

This alga was taken from the bottom of a melted tundra pond, Collinson point, June 4, 1914.

Tolypothrix tenuis Kütz.

A few fragments were obtained from a tundra pond at Teller.

STIGONEMACEAE.

Hapalosiphon Näg.

Hapalosiphon fontinalis (Ag.) Bornet

This also occurred as a few small fragments from the tundra pond at Teller.

Stigonema Agardh.

Stigonema informe Kütz.

This occurred only in a tundra pond at Collinson point. Not common.

Stigonema lubricum (Dillw.) Kütz.

The *Hippuris* swamp at Herschel island was the only locality from which this was obtained. It was comparatively rare.

Stigonema ocellatum (Dillw.) Thur.

This alga was found in a lagoon just west of Martin point, and at Collinson point. Common.

RIVULARIACEAE.

Calothrix Agardh.

Calothrix parietina (Näg.) Thur.

This alga was the dominant species in calcareous incrustations on pebbles in a creek containing warm water coming from hot springs and running into the Sadlerochit river.

Rivularia (Roth) Agardh.

Rivularia borealis Richt.

This species was obtained in a lagoon just west of Martin point, July, 1914. Not abundant.

CHLOROPHYCEAE.

ISOKONTAE.

VOLVOCACEAE.

Gonium Müll.

Gonium pectorale Müll.

This alga was found only in the big lake at Bernard harbour and in small numbers. Very few of these were perfect 16-celled colonies, most of them having had one or two of the cells injured and killed by some means before reaching maturity. It is fairly plentiful in some parts of Canada, but it is not common in these arctic collections and does not appear to be generally found in arctic regions.

Eudorina Ehrenb.

Eudorina elegans Ehrenb.

This was the only member of the Volvocaceae which was common in algal collections. It occurred in the plankton and other collections from the lake at Teller and from Bernard harbour. It was also present in the brackish pond at Teller, and in collections from the *Hippuris* swamp at Herschel island, from Chantry island, and from Cape Bathurst.

Volvox (L.) Ehrenb.

Volvox aureus Ehrenb.

Only one specimen of this beautiful alga was observed. It was in the material from the *Hippuris* swamp at Herschel island. Diameter of coenobium 300μ; daughter cells, antheridia, and oogonia absent. It is not common in arctic regions.

PALMELLACEAE.

Gloeocystis Näg.

Gloeocystis infusionum (Schrank) W. & G. S. West (Plate III, fig. 5)

This alga was by no means common, only a few cells being found in any one collection. It occurred in the big lake at Bernard harbour, at Chantry island, and at Cape Bathurst. I cannot find any previous record for the North American continent or arctic regions for this species. Size, with integument, 60μ in diameter; cell 21μ.

AUTOSPORACEAE.

Oocystis Näg.

Oocystis solitaria Wittr.

This was the only species of this genus and occurred in plankton and bottom deposits of the lake at Teller. It was also present in much less quantity at Bernard harbour.

Nephrocytium Näg.

Nephrocytium obesum W. West (Plate IV, fig. 17)

This was only once observed, three plants being found in the plankton at Bernard harbour, July 3, 1916. It is the first record for the American continent and for the arctic.

Tetraëdron Kütz.

Tetraëdron enorme (Ralfs) Hansg.

This species appeared in small numbers in the material from the *Hippuris* swamp at Herschel island and was not observed elsewhere. It has not been previously recorded from the arctic regions of America.

Selenastrum Reinsch.

Selenastrum acuminatum Lagerh. (Plate III, fig. 3)

This species occurred only in a collection of bottom deposits and plankton from Teller, August 6, 1913.

Scenedesmus Meyen.

Scenedesmus denticulatus Lagerh.

This species was the rarest of the genus. It was found only in small quantity in the bottom deposit collections from the lake at Teller.

Scenedesmus obliquus (Turp.) Kütz.

This species, although not common, occurred in more localities than the preceding species. It occurred in the lagoon lake at Teller, in the plankton at Bernard harbour, and in the *Hippuris* swamp at Herschel island. The *Dactylococcus* stage was found with the *Ophrydium* mass at Bernard harbour.

Scenedesmus quadricauda (Turp.) Bréb.

This alga was very common in the collections from Teller. It was found in smaller quantities at Bernard harbour, Demarcation point, and Herschel island.

Crucigenia Morren.

Crucigenia rectangularis (Näg.) Gay

This species occurred only in the plankton of the big lake at Bernard harbour. The cells were a little below average size, being $3 \cdot 5\mu$ to 5μ by 4μ to 6μ. The colonies usually contained 8 or 16 cells.

Crucigenia sp?

In the collections from Bernard harbour with *C. rectangularis* were seen a few colonies of 4 and 8 cells of a species abour one-half of the size of *C. rectangularis*, *i.e.*, 2 to $2 \cdot 5\mu$ by $2 \cdot 5\mu$ to 3μ. The cells were badly collapsed. This condition was probably caused by the alcohol in which they were preserved. I could not therefore determine the species with accuracy. It resembled *C. rectangularis* in general appearance and is probably a small variety of that species; but to make sure of its exact systematic position material in a better state of preservation would be required.

Coelastrum Näg.

Coelastrum microporum Näg.

This species occurred in two localities only and was not very plentiful in either of them. It was found in the plankton at Bernard harbour (September 26, 1916) and in the *Hippuris* swamp at Herschel island.

Coelastrum reticulatum (Dang.) Senn.

Three individuals of this peculiar species of *Coelastrum* were found in material at Herschel island in the *Hippuris* swamp. It is not a common alga in North America. It has been recorded from Put-in-Bay, Lake Erie (Snow), and I have recently found it in Manitoba and Ontario. It is not generally found in arctic regions.

HYDRODICTYACEAE.

Pediastrum Meyen.

Pediastrum Boryanum (Turp.) Menegh.

This was about the most frequent alga of the collections. It was secured in all possible habitats—tundra ponds, brackish ponds, mud and bottom deposits, and plankton—and was common at the following localities: Teller, Collinson point, Demarcation point, Bernard harbour, and Herschel island.

Pediastrum Boryanum (Turp.) Menegh. var. **granulatum** (Kütz.) Braun

This variety is not uncommon to North America although it was only found at Herschel island. It has not been previously recorded for the arctic regions of America.

Pediastrum glanduliferum Benn. (Plate III, fig. 1)

This species is one of the less frequent of the genus. The glandular processes on all were quite typical. I cannot find any previous record for this species in North America or arctic regions, although I have recently found it near Winnipeg. It occurred in small quantities in collections from the lagoon lake at Teller, in the plankton of the big lake at Bernard harbour, and at Chantry island.

Pediastrum integrum Näg. (Plate III, fig. 2)

A few individuals of this species, with its very angular walls and the short processes, were found in the water of the big lake at Bernard harbour, and one in the brackish pond in the same locality.

Pediastrum tetras (Ehrenb.) Ralfs

This species was second in abundance to *P. Boryanum*. The 4-celled form was common at Teller, and at Bernard harbour. At Herschel island both 4- and 8-celled forms were frequent.

VAUCHERIACEAE.

Vaucheria DC.

Vaucheria terrestris (Vauch.) DC.

Fragments of *Vaucheria* occurred in a small number of the collections, but the only place where any quantity was secured was at Cape Bathurst, July 26, 1916. Reproductive organs were not numerous and mostly in the earlier stages; a few ripening oospores were present.

CLADOPHORACEAE.

Cladophora Kütz.

Cladophora fracta (Dillw.) Kütz.

Small masses and numerous fragments of this alga were common at Teller, and at Bernard harbour, especially in the collections from tundra ponds.

Cladophora sp?

A few fragments were found in a fish stomach (*Coregonus* sp.), Port Epworth, October 4, 1915. Identification of the species was not possible.

Rhizoclonium Kütz.

Rhizoclonium hieroglyphicum (Ag.) Kütz. var. **tortuosum** (Kütz.) Stockm.

Amongst the Cladophora from a tundra pond at Collinson point was a quantity of this Rhizoclonium. As it did not seem quite typical I submitted some to Professor G. S. West and he identified it as the var. *tortuosum* which I believe is new to this continent.

ULVACEAE.

Enteromorpha Harvey.

Enteromorpha crinita (Roth) Agardh

This alga was abundant in both brackish and freshwater collections from Teller, and from Bernard harbour. It is really a marine species adapting itself to less saline conditions. F. S. Collins[1] has already reported this species growing in fresh water along with *Spirogyra* and *Oedogonium*. It is a filiform, cylindrical or flattened, much branched species, the branches tapering to a single series of small cells, and it is readily distinguished from *E. intestinalis* frequently found with it in these collections.

Enteromorpha intestinalis (L.) Greville

This alga was exceedingly abundant at Bernard harbour, in fresh water and brackish water, and at the mouth of the creek.

PRASIOLACEAE.

Prasiola (Ag.) Menegh.

Prasiola crispa (Lightf.) Menegh.

No collection of algae from the north or south polar regions could be complete without this species. All stages from the *Hormidium* stage to fairly large fronds were found on rocks, especially where sea birds were common, at Bernard harbour, Peers point (Wollaston land), and Collinson point.

Schizogonium Kütz.

Schizogonium murale Kütz.

This alga very closely resembles *Prasiola crispa* in the *Hormidium* stage and may be a form of that species. It was found on the beach of the island at Bernard harbour.

ULOTHRICHACEAE.

Ulothrix Kütz.

Ulothrix tenerrima Kütz.

This alga and the next were found in the collections only as fragments. It was found at Teller, in a pond on Pihumalerksiak island (Cockburn point), and at Bernard harbour.

Ulothrix variabilis Kütz.

This was found in material from the bottom of a tundra pond at Collinson point, and at Bernard harbour, where it occurred in the brackish pond as well as in the large lake.

MICROSPORACEAE.

Microspora Thuret.

Microspora stagnorum (Kütz.) Lagerh.

This alga was not abundant. It was found in a mud sample from the big lake east of Bernard harbour, and also at Teller, where some small fragments occurred in the brackish pond and the freshwater lake.

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[1]Collins. The Green Algae of North America.

CHAETOPHORACEAE.

Draparnaldia Bory.

Draparnaldia glomerata (Vauch.) Ag.

This alga was secured only from one locality, the *Hippuris* swamp at Herschel island, where it was exceedingly abundant.

Akontae.

ZYGNEMACEAE.

Mougeotia Agardh.

Mougeotia sp?

A number of fragments without any reproductive stages occurred in the big lake and other places at Bernard harbour.

Zygnema Agardh.

Zygnema stellinum (Müll.) Ag.

This alga was exceedingly plentiful in the Bernard harbour district. Aplanospore formation was found in the second bay east of Bernard harbour on June 16, 1915, and lateral and scalariform conjugation on August 6, 1915. Lateral conjugation in *Zygnema* is not common.

Spirogyra Link.

Spirogyra inflata (Vauch.) Kütz.

This species occurred in the *Hippuris* swamp at Herschel island with all stages of conjugation. A species with one chloroplast (probably this one), but not in conjugation, was common at Bernard harbour, Chantry island, Pihumalerksiak island, and at Teller; at this last place it was found in the brackish pond as well as the freshwater lake.

Spirogyra insignis (Hass.) Kütz.

In conjugation. Found only at Herschel island. It is not a common arctic species.

DESMIDIACEAE.

Cylindrocystis Menegh.

Cylindrocystis crassa De Bary (Plate III, fig. 4)

This desmid occurred in large gelatinous masses at Collinson point. A small quantity was also found in the pond in the second bay east of Bernard harbour, June 16, 1915. This is the first arctic record for this species. Identification was confirmed by the late Professor G. S. West.

Penium Bréb.

Penium cruciferum (De Bary) Wittr. (Plate III, fig. 7)

This species was found in the lagoon lake at Teller. It is more sub tropical than arctic; it has been recorded from Lapland but not from any other northern or arctic region.

Penium margaritaceum (Ehrenb.) Bréb.

Although this species is fairly common in northern countries, it was only found in the collection from the lagoon lake at Teller.

Penium spirostriolatum Barker (Plate III, fig. 6)

A few individuals of this beautiful desmid occurred in the *Hippuris* swamp at Herschel island. It also has not been previously recorded from arctic America.

Closterium Nitzsch.

Closterium Cornu Ehrenb. (Plate IV, fig. 16)

This was a very common species from the tundra pond and the pond between the lake and sea at Teller. It was found also on Pihumalerksiak island (Cockburn point). The majority of specimens were more curved then the type form. Not previously recorded from American arctic regions.

Closterium Dianae Ehrenb.

This little *Closterium* was found with some plankton gatherings, August, 1915, from the big lake at Bernard harbour.

Closterium didymoctocum Corda var. **striatum** nov. var. (Text fig. 2)

Semicellulae membrana atrofulva, striata, striis 13–15 transversis bene distinctis.

Cells large as in type, 9–12 times longer than their diameter. Outer margin slightly curved, inner margin almost straight. Sides gradually attenuated towards the apices which are broad and truncate with rounded, somewhat slightly recurved angles; cell wall reddish brown, definitely striate, 13–15 striae visible across the cell; annular thickening of darker colour at each apex. Length, 340μ.

It was not common but all individuals seen were the same. It was obtained on Herschel island.

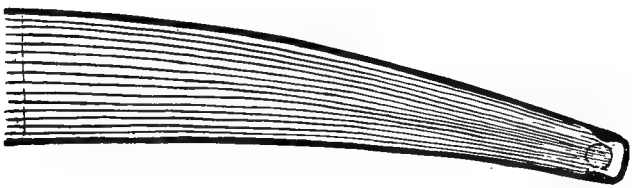


Fig. 2. *Closterium didymoctocum* Corda var. *striatum* nov. var. × 475; semi-cell showing the striated wall and the regular characters of the apex.

Closterium Jenneri Ralfs

The type form was found in the *Hippuris* swamp at Herschel island. A form with apices less curved than type was found in a collection of bottom deposits and plankton from Teller.

Closterium moniliferum (Bory) Ehrenb.

This was only found in the lagoon lake at Teller. It is common in Canada and the United States, but had not been previously recorded from the arctic regions of America.

Closterium parvulum Näg.

This small *Closterium* is common in arctic regions, but only appeared in collections from two localities and was not abundant. It was found with other species of this genus in the lake at Teller, and in a lagoon just west of Martin point.

Closterium rostratum Ehrenb.

Although this species is more northern than *C. setaceum*, it was found in small numbers. It occurred only in the *Hippuris* swamp at Herschel island.

Closterium setaceum Ehrenb.

This plant is much rarer than the preceding species, especially in arctic and subarctic areas, yet it was more plentiful in proportion to the numbers of other species. It was found in a collection of bottom deposits and plankton from the lake and from the pond between the lake and sea at Teller.

Closterium striolatum Ehrenb.

This is a very common species and is well known from almost all parts of the earth. It occurred in the lake, brackish pond, and tundra ponds at Teller, and in the *Hippuris* swamp at Herschel island.

Closterium Venus Kütz.

This species was not in great abundance in any one locality, although fairly common in two ponds at Teller. It was also found at Chantry island, Herschel island, and at Bernard harbour.

Pleurotaenium Näg.

Pleurotaenium Trabecula (Ehr.) Näg. forma **clavata** (Kütz.) W. & G. S. West (Plate III, fig. 16)

The type form of this species has been found in Greenland and in a few other arctic localities, but the form *clavata* has only been previously recorded from a few localities in France, Germany, Italy, Sweden, the British Isles and the United States. Three individuals of this form were found in material from a drying tundra pond at Demarcation point, May 14, 1914.

Pleurotaenium truncatum (Bréb.) Näg.

This species was found only in the lagoon lake at Teller, where it was not uncommon.

Euastrum Ehrenb.

Euastrum ansatum Ralfs

This species occurred in the lagoon lake at Teller, and in the swamp at Herschel island. At both localities it was fairly common.

Euastrum bidentatum Näg.

This species was the most common of the genus and was found in the lagoon lake, a tundra pond, and in a pond between the lake and sea at Teller, also at Demarcation point, Herschel island, and in the lake at Bernard harbour.

Euastrum binale (Turp.) Ehrenb.

The type form occurred in small numbers at Camden bay, in the tundra pond and the pond between the lake and sea at Teller, and at Herschel island.

Euastrum binale (Turp.) Ehr. forma **Gutwinskii** Schm. (Plate III, fig. 13)

This occurred along with the type form in the tundra pond at Teller.

Euastrum denticulatum (Kirchn.) Gay

This species was found only in one locality, Teller, and was not very abundant.

Euastrum dubium Näg. (Plate III, fig. 12)

A few individuals of this species were found in the collection from the drying tundra pond at Demarcation point. From Chantry island five specimens were seen, and all were approaching the variety *Snowdoniense* (Turn.) W. and G. S. West.

Euastrum elegans (Bréb.) Kütz.

This pretty and common species was abundant in several ponds at Teller, and in the *Hippuris* swamp at Herschel island.

Euastrum oblongum (Grev.) Ralfs

This species was found fairly common in the collection from the lagoon lake at Teller. It was not seen in any other collection although it is known to be common in the arctic regions.

Euastrum occidentale W. and G. S. West

This species was the rarest of the genus; only two individuals were seen. They occurred in the material from the drying tundra pond at Demarcation point, May 14, 1914. It has been previously found in Nova Scotia and some of the eastern states of the United States of America, and in one locality in Great Britain. Its distribution is apparently limited and it is here recorded from arctic regions for the first time.

Micrasterias Agardh.

Micrasterias apiculata (Ehrenb.) Menegh. var. **brachyptera** (Lund.) W. and G. S. West (Plate III, fig. 9)

I was disappointed in not finding more than one species belonging to this genus. This one was not common, for only a few empty semi-cells were seen. All were a little less spiny than is general in this variety, but they possessed the very wide polar lobe which distinguishes it from the specific type. *Hippuris* swamp, Herschel island, July 30, 1916.

Cosmarium Corda.

Cosmarium asphaerosporum Nordst. var. **strigosum** Nordst. (Plate III, fig. 15)

This is a very small desmid and easily overlooked, which fact may account for the few records of it. The type form has a very limited distribution and has been found in the United States of America and arctic regions of Europe and Asia. The variety mentioned here was found in small numbers at Teller, and has only been previously recorded from Sweden and one locality in England. Specimens were below average size.

Cosmarium binum Nordst. (Plate IV, fig. 6)

This species is more frequent in the tropical zone than in the temperate, and has not previously been recorded in arctic regions. A few individuals with sufficient characters to show their relation to this species were found at Herschel island. However, they differed from the type form in the following points: smaller and proportionately shorter; more truncate; crenulations fewer, 15 to each semi-cell; vertical granulate ridges only 5; length 44μ, breadth 36μ, breadth of isthmus 14μ.

Cosmarium Botrytis Menegh.

This is probably the most generally distributed species of this genus and was the commonest desmid in the collection. It was usually a little below average size, although there were a few as large as any I have found in other parts of Canada or Great Britain. It occurred in collections from Teller, Demarcation point, Collinson point, and from Bernard harbour, Herschel island, and Cape Bathurst.

Cosmarium conspersum Ralfs

This species was also fairly plentiful wherever found. It occurred at Teller and Demarcation point, and at Bernard harbour and Herschel island.

Cosmarium contractum Kirchn. var. **ellipsoideum** (Elf.) W. and G. S. West (Plate III, fig. 17)

The type form of this species has been recorded from the United States. It is more tropical than northern. The variety recorded here from Herschel island has not previously been recorded from the North American continent, but it is more northern than the type and has been found in arctic regions outside America.

Cosmarium costatum Nordst.

This is a rare and typically arctic and alpine desmid. It was found in the plankton collection of July 3, 1916, from the big lake at Bernard harbour.

Cosmarium crenatum Ralfs

This also is a desmid common in arctic and alpine collections. It was fairly common in the lagoon lake at Teller, but was found in no other locality.

Cosmarium Cucumis (Corda) Ralfs (Plate IV, fig. 1)

This species is world-wide in its distribution, although not recorded from North America. It has been found in Greenland. It was found by the expedition in the lake at Teller. Rare.

Cosmarium Cucurbita Bréb. var. **attenuatum** G. S. West (Plate III, fig. 8)

This variety has a very limited distribution. The type form is fairly universal, but this variety has only been recorded from England, Germany, and the West Indies. It was found in the plankton of the big lake at Bernard harbour, where it was very abundant. All specimens were small and about same size, length 26μ, breadth 15μ.

Cosmarium cyclicum Lund. var. **Nordstedtianum** (Reinsch) W. and G. S. West (Plate III, fig. 18)

This is another variety with a very limited distribution, being recorded previously only from England, Ireland, Austria and North Russia. The type form is fairly common in the north and has been found in Greenland, Spitzbergen, and the United States of America. A few individuals of the variety were found in the *Hippuris* swamp at Herschel island.

Cosmarium globosum Bulnh. (Plate IV, fig. 7)

This rather small desmid occurred in the lagoon lake at Teller, where it was fairly plentiful. Most specimens were a little below average size.

Cosmarium granatum Bréb.

This desmid was almost as plentiful as *C. Botrytis* and was found in almost as many localities. It was found in the brackish pond as well as in the freshwater pond at Teller, and also occurred at Collinson point and Demarcation point, and at Bernard harbour.

Cosmarium Hammeri Reinsch

This species has world-wide distribution and is as frequent in the arctic as in the tropics. It only appeared in the collections from the big lake at Bernard harbour where it was fairly plentiful. The size of all specimens was a little below the average.

Cosmarium Holmiense Lund. var. **integrum** Lund.

This variety is well distributed in northern waters. It was found in collections from the big pond at Bernard harbour and in a pond in the second bay east of Bernard harbour. All specimens were characteristic of the variety.

Cosmarium humile (Gay) Nordst. var. **striatum** (Nordst.) Schmidle (Plate III, fig. 11)

This small desmid has not been previously recorded from the arctic regions of America. It was found by the expedition in two localities, at Teller, where it was found in the brackish pond as well as in the freshwater pond, and at Bernard harbour, amongst stones and other algae in the river bed.

Cosmarium impressulum Elfv.

This is a widely distributed species and fairly common in the arctic. It was found in the lake at Teller, and in the lake at Bernard harbour. At the latter place it was found with other algae in summer collections, also once in plankton taken under the ice in winter, February 28, 1916.

Cosmarium inconspicuum W. and G. S. West (Plate III, fig. 19)

This is one of the rarest desmids collected by the expedition. Only four individuals were seen from a pond in the second bay east of Bernard harbour, June 16, 1915. This species has only been previously recorded from Great Britain and Ireland.

Cosmarium margaritatum (Lund.) Roy and Biss.

This is a generally distributed species much resembling *C. conspersum*. The punctulations between the granules, which distinguish it from *C. conspersum*, were well marked. It occurred at Teller and at Herschel island, along with other desmids. It was fairly numerous.

Cosmarium ochthodes Nordst.

This species was found in two collections from the big lake at Bernard harbour, but was not abundant. It was more common at Herschel island. Here, some of the granulations were irregular as in var. *amoebum* W. West, but otherwise they were typical of the specific type.

Cosmarium Pokornyanum (Grun.) W. & G. S. West

This small desmid was only found in the collection from the pond in the second bay east of Bernard harbour. However, it was not very scarce. It varied in size, being from 20–35μ in length and 12–18μ in breadth.

Cosmarium punctulatum Bréb.

This species was almost as common as *C. Botrytis* and was found in nearly every collection. It occurred frequently at Teller, both in brackish and fresh water, at Collinson point, Demarcation point, the big lake at Bernard harbour, plankton and bottom samples, and in the pond in the second bay east of Bernard harbour.

C. punctulatum Bréb. var. **subpunctulatum** (Nordst.) Borg. (Plate IV, fig. 3)

The variety was nearly as frequent as the species in the lagoon lake and in a pond between the lake and sea at Teller. The variety has not been recorded previously from North America.

Cosmarium pygmaeum Arch.

This species is almost entirely confined to *Sphagnum* bogs and peaty pools. It was not uncommon in the collection from the *Hippuris* swamp, which contained some *Sphagnum*, at Herschel island.

Cosmarium quadratum Ralfs

This desmid was fairly abundant in the big lake at Bernard harbour, where it appeared in the plankton and with other algae from the lake bottom. It was also found in smaller quantity in the pond in the second bay east of Bernard harbour.

Cosmarium radiosum Wolle

This is one of the rare algae of the expedition. Only three individuals were seen altogether, one in the brackish pond and the others in the lake at Teller, August 3, 1913. Its occurrence here is of interest, as it has hitherto been recorded only from the United States and Ireland.

Cosmarium rectangulare Grun.

This is not uncommon in arctic regions and was found by the expedition in two localities but not in abundance, in the tundra pond, Demarcation point, and in the big lake at Bernard harbour.

Cosmarium reniforme (Ralfs) Arch.

This is another typical bog desmid of northern regions. It was found, however, only in the *Hippuris* swamp at Herschel island. Not common.

Cosmarium speciosum Lund. var. **biforme** Nordst.

This is also a bog form from alpine or arctic regions. It was secured in two localities, near Bernard harbour amongst stones and other algae of the river bed, and in the pond in the second bay eastward. It was fairly common.

Cosmarium Stefanssonii sp. nov. (Text fig. 3)

C. minutum, oblongum, sinu angusto, versus apicem haud dilatato; semicellulae fere rectangulares, angulis inferioribus rotundatis; membrana subtiliter granulata, areolata; areolae sat numerosae, ovales, paulo elevatae, scrobiculatae. Long. 32–36μ; lat. 25–27μ; crass. 20–22μ.

Cells small, 1–1½ times longer than broad, moderately constricted; sinus narrow, not dilated at the apex; semicells sub-rectangular, basal angles rectangular and rounded. The surface made up of canal-like depressions separating more or less oval, slightly elevated areas. On each semi-cell these

areas form two groups—a polar group of 12–14 areas and a band next to the sinus of 18–22 areas, 7–11 seen on one side. Each elevated area, from sinus to pole, bears 4–5 pairs of scrobiculations and often an unpaired terminal one.

This is a peculiar type of desmid without any close relation to other species. In possessing canal-like depression with scrobiculate elevated areas it is distinct from other species of this genus. Only a few plants were seen in the material collected from the creek at Bernard harbour, August 16, 1915.

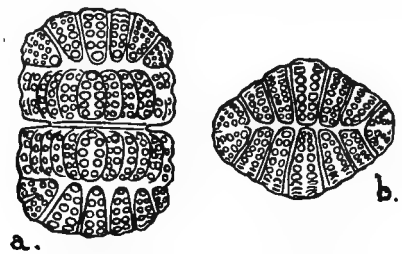


Fig. 3. *Cosmarium Stefanssonii* nov. sp. × 840; *a*, face view, *b*, end view.

Cosmarium subcostatum Nordst.

This is a small desmid. It occurred in the plankton of the lake at Bernard harbour, and in the swamp at Herschel island. It closely resembles *C. subcrenatum* which is also found at Bernard harbour. The crenulations were almost wanting at the apex and they were generally bi-granulate in other places. Central granules 14–16.

Cosmarium subcrenatum Hantzsch

This is a species of world-wide distribution. It was found in small quantities in two localities, from the bottom of a tundra pond at Collinson point, and with other desmids in the river bed at Bernard harbour.

Cosmarium Subcucumis Schmidle (Plate IV, fig. 2)

This species is interesting on account of its limited distribution, for hitherto it has been recorded only from Great Britain, Germany, and Austrian Galicia. It was found in the collection from the *Hippuris* swamp at Herschel island.

Cosmarium subexcavatum W. and G. S. West

This desmid has been recorded from Nova Zembla and Greenland, so it is not surprising that it should turn up in the Canadian arctic. In the pond in a swamp in the second bay east of Bernard harbour. It was not very plentiful.

C. subexcavatum var. **ordinatum** W. and G. S. West (Plate III, fig. 10)

Amongst the individuals of the last-mentioned species was one which was less granulate and longer than the typical form and identical with West's figure of the var. *ordinatum*, so that I have no hesitation in recording this variety, although it has only been recorded previously from Switzerland and England.

Cosmarium subtumidum Nordst. var. **Klebsii** (Gut.) W. and G. S. West. (Plate IV, fig. 5)

There is little difference between the species and its variety, but the specimens from the north were identical with some specimens I collected in Lake Winnipeg, Manitoba, and which the late Professor G. S. West immediately identified as the variety *Klebsii*. It was fairly common at Bernard harbour in plankton and bottom deposits and in a drying tundra pond at Demarcation point.

Cosmarium tetraophthalmum Bréb.

This large, universally distributed species was found only in the *Hippuris* swamp at Herschel island, where it was in fair quantity. All specimens observed were of full size and showed both the granulate and punctate character of the wall clearly and the relatively smooth apex.

Cosmarium trachypleurum Lund. var. **minus** Racib. (Plate IV, fig. 4)

A small form of this variety occurred in a mixture of plankton and bottom deposits from a tundra pond, and also in a pond between the lake and sea at Teller.

Cosmarium Turpinii Bréb.

This species was almost as common as *C. Botrytis*. It was found in the lagoon lake at Teller and Demarcation point, and in the plankton and bottom samples of the big lake and in the river bed at Bernard harbour.

Cosmarium undulatum Corda

This species, although widely distributed in the world, is not generally common. It was found by the expedition only at Bernard harbour, where it occurred in a plankton collection and a general collection from the big lake.

Xanthidium Ehrenb.

This genus, which has numerous widely distributed species, was represented by only three species, all from the *Hippuris* swamp at Herschel island.

Xanthidium antilopaeum (Bréb.) Kütz.

This was the commonest member of the genus. However, it was not very plentiful. All specimens observed were quite normal and of average size.

Xanthidium cristatum Bréb. var. **bituberculatum** nov. var. (Text fig. 4, a, b)

A specie typica maxime distinctum semicellulis majoribus, paulo longioribus quam lat., minus angulatis; area centralis tuberculis duobus munita; a vertice visae (semicellulae) ellipticae, lateribus bituberculatis.

Cells slightly smaller than in the type, a little longer than broad. Sinus open and deeply constricted. Vertical view elliptic. Semi-cell somewhat subsemicircular with a convex base furnished with spines as in the type, but less angular at the spines. The central area is provided with two circular tubercles in a line parallel to the long axis of the semi-cell. Apical view elliptical, showing

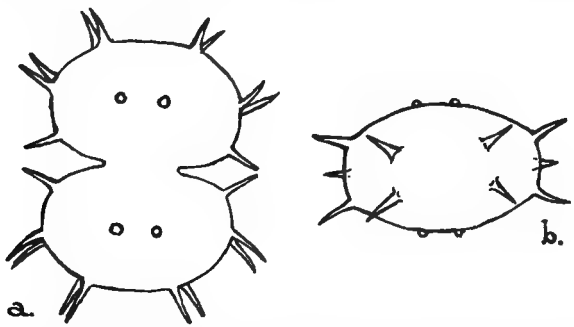


Fig. 4. *Xanthidium cristatum* Bréb. var. *bituberculatum* nov. var. × 500; *a*, face view, *b*, end view.

two tubercles on each side. Length without spines 64–68μ, with spines 78–84μ; breadth without spines 50–53μ, with spines 66–68μ. Breadth of isthmus 20μ. Tubercles diameter 3μ, distance apart 9–11μ.

No cells were observed with a large central tubercle such as is found in the type, and no other varieties were seen. It was not quite as numerous as the preceding species.

Xanthidium fasciculatum Ehrenb.

This species was about as frequent as *X. antilopaeum.* Most of the plants were slightly below average size.

Arthrodesmus Ehrenb.

Arthrodesmus Incus (Bréb.) Hass. var. **Ralfsii** W. & G. S. West forma **subhexagona** W. & G. S. West (Plate III, fig. 14)

This was the only representative of the genus. It is a world-wide species with a considerable variation. It was fairly common in the collection from the *Hippuris* swamp at Herschel island, and all specimens seen were small, short spined, sub-hexagonal forms characteristic of the forma *subhexagona* of the var. *Ralfsii.*

Staurastrum Meyen.

Staurastrum Avicula Bréb. (Plate IV, fig. 13)

This species was frequent in a mixed collection of plankton and bottom deposits from the tundra pond at Teller.

Staurastrum Brébissonii Archer (Plate IV, fig. 12)

A form of this species was not infrequent in the lake at Teller. It differed from the type in having the spines at the angles shorter than usual.

Staurastrum brevispinum Bail.

This species was rather rare and was found only in the plankton from the big lake at Bernard harbour.

Staurastrum brevispinum Bail. var. **inerme** Wille

I was uncertain at first as to the exact determination of this desmid, so I submitted some drawings to the late Professor G. S. West, and he identified it as this variety. It was fairly abundant in the lake at Teller. Previous records are known from Nova Zembla, England, and the United States of America.

Staurastrum denticulatum Archer

This species was also fairly abundant at Teller, in the lagoon lake, along with other algae. It was also found a few times in the plankton. Although a fairly common species it was not found in any other locality.

Staurastrum furcigerum Bréb. (Plate IV, fig. 9)

Only a few empty semi-cells of this species were observed, and they were all in the material from the *Hippuris* swamp, Herschel island. With one exception they were all triangular forms and true to type. One semi-cell was abnormal, bearing, in addition to the usual pair of arms at each angle, a seventh arm or process arising in the middle of one side. The species is not uncommon in arctic regions.

Staurastrum hexacerum (Ehrenb.) Wittr.

This species, of which the observed specimens were smaller than usual, was found in small quantities in the lake at Teller, and an imperfect form appeared at Herschel island.

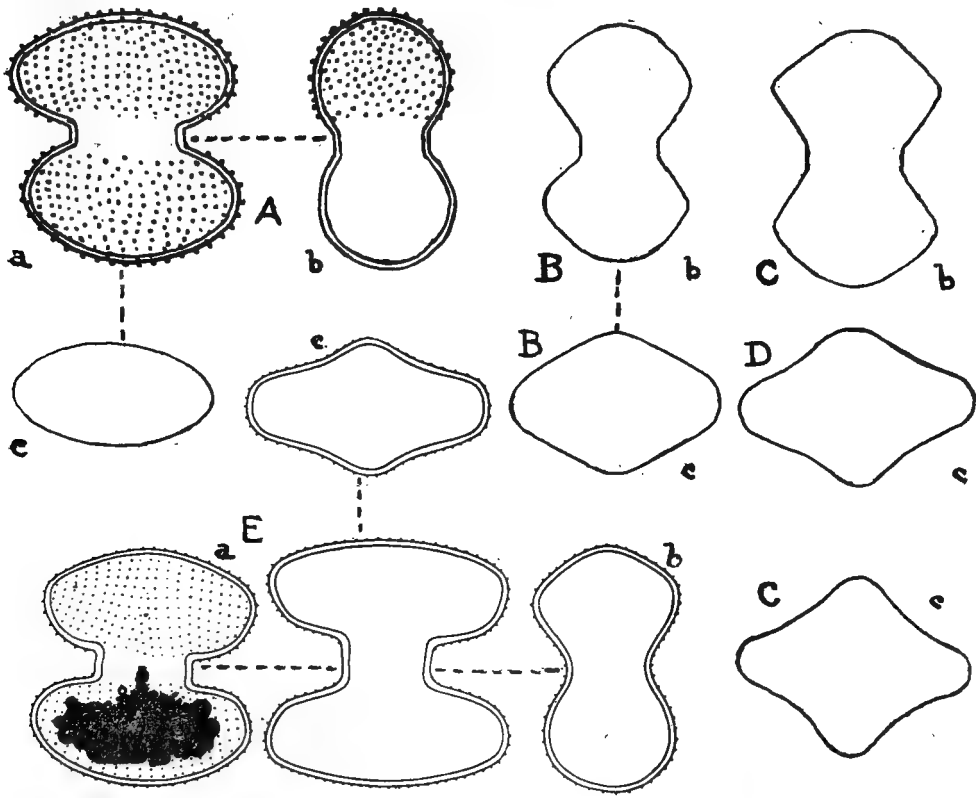


Fig. 5. *Staurastrum Holmii* nov. comb. (*Cosmarium Holmii* Wille). *A*, *B*, *C* and *D* drawings of specimens found by the C. A. E. showing variations in shape from a two-sided form to a four-sided form. *E* reproduction of Wille's figures; all × 500; *a*, face view, *b*, side view, *c*, end view.

Staurastrum Holmii (Wille) nov. comb. *Cosmarium Holmii* Wille.
(Text fig. 5)

This desmid was first described by Wille in the report of the Dijmphna-Expedition of 1882[1]. In his description he states: "This species occupies a rather separate position in the genus *Cosmarium* by its very broad sinus, so that it resembles certain species of *Staurastrum*. However, were it a *Staurastrum*, one would expect a tendency to three-cornered shape, but all the specimens I have examined proved to be regular when seen from above, with an equally large swollen place on each side of the semi-cells[2]."

The specimens described by Wille have a form intermediate between (1) a form which has no swellings on the sides of the semi-cells and is elliptical in end view like all *Cosmaria*, and (2) a form in which the swellings have become so large that a typical four-sided *Staurastrum* is the result (Fig. 5, C). In consideration of this variation from two-sided to four-sided forms, and also in view of the fact that it has a broad sinus, I have come to the conclusion that it is really a *Staurastrum* and not a *Cosmarium*. The granulations were well marked in all specimens and differed but slightly in the different forms.

[1]Wille, Alger fra Novaia Zemblia og Kara-Havet, samlede paa Dijmphna Expeditionen, 1882, Copenhagen, 1887.
[2]I am indebted to Mr. F. Johansen for this translation from the Danish original.

Two-sided form: semi-cell 60 x 28μ; sinus, breadth 30μ; length of whole cell 66μ. Four-sided form: semi-cell 60 x 50μ; sinus 30μ; length of whole cell 66μ.

The specimens examined by Wille were found on the gelatinous envelope of a Protozoan colony, *Ophrydium versatile*. The majority of individuals I found were also attached to the gelatinous wall of an *Ophrydium* colony, probably the same species. They were fairly numerous, and it is possible that there is a commensual relation between the two organisms. The *Ophrydium* mass was obtained in the big lake at Bernard harbour, and in the same lake a few individuals of this desmid appeared free in the plankton (July 3, 1916). It also occurred in collections from Demarcation point and Chantry island. Distribution: Norway, Austria, Nova Zembla, Arctic America.

Staurastrum lunatum Ralfs (Plate IV, fig. 11)

A form of this species approaching *S. tunguscanum* Boldt was common in the plankton collections from Teller.

Staurastrum lunatum Ralfs var. **planctonicum** W. & G. S. West

This variety was found in small numbers in the plankton of the big lake at Bernard harbour. It is fairly common in the European Arctic plankton, but not in that of the American Arctic.

Staurastrum megacanthum Lund.

This species occurred only in the *Hippuris* swamp at Herschel island, where it was fairly abundant. It is not unknown from arctic regions but has not been recorded from those of America.

Staurastrum muricatum Ralfs

This desmid was found in the plankton of the lagoon lake at Teller and was not infrequent. It has about the same distribution as the last species.

Staurastrum muticum Bréb.

This species was far more common and occurred in three localities. It was found in the lagoon lake at Teller, in the *Hippuris* swamp at Herschel island, and in the big lake and amongst other algae from the river bed at Bernard harbour.

Staurastrum orbiculare Ralfs

This species was fairly common in the lake at Teller. It is frequent throughout the United States but not in the arctic parts of America, although common in Spitzbergen and Nova Zembla.

Staurastrum pachyrhynchum Nordst. (Plate IV, fig. 14)

This is a species common in northern regions and has been found frequently in arctic waters. However, it was not common in these collections, appearing in small quantity only from Herschel island.

Staurastrum paradoxum Meyen

This species is one of the most frequent in some Canadian lakes but was exceedingly rare in the arctic material. Two specimens were seen from Demarcation point, and a poorly developed one from Herschel island.

Staurastrum polymorphum Ralfs

This species is a common one in all parts of the earth, and in the collections made by the expedition was, in its genus, only second in abundance to *S. punctulatum*. It was found at Teller, in the big lake and in the river at Bernard harbour, and in the swamp at Herschel island. Three- and four-sided forms were about evenly distributed.

Staurastrum polytrichum Pert.

This very spiny desmid was found in small quantity in the material collected from the *Hippuris* swamp at Herschel island. It has not been previously recorded from the arctic regions of America.

Staurastrum punctulatum Bréb.

This was found in larger numbers and in more localities than any other species of its genus. At Teller it occurred in the lagoon lake, the brackish pond, and in the pond between the lake and sea. It was also found at Demarcation point and Collinson point, at Bernard harbour, and on Herschel island.

Staurastrum Reinschii Roy (Plate IV, fig. 8)

This species is one of those found only at Herschel island. It is common in Europe generally but not in arctic waters. It was not very plentiful. A number of empty semi-cells were found, but very few complete plants.

Staurastrum setigerum Cleve

Like the last species, this also was found only at Herschel island, and it was moderately frequent. It is common in the United States of America and occurs also in Manitoba.

Staurastrum vestitum Ralfs

This is another species collected only from the *Hippuris* swamp at Herschel island. It was a little below average size and about as common as the last species. It is well known in Europe and the United States but is not previously known from arctic America.

Sphaerozosma Corda.

Sphaerozosma excavatum Ralfs

This filamentous desmid appeared only from Herschel island and was not abundant. It has been previously found in Alaska and is not uncommon in the arctic. Cells slightly below average size.

Spondylosium Bréb.

Spondylosium planum W. & G. S. West

This is a desmid fairly abundant in the United States and in some parts of Canada but is not frequent in arctic regions. It appeared only in bottom deposits from the lake at Teller, in short filaments of usually not more than eight cells. Not common. Size: 11μ wide, 9μ long.

Hyalotheca Ehr.

Hyalotheca dissiliens (Smith) Bréb.

This species was found only at Herschel island, in the *Hippuris* swamp. It is well known from some arctic regions but not from those of the American continent. The cells of the filaments were of the average size.

Hyalotheca mucosa (Mert.) Ralfs (Text fig. 6)

This desmid with its enormously wide sheath, was fairly common in one of the tundra ponds at Teller. A few small fragments were also found in the material from Herschel island. It is a species common in the warmer temperate regions and I do not think it has been recorded before from arctic waters.

Diameter of sheath 100–110μ, diameter of cells 15μ, length of cells 18–20μ.

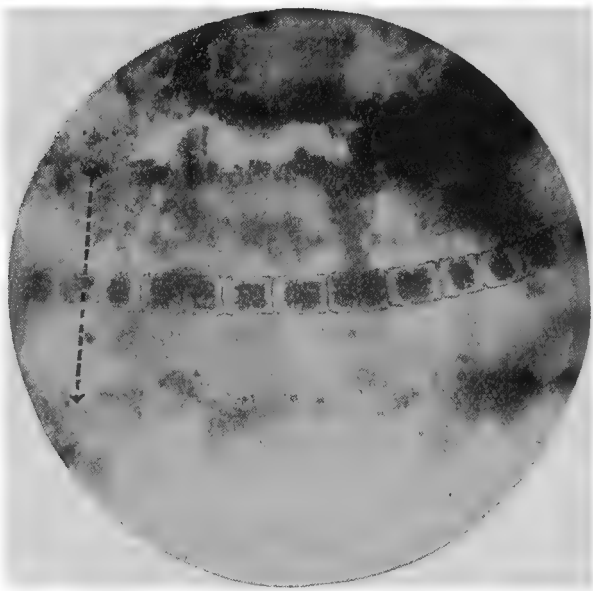


Fig. 6. *Hyalotheca mucosa* (Mert.) Ralfs. A photomicrograph to show diameter of the mucus sheath indicated by the broken line × 340.

STEPHANOKONTAE.

OEDOGONIACEAE.

Bulbochaete Agardh.

Bulbochaete sp.

Fragments belonging to this genus appeared in collections from nearly all localities visited by the Southern Party. They were fairly abundant and in all cases bore exceedingly long bristles. No reproductive stages were present. Hence it was impossible to identify the species.

Vegetative cell: diameter 15–21μ; length 20–25μ.

Oedogonium Link.

Oedogonium sp.

Filaments of *Oedogonium*, more or less fragmented, were even more frequent than those of *Bulbochaete*. With the exception of the material from Herschel island, in which sexual organs were present, it was found only in the vegetative condition, so that identification of species was limited to the Herschel island collections.

Oedogonium nodulosum Wittr. (Plate IV, fig. 15)

A few small filaments of this species were observed in the collection from the *Hippuris* swamp, Herschel island. It is a monoecious form with the vegetative cells bearing two constrictions dividing each cell into three wide parts with narrower parts connecting them. The plants observed were somewhat smaller then the type. It has been recorded from Europe, Asia, and South

America, but not from North America, although a variety *commune* Hirn., which is larger than the type, is known from Massachusetts, U.S.A.

Vegetative cell diameters: constriction 14μ; wider part 23–25μ; $2\frac{1}{2}$–3 times diameter in length.

Oogonia: 45 x 60μ.

Oospore: none fully ripened.

Antheridia: diameter 18μ, length 5μ.

Oedogonium paludosum (Hass.) Wittr. var. **americanum** Nordst.

This species was slightly more plentiful than the last and occurred with reproductive organs only in the swamp at Herschel island. It is a monoecious species bearing single ellipsoid oogonia with a superior pore. Oospores were not fully matured and the details of the wall were rather obscure. Distinct longitudinal lines were visible and were 18–24 in number. Antheridia were 1–5 celled, usually 3 celled. Neither the type nor variety are common in U.S.A., nor have they been recorded from Canada or the arctic regions.

Vegetative cell: 15–25μ diam., $1\frac{1}{2}$–8 diameters in length.

Oogonia: 60–65μ diam., 80–100μ long.

Oospores: 45–50μ diam., 74–90μ long.

Antheridial cell: 12–20μ diam., 5–8μ long.

HETEROKONTAE.

BOTRYOCOCCACEAE.

Botryococcus Kütz.

Botryococcus Braunii Kütz.

This alga is a typical plankton organism, although it is frequent in algal collections apart from plankton. Fairly large masses were found in the plankton and in tundra collections from Teller, and in the plankton of the big lake at Bernard harbour, where it was also fairly abundant. It is common throughout Europe and in the U.S.A. I have recently found it in Manitoba, although, at present there is no published record for Canada. I cannot find any arctic record for it.

OPHIOCYTIACEAE.

Ophiocytium Näg.

Ophiocytium majus Näg.

This species is the largest of the genus and readily recognized. One end of the cell is usually slightly swollen and capitate, and the other is attenuated into a spine of varying length. It is not common in America and has not been previously recorded from American arctic regions. It is fairly plentiful at Teller, where it was found in the brackish pond as well as in fresh water. It was also present in collections from Herschel island, and in the plankton of the big lake at Bernard harbour.

TRIBONEMACEAE.

Tribonema Derbes & Solier.

Tribonema bombycina (Ag.) Derb. & Sol. forma **tenuis** Hazen

This, which is a small form of the species, is fairly common in most parts of the world, although not so common as the type; it is not infrequent in arctic regions. It occurred with other algae in a lagoon just west of Martin point, at Herschel island, and at Cape Bathurst. At no place was it very plentiful.

PHAEOPHYCEAE.

Synura Ehrenb.

Synura Uvella Ehrenb.

This was the only representative of the brown algae and occurred in small quantity at Cape Bathurst, July, 1916.

RHODOPHYCEAE.

HELMINTHOCLADIACEAE.

Batrachospermum Roth.

Batrachospermum vagum (Roth) Ag.

This species is well known from the fresh waters of nearly all temperate and tropical countries, and a form has been recorded previously from southern Alaska. It was secured by the expedition only from a tundra pond at Teller along with *Hyalotheca mucosa* and other algae. Cystocarps absent. It is one of the earliest known freshwater algae of Canada and was recorded by Kemp in 1858, Paris, Canada West (Ontario).

II.

The Freshwater Diatoms of the Canadian Arctic Expedition, 1913-18

By Charles W. Lowe

This report is upon the diatoms found in the freshwater and brackishwater collections of algae in general, no special collections being made for diatoms in particular.

The Bacillarieae is the one group of algae which is numerously represented in all bodies of water, fresh or marine, and since these collections were made so close to the arctic seaboard it is not surprising that a number of marine forms were found in them.

The conditions of life in the brackish ponds have been dealt with in the report upon the freshwater algae and will explain how it is possible for freshwater and marine species of diatoms to thrive in the same body of water.

The samples collected differed greatly in the number of diatoms present; in some they were very scarce and in others they were numerous. There was such a mixture of plant and animal life in many samples that it was hardly possible to separate the diatoms from the other organisms in order to properly clean the diatoms with acids, before mounting them for examination. Also there was not sufficient bulk of material for cleaning except in a few collections from Teller, the warm creek near the Sadlerochit river, and from the big lake at Bernard harbour.

Many of the marine forms in the accompanying list were sent to Dr. L. W. Bailey for identification or confirmation of identity, and the author wishes here to acknowledge the kindness of Dr. Bailey for this help and for gifts of literature upon diatoms.

In addition to the literature cited in the report upon the freshwater algae the following works were also consulted:

H. Van Heurck . . Traité des Diatomées.

Wolle . . . . . The Diatomaceae of North America.

and various papers by A. M. Edwards, L. W. Bailey, and others. The following list gives the details of the species recorded. It represents 29 genera and 87 species and varieties. As is usually the case the genus *Navicula* has the largest representation with 23 species. The classification used is that of Forti, as modified by G. S. West.

CENTRICAE.

Melosireae.

Syndendrium Ehr.

Syndendrium Diadema Ehr.

A few frustules of this marine diatom were found in a mud sample taken from under the ice from the big lake at Bernard harbour, February, 1916. As this is the only occurrence of this species in the freshwater collection I conclude that it has been carried into the lake by wind or other means and was not really living in the lake.

Melosira Ag.

Melosira granulata (Ehr.) Ralfs

This is a typical plankton diatom in the lakes of the Dominion. It was found in the plankton of the lagoon lake at Teller, July and September, 1913, and in a tundra pond at Collinson point, June, 1914.

Melosira undulata Ehr.

This species was found in a collection of bottom deposits and plankton from the lagoon lake at Teller, August, 1913, and in a plankton sample taken from the big lake at Bernard harbour, September, 1915, and in a mud sample from the same place, February, 1915.

Melosira varians Ag.

A few short filaments of this species were found attached to other plants in a collection from a tundra pond at Teller, August and September, 1913.

Cyclotella Kütz.

Cyclotella antiqua W. Sm.

This pretty little diatom was not very numerous in any one locality but was present in many collections. It occurred in the brackish pond at Teller, August, 1913, and in the plankton from the big lake at Bernard harbour in the months of July and August, 1915, and February, June and July, 1916. It was also attached to the *Ophrydium* mass taken from the same lake, August, 1915.

Stephanodiscus Ehr.

Stephanodiscus niagarae Ehr.

This common American diatom was found only in the mud sample from under the ice taken in February, 1916, at the big lake at Bernard harbour. Only a small number were present.

Tabellarieae.

Grammatophora Ehr.

Grammatophora angulosa Ehr.

This is another marine species found in the big lake at Bernard harbour in the mud sample taken February, 1916. Its presence here is probably accidental.

Tabellaria Kütz.

Tabellaria fenestrata (Lyng.) Kütz.

This is a common plankton diatom. It was found in collections of plankton from the lagoon lake, Teller, July and August, 1913. At Bernard harbour it was in the lake plankton in June, 1916, August and September, 1915. It was taken at the creek mouth, July, 1915, in the same locality, and at Herschel island in the *Hippuris* swamp, August, 1914.

Tabellaria flocculosa (Roth) Kütz.

This species was about as frequent as the preceding one. It was found at Teller, July, 1913, in the lagoon lake, and August of the same year in a tundra pond, also at Martin point in a tundra pond, in the plankton of the lake at Bernard harbour, August, 1915, and in the stomach of a fish taken October 4, 1915.

Rhabdonema Kütz.

Rhabdonema arcuatum (Ag.) Kütz.

This also is a marine form found in the mud of the lake at Bernard harbour, February, 1916.

PENNATAE.

Diatomeae.

Diatoma DC.

Diatoma vulgare Bory

This species was only found in two collections made August, 1915, at Bernard harbour. A few were seen in the sample obtained from the brackish pond and more were found in the plankton from the big lake. It was not abundant although found in most freshwater areas.

Denticula Kütz.

Denticula tenuis Kütz.

This species was somewhat more frequent than the last named. It was found at Camden bay, July 4, 1914, in the big lake at Bernard harbour, June, 1915, July, 1916, and in the stomach of a fish taken October 4, 1915.

Opephora P. Petit.

Opephora Schwartzii (Grun.) P. Petit

This species was found only in a collection taken from the lagoon lake at Teller, August, 1913. It was not numerous.

Synedreae.

Synedra Char. Em.

Synedra amphicephala Kütz.

This also was very limited in its distribution, being found only at Bernard harbour, at the creek mouth and the big lake, July, 1915.

Synedra Ulna (Nitz.) Ehr.

This diatom was fairly plentiful, being found in freshwater samples obtained in July and August, 1913, at Teller, and at Bernard harbour during July and August, 1915, and February, 1916, in the plankton; also in a fish stomach obtained October 4, 1915.

Asterionella Hass.

Asterionella formosa Hass.

This is a common lake plankton diatom but was not very numerous in these northern collections. It was found in the plankton of the big lake, Bernard harbour, July and September, 1915, June, 1916, and also at the creek mouth, July, 1915.

Eunotieae.

Eunotia Ehr.

Eunotia gracilis (Ehr.) Rab.

This species was found only at Teller, where it occurred both in the brackish pond and the lagoon lake, August, 1913. It was not very numerous.

Eunotia diodon Ehr.

This likewise was found only at Teller, and in only one sample from the lagoon lake, July 27, 1913. Rare.

Eunotia monodon Ehr.

This was a little more plentiful than *E. diodon*, being found upon two occasions in July, 1913, in the same lake.

Eunotia triodon Ehr.

This was the most frequent of the genus, being found in samples obtained in July and August, 1913, at Teller, and on June 28, 1916, at Martin point.

Eunotia pectinalis (Kütz.) Rab.

This species was found in a small quantity in a tundra pond at Teller, August, 1913.

Eunotia praerupta Ehr.

The lagoon lake at Teller was again the only locality in which this species was found, July, 1913. It was not uncommon.

Eunotia praerupta Ehr. var. **curta** Grun.

Amongst the specimens of the last mentioned species were a few of this variety.

Epithemia Bréb.

Epithemia Argus Kütz.

This species occurred in a sample obtained June 17, 1916, in a moss-tundra lake at Chantry island. Only a few frustules were observed.

Epithemia gibba Kütz.

This was a fairly common species and was found in various localities. It occurred in the lagoon lake and brackish pond at Teller, in the river bed, and embedded in the calcareous pebbles taken from the bed of the warm creek in northern Alaska, November, 1913, and from the big lake at the creek mouth at Bernard harbour.

Epithemia Hyndmanii W. Sm.

This diatom was found only in the lime-encrusted pebbles taken from the warm creek near the Sadlerochit river. It was fairly abundant.

Epithemia Sorex Kütz.

This species was not quite so frequent as the last named. It likewise was found in fresh and brackish water at Teller. It also occurred in the plankton from the lake at Bernard harbour and at the creek mouth.

Epithemia turgida (Ehr.) Kütz.

This was the most abundant species of the genus. It occurred in fresh and brackish samples at Teller, in various samples from Bernard harbour, and was the commonest diatom associated with the calcareous pebbles taken from the warm creek in northern Alaska.

Epithemia turgida (Ehr.) Kütz. var. **granulata** Kütz.

Amongst the specimens found in the calcareous pebbles found in the warm creek, northern Alaska, were a large number of valves characteristic of this variety. They were obtained only from these pebbles.

Epithemia turgida (Ehr.) Kütz. var. **Westermanii** Kütz.

In addition to being found in fair quantity along with the species this variety was also found at Martin point, June, 1914, and on the *Ophrydium* mass from the lake at Bernard harbour, August, 1915.

Epithemia zebra (Ehr.) Kütz.

This small member of the genus was not common and only occurred in two samples obtained in July and August, 1913, at Teller.

NITZSCHIEAE.

Hantzschia Grun.

Hantzschia amphioxys (Ehr.) Grun.

This species was found in small quantities in the lagoon lake at Teller, August, 1913, in a tundra pond at Collinson point, June, 1914, and at Bernard harbour, June, 1915.

Nitzschia Hass.

Nitzschia acuminata (W. Sm.) Grun.

Only a few frustules of this species were seen in a sample from the lagoon lake at Teller. It is normally a brackishwater type.

Nitzschia Brébissonii W. Sm.

This species also was only recorded from the brackish pond at Teller, August, 1913. It is a brackishwater species.

Nitzschia Closterium W. Sm.

Like the preceding species this is a brackishwater type and was found in the brackish pond at Teller. Rare.

Nitzschia lanceolata W. Sm.

This is another of the brackish forms from the brackish pond at Teller. Not common.

Nitzschia Tryblionella Hantz.

The type form of this species was found in the lagoon lake at Teller.

Nitzschia Tryblionella Hantz. var. **littoralis** Grun. [*N. littoralis* Grun.]

This diatom was found in the lagoon lake at Teller, July and August, 1913, and in a fish stomach obtained at Bernard harbour, October 4, 1915. Not abundant.

Nitzschia scutellum S.B.D.

This species was found in the same collections at Teller as the last named one and was about as frequent.

Nitzschia sigmoidea (Ehr.) W. Sm.

This species was found in a number of collections from Teller and in a sample from the tundra pond at Collinson point; also one frustule in a fish stomach, October 4, 1915, at Bernard harbour.

Nitzschia stagnorum Rab.

Two frustules of this species were seen in the material from a fish stomach, secured October, 1915, at Bernard harbour.

SURIRELLEAE.

Cymatopleura W. Sm.

Cymatopleura Solea (Bréb.) W. Sm.

This diatom was not common, being seen only on two occasions. One frustule occurred in the content of a fish stomach, October 4, 1915, and two more from the *Hippuris* swamp at Herschel island, August, 1914.

Surirella Turpin.

Surirella arctissima A.S.

This species was found only in a mud sample taken from the bottom of the big lake at Bernard harbour, February, 1916.

Surirella fastuosa Ehr.

This is a marine form found at Teller.

Surirella ovalis Bréb.

This species occurred in the lagoon lake at Teller and at Bernard harbour in the big lake, September, 1915, and in a fish stomach taken in October of the same year.

Surirella recedens A.S.

This species, sometimes regarded as a variety of *S. fastuosa*, was found only at Teller.

Surirella regina Janisc.

This also was found only at Teller, along with *S. fastuosa* and *S. recedens*. Not common.

CYMBELLEAE.

Amphora Ehr.

Amphora ovalis Kütz.

This species was fairly abundant in the lagoon lake at Teller. It was exceedingly common at Bernard harbour, appearing in plankton and other collections from the big lake in June, July, August, September and November, 1915, and February, 1916, also at the creek mouth in July, in a fish stomach, October, 1915, and in the brackish pond, August, 1915. It also occurred at Herschel island, August, 1914.

Cymbella Ag.

Cymbella cistula Hempr.

This species was found only in the lagoon lake at Teller, August, 1913.

Cymbella cuspidata Kütz.

This species, like the last named, was found only in the lake at Teller, July, 1913. Some of the species varied and were approaching the form of *Cymbella heteropleura* (Ehr.) Kütz.

Cymbella gastroides Kütz.

This species was almost as frequent as *Amphora ovalis* Kütz. and was found in the same localities; at Teller, in the lagoon lake and brackish pond, July and August, 1913; Herschel island, August, 1914; the creek mouth and big lake at Bernard harbour, August, 1915, and February, 1916, in both bottom samples and plankton. It was also found in the *Ophrydium* mass, August, 1915.

Cymbella gastroides Kütz. var. **minor** H. V. H.

This variety was rare when compared with the species; it was found in the brackish pond and lagoon lake at Teller, and in the plankton sample, September, 1915, at Bernard harbour.

Cymbella ventricosa Ag.

This species was found only in one locality but was very plentiful. It was obtained from the bed of the warm creek near the Sadlerochit river.

Cocconema Ehr.

Cocconema lanceolatum Ehr.

This diatom was by no means common, occurring only in small numbers at Teller, August, 1913. Most specimens were below average size.

Naviculoideae.

Stauroneis Ehr.

Stauroneis Gregorii Ralfs

This species is typically a brackish one and was found in the brackish pond and a tundra pond at Teller, August, 1915.

Stauroneis Phoenicenteron Ehr.

This species was found only in the big lake at Bernard harbour, where it appeared in one mud sample and one plankton collection.

Stauroneis Smithii Grun.

This species occurred in small numbers in the lagoon lake at Teller.

Navicula Bory.

Navicula aspera Ehr.

This is a marine species which was found in a mud sample taken from under the ice of the big lake at Bernard harbour, February, 1916. Only a few specimens were observed.

Navicula Bombus Ehr.

Although a marine species this diatom was not uncommon in three samples obtained from the lagoon lake at Teller, July and August, 1913.

Navicula borealis Ehr.

This species occurred in two July collections from the lagoon lake at Teller. It is a freshwater diatom.

Navicula Braunii Grun.

This species occurred in the same collections as the last mentioned one. Both species were very infrequent.

Navicula Crabo Ehr.

This is a marine species which was found only in the brackish pond at Teller. Not common.

Navicula didyma Ehr.

This is another marine species found only in collections from Teller.

Navicula elliptica Kütz.

This species is both a freshwater and brackishwater one. It was found only at Teller.

Navicula fusca Greg.

This is a marine species which was found at Teller, July, 1913; it was fairly plentiful.

Navicula fusca Greg. var. **delicata** A.S.

This variety appeared in two collections from Teller, once in July collections and once in August collections.

Navicula Hennedyi W. Sm.

This is one of the few marine diatoms that were found at Bernard harbour. It was in the mud taken from the big lake, February, 1916.

Navicula Hitchcockii Ehr.

This species was found only at Teller, in the lagoon lake, 1913.

Navicula humerosa Bréb.

This marine form was secured from the brackish pond at Teller, and from a mud sample, February, 1916, from the big lake at Bernard harbour.

Navicula longa Greg.

This is a marine form found repeatedly in the freshwater collections. It appeared in the lagoon lake and the brackish pond at Teller, July and August, 1914. At Bernard harbour it appeared in the plankton of the big lake and on the *Ophrydium* mass.

Navicula maculata Edwards

This species was rather numerous in one sample of plankton, September, 1915, and also on the *Ophrydium* mass from the lake at Bernard harbour.

Navicula major Kütz.

This species appeared in small numbers in the collections from the lagoon lake at Teller.

Navicula mesolepta Ehr.

This diatom was found in the same gatherings as the last species but was somewhat more numerous.

Navicula nobilis Ehr.

This large diatom appeared in a number of collections and was usually somewhat below average size. It was not numerous in any one sample. It occurred in the lagoon lake and the brackish pond at Teller, in the *Hippuris* swamp at Herschel island, at Collinson point, at Bernard harbour in the lake collections; one frustule was seen in the contents of a fish stomach taken at Bernard harbour, October 4, 1915.

Navicula ovalis W. Sm.

This species was found in the lagoon lake at Teller, and in a mud sample from the big lake at Bernard harbour. It was not plentiful in either of the collections. It is more of a brackish than a freshwater diatom.

Navicula palpebralis Bréb. var. **semiplena** Greg.

This variety was not uncommon in some of the collections from the lake at Teller. With them were a few specimens which seemed to be intermediate between this variety and *N. elegans* W. Sm.

Navicula punctulata W. Sm.

This was only found in the same collections as the last mentioned species and is a freshwater form. It was slightly more numerous.

Navicula radiosa Kütz.

This species was found only in one sample taken from the big lake at Bernard harbour, September, 1915.

Navicula Silicula Ehr.

This species was found in small numbers in the lagoon pond at Teller, and once in the brackish pond in that locality.

Navicula Smithii Bréb.

This is a marine species occurring only in a few samples obtained July, 1913, at Teller. It was not very plentiful. Some of the specimens were somewhat rhomboid in outline and may represent a new variety of the species.

Pleurosigma W. Sm.

Pleurosigma angulatum W. Sm. var. **strigosum** W. Sm.

This is another of the marine forms appearing only at Teller. The oblique lines on the valves cut each other at an angle of 55°.

Pleurosigma attenuatum W. Sm.

This was fairly common in some of the collections. It was found at Teller, Collinson point, Bernard harbour, and in the stomach of a fish taken at the latter place, October 4, 1915.

Pleurosigma Fasciola W. Sm.

This species was found a few times in the material from the brackish pond at Teller. It is normally a marine species.

Pleurosigma hippocampus W. Sm.

This is a brackishwater species that appeared in a brackish pond at Teller. It was not plentiful.

Amphipora (Ehr.) Cleve.

Amphipora ornata Bail.

This species appeared in collections from Teller, in the lagoon pond, in a tundra pond at Collinson point, and also in the big lake and brackish pond at Bernard harbour.

GOMPHONEMEAE.

Gomphonema Ag.

Gomphonema cristatum Ralfs

This species appeared in very small quantities in three localities, in the *Hippuris* swamp at Herschel island, in the bed of the warm creek in northern Alaska (near Sadlerochit river), and in a bottom sample from the lake at Bernard harbour.

COCCONEIDEAE.

Cocconeis (Ehr.) Grun.

Cocconeis placentula Ehr.

This species occurred only in two collections from Bernard harbour, viz.: from the creek mouth, July, 1915, and in a mud sample from the lake bottom, February, 1916.

PLATE I.

Fig. 1. Panoramic view of Bernard harbour, seen from ridge to the south, showing the creek outlet from the lake and a small pond in the foreground. The new species *Cosmarium Stefanssonii* was found in this creek. August, 1915. Photo F. Johansen.

Fig. 2. Shallow tundra pond in swamp at Bernard harbour. August, 1915. Photo F. Johansen.

PLATE II.

Fig. 1. Large lake at Konganevik, Camden bay. Note the broad belt in the foreground of aquatic flowering plants. July, 1914. Photo F. Johansen.

Fig. 2. Pond overgrown with *Hippuris, Eriophorum, Carex,* etc., inland on Herschel island. It was from this swamp that the comparatively rich desmid flora was secured. July, 1916. Photo F. Johansen.

PLATE III.

Fig. 1. *Pediastrum glanduliferum* Benn., × 400.
Fig. 2. " *integrum* Näg., × 600.
Fig. 3. *Selenastrum accuminatum* Lagerh., × 1000.
Fig. 4. *Cylindrocystis crassa* De Bary, × 500.
Fig. 5. *Gloeocystis infusionum* (Schrank) W. and G. S. West.
Fig. 6. *Penium spirostriolatum* Barker, × 500.
Fig. 7. " *cruciferum* (De Bary) Wittr., × 500.
Fig. 8. *Cosmarium Cucurbita* Bréb. var. *attenuatum* G. S. West, × 500.
Fig. 9. *Micrasterias apiculata* (Ehrenb.) Menegh. var. *brachyptera* (Lund.) W. and G. S. West, × 500.
Fig. 10. *Cosmarium subexcavatum* W. and G. S. West var. *ordinatum* W. and G. S. West, × 500.
Fig. 11. " *humile* (Gay) Nordst. var. *striatum* (Nordst.) Schmidle, × 500.
Fig. 12. *Euastrum dubium* Näg., × 500.
Fig. 13. " *binale* (Turp.) Ehrenb. forma *Gutwinskii* Schmidle, × 500.
Fig. 14. *Arthrodesmus Incus* (Bréb.) Hass. var. *Ralfsii* W. and G. S. West forma *subhexagona* W. and G. S. West, × 500.
Fig. 15. *Cosmarium asphaerosporum* Nordst. var. *strigosum* Nordst., × 500.
Fig. 16. *Pleurotaenium Trabecula* (Ehrenb.) Näg. forma *clavata* (Kütz.) W. and G. S. West, × 400.
Fig. 17. *Cosmarium contractum* Kirchn. var. *ellipsoideum* (Elf.) W. and G. S. West, × 400.
Fig. 18. " *cyclicum* Lund. var. *Nordstedtianum* (Reinsch) W. and G. S. West, × 375.
Fig. 19. " *inconspicuum* W. and G. S. West, × 500.

a, face view; b, side view; c, end view.

PLATE III.

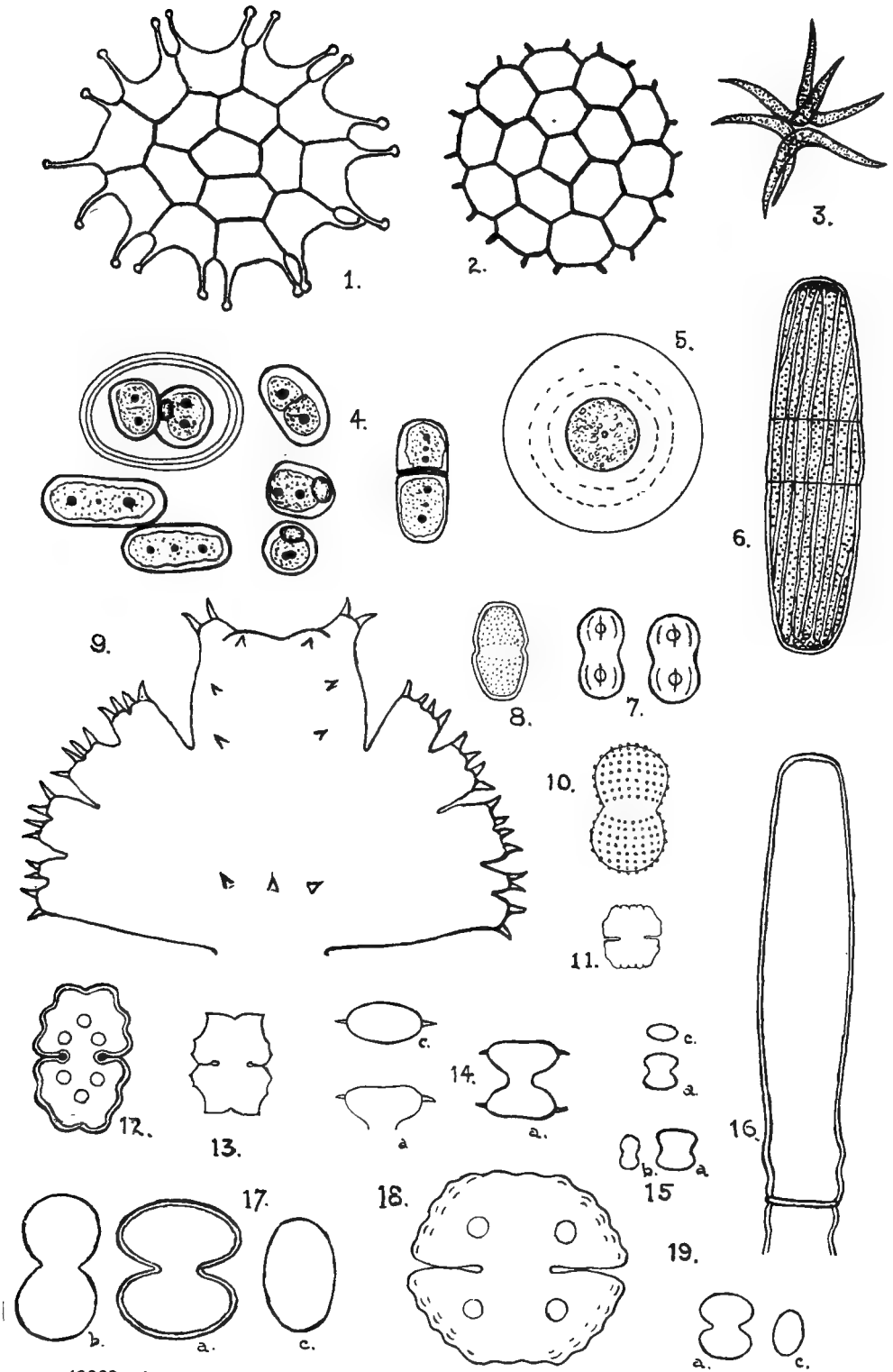


PLATE IV.

Fig. 1. *Cosmarium Cucumis* Ralfs, × 500.
Fig. 2. " *Subcucumis* Schmidle, × 500.
Fig. 3. " *punctulatum* Bréb. var. *subpunctulatum* (Nordst.) Borg.
Fig. 4. " *trachypleurum* Lund. var. *minus*, Racib., × 500.
Fig. 5. " *subtumidum* Nordst. var. *Klebsii* W. and G. S. West, × 500.
Fig. 6. " *binum* Nordst. forma, × 500.
Fig. 7. " *globosum* Bulnh., × 500.
Fig. 8. " *Staurastrum Reinschii* Roy, × 500.
Fig. 9. " *furcigerum* Bréb. An abnormal form with an extra unpaired process (x).
Fig. 10. " *vestitum* Ralfs, × 500. c′ normal, c″ variation with additional process.
Fig. 11. " *lunatum* Ralfs.
Fig. 12. " *Brébissonii* Archer, small spines at angles, × 500.
Fig. 13. " *Avicula* Bréb., × 500.
Fig. 14. " *pachyrhynchum* Nordst., × 500.
Fig. 15. *Oedogonium nodulosum* Wittr., × 300.
Fig. 16. *Closterium Cornu* Ehrenb., showing variation in size and shape, all × 500.
Fig. 17. *Nephrocytium obesum* W. West, × 500.
Fig. 18. *Gomphosphaeria aponina* Kütz., × 500.

a, face view; b, side view; c, end view.

PLATE IV.

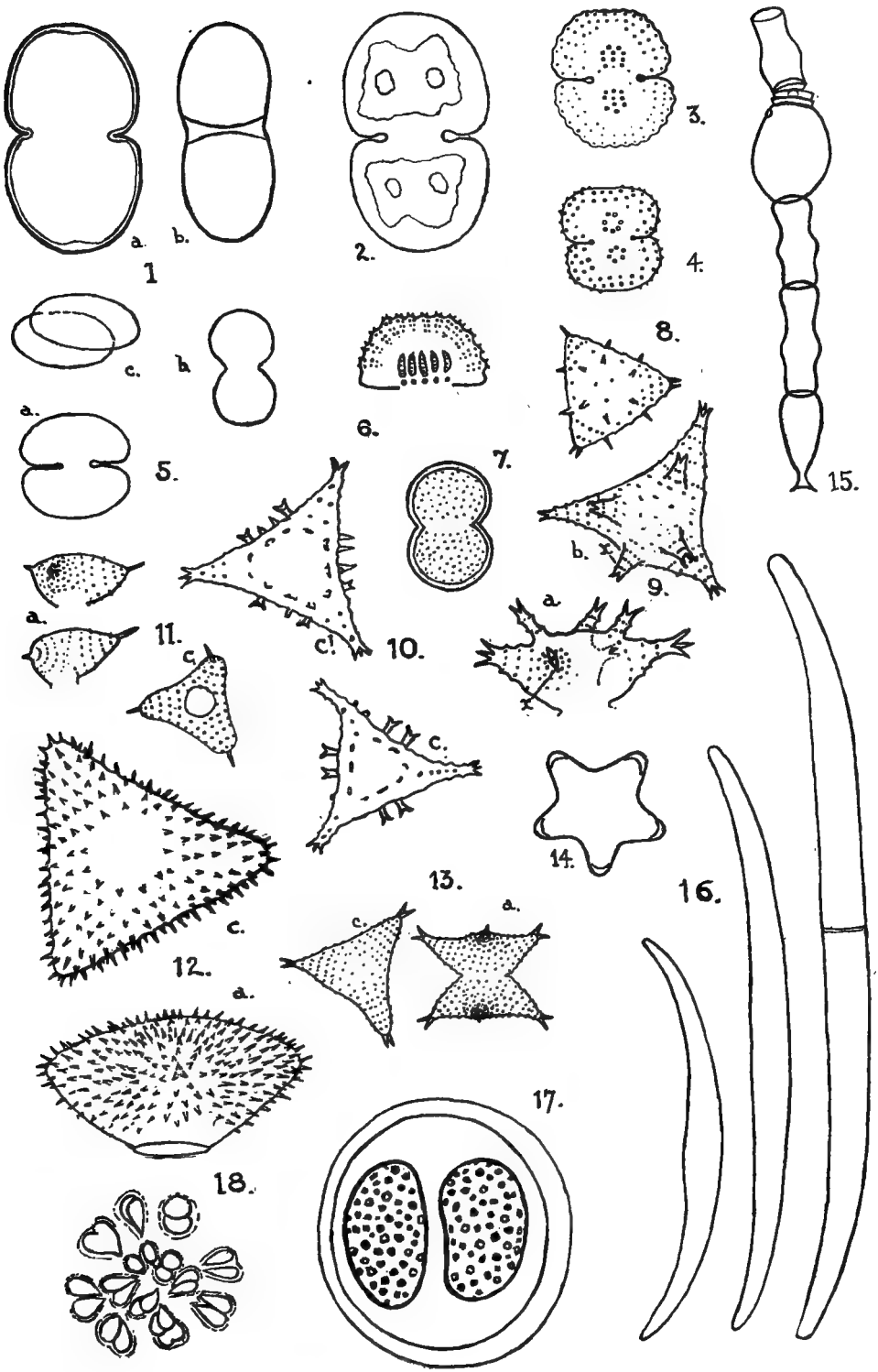
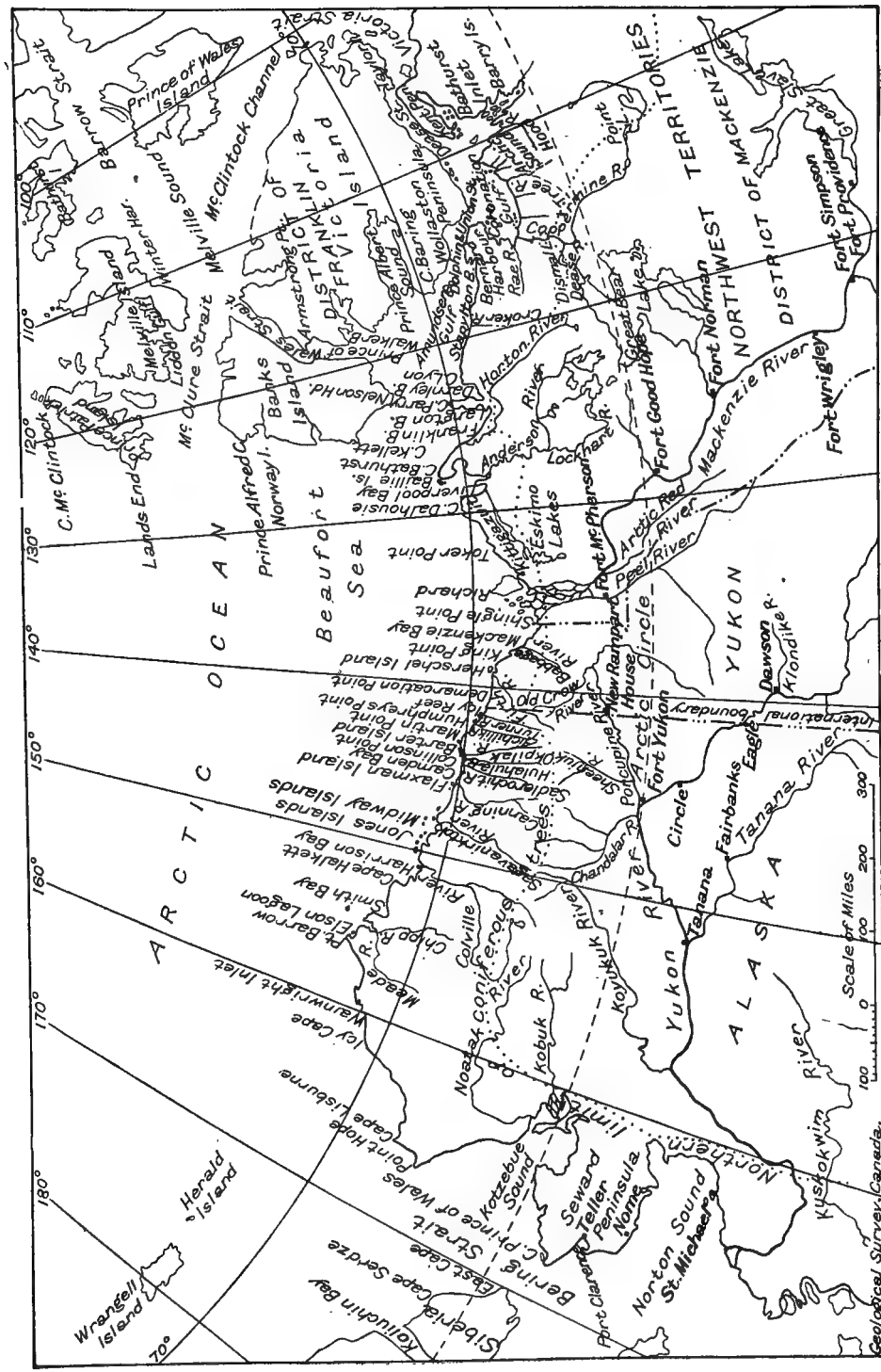


PLATE V.



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Report of the Canadian Arctic Expedition, 1913-18.

VOLUME VIII: MOLLUSKS, ECHINODERMS, COELENTERATES, ETC.

Part A: MOLLUSKS, RECENT AND PLEISTOCENE. By William H. Dall. (*Issued September 24, 1919*).
Part B: CEPHALOPODA AND PTEROPODA.
Cephalopoda. By S. S. Berry.
Pteropoda. By W. F. Clapp.....(*In preparation*).
Part C: ECHINODERMS. By Austin H. Clark.....(*Issued April 6, 1920*).
Part D: BRYOZOA. By R. C. Osburn.....(*In press*).
Part E: ROTATORIA. By H. K. Harring.....(*Issued December 31, 1921*).
Part F: CHAETOGNATHA. By A. G. Huntsman.....(*In preparation*).
Part G: ALCYONARIA AND ACTINARIA. By A. E. Verrill.....(*Issued April 28, 1922*).
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