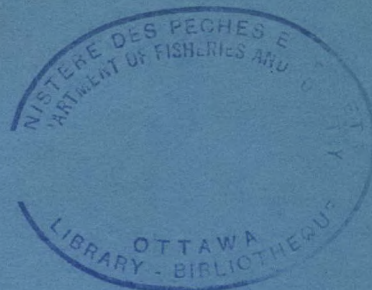


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FISHERIES RESEARCH BOARD OF CANADA  
ANNUAL REPORT  
OF  
EASTERN ARCTIC FISHERIES INVESTIGATION  
FOR  
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O T T A W A

DECEMBER, 1951.

## ARCTIC INVESTIGATIONS, 1951

### "Calanus" expedition.

The base of operations of the "Calanus" was moved, during the 1951 season, from Fort Chimo (Ungava Bay) to Frobisher Bay (Baffin Island), and most of the summer's field work was done in Frobisher Bay. During late June and early July, a cruise was made to George River and Adlorilik Fjord, on the east side of Ungava Bay, in order to complete work begun there in 1950. On July 23rd she left the mouth of the George River for Akpatok Island, Cape Hopes Advance, Lake Harbour and Frobisher Bay, arriving there on August 1st. An oceanographic section of four stations was made between George River and Akpatok, in order to fill in an apparent gap in the oceanographic work of former seasons. Sailing and working weather was almost perfect during the whole summer, and there was little ice. Consequently it was possible to arrive at Frobisher Bay considerably earlier, and to do more work in Frobisher Bay itself, than had been anticipated. The "Calanus" was brought in for beaching on September 4th.

The physical oceanography occupied a considerable proportion of the time. Frobisher Bay is as yet poorly sounded, and it was therefore necessary to make sounding runs whenever possible. From these soundings an interesting bathymetric pattern was brought to light, the two main features of which are: (1) A deep trough along the southwest side of the bay, extending from a fairly deep threshold at the mouth (about 150 fathoms) to the islands which separate the outer and inner bays. This trough often goes deeper than 300 fathoms and sometimes deeper than 350 fathoms, which is the limit of the depth sounder scale on the "Calanus". (2) A shelving bank in the northeast half of the bay extending from the level of Wiswell Inlet at least to Loks Land; it probably continues around to the coast north of Frobisher Bay. This bank shelves off from very shallow depths next the shore-line to some 70 fathoms, before meeting the deep trough already described. It might be looked upon as a very even continental shelf; for the purposes of this report it will be referred to as the "Calanus Shelf". It extends approximately half way across the bay.

Besides the section across Ungava Bay, four sections were across Frobisher Bay, comprising 12 stations in all; altogether fifteen stations were made in Frobisher Bay waters, and one at the mouth of Lake Harbour Inlet. This material has not yet been worked out, and little can be said here in advance of the final report, except that the bulk of the water of Frobisher Bay, below 50 - 100 metres, was often slightly warmer than the corresponding depths in Ungava Bay. It is possible that Frobisher Bay is influenced somewhat by west Greenland water. The deepest water measured, at 600 metres, had a temperature of  $-1.22$  degrees C., and a salinity of 33.04 o/oo, on August 19. The lowest temperature recorded was at 160 metres in Victoria Bay, off the Countess of Warwick Sound, where a shallow threshold isolated the deeper water inside the bay; this temperature was  $-1.72$  degrees C., and is not typical of the Frobisher Bay water generally. Salinities in Frobisher Bay

showed the usual arctic or subarctic range, between 31 o/oo and 34 o/oo. Both oxygen and phosphate concentrations were measured at every station.

A light eight-foot beam trawl, made of 2-inch pipe and  $\frac{1}{8}$ -inch iron strap, and carrying a net of 2-inch mesh shrimp netting and a cod-end of  $\frac{3}{4}$ -inch mesh (meshes in stretched measure), was used on the "Calanus Shelf". This trawl was much more satisfactory than the heavy 18-foot beam trawl used in 1949 in Ungava Bay. Excellent trawling bottom was found on the shelf, consisting of sandy mud and shells, with small gravel stones, and in depths of 20 and 40 fathoms considerable numbers of shallow-water shrimp were taken. Greater depths (down to 70-80 fathoms) were dominated by crinoids, with a few fishes, mostly cottidae (sculpins). The deep trough beyond the shelf was beyond the reach of the "Calanus" trawling gear. Only seven hauls were made with the trawl, and eight with the 3-foot dredge, in Frobisher Bay during the 1951 season. More extensive trawling is planned for 1953. From present results, it is not expected that the shelf will be found to carry fish populations of value either to the Eskimos or to commercial interests.

Four long-line trawls were laid on the "Calanus" and one in Jackman Sound, each with from 35 to 50 hooks, sizes 15 and 16, baited with arctic char meat. Results, as in Ungava Bay, were negative, and the bait was invariably eaten off the hooks in a few hours, by benthonic amphipods. Hand-lines (jigs) were also tried on the shelf and at every anchorage used throughout August, also with negative results except for the occasional sculpin. According to Eskimo reports, neither Atlantic cod nor halibut (Atlantic or Greenland) are known in Frobisher Bay proper (with the exception of the cod at Ney Harbour described in the next paragraph), and the past season's work has established that cod are not to be found in the bay during August. Fishing will continue in September, 1952.

The bottom temperature on the shelf, at 50 metres, was  $-0.50^{\circ}\text{C}$ . on August 24th. Except for one line laid with nine hooks in late August, shark fishing was not attempted in 1951; native opinion on sharks is that "they suppose there are some there", but none of the half-dozen Eskimos questioned had ever seen one.

That codfish existed in a lake at the head of Ney Harbour, called "Ogac Lake", has been known to the Eskimos for a very long time but the lake has never been investigated, and there is only one record of it ever having been visited by a white man, namely by Mr. Ney, while engaged on a coastal and geodetic survey some few years ago. The "Calanus" expedition visited the lake on August 4th, anchoring at the head of Ney Harbour. The ship's dinghy was pulled over the threshold into the lake, and some five hours were spent in studying what turned out to be a most unusual ecological situation. Ogac Lake is roughly in the shape of an "L", the longer arm being about one mile in length or somewhat less,

and the shorter arm about two thirds of a mile. It consists of three basins, separated by shallower water. The central basin, in the angle of the "L", is a little over 60 metres deep, the innermost basin (farthest from the fjord) was not sounded but is probably shallower, and the outer basin, next the outflow to the fjord, is about 20 metres deep. There is a river flowing into the head of the lake, and the outflow to the fjord is about 80 yards long. For most of the time there is a cascading fall down to the fjord, but at spring high tides the levels are equalized and it is probable that some salt water can flow in to the lake. The volume of fresh water flowing in and out of the lake is quite considerable, the outflow stream being about thirty yards wide on the average, and some two to three feet deep in its upper portion. The surface water of the lake is fresh, but at 10, 25 and 50 metres in the central basin, salinities of 22.32, 26.10 and 26.95 o/oo, respectively, were measured. Temperatures at 0, 10, 25 and 50 metres were 7.40, 7.31, 8.12 and 4.52°C. The 50-metre water is stagnant, devoid of oxygen.

Between the stagnant water at the bottom and freshwater layer above, lives a population of Atlantic cod (Gadus callarias). The cod seem to be most numerous in the outer basin, which is shallower than the central basin and which was not found to contain any de-oxygenated water. Thirty fish were taken by hand-line from the lake, varying in size from 26 to 128 cm. These cod grow to very much larger sizes than the Burwell cod or the general run of Labrador cod, and moreover, in agreement with the high temperatures recorded, their vertebral count is low - 51-52, excluding the hypural plate or urostyle. Many of them were of a golden brown colour, which may be associated with their habit of eating sea-weed and sea-urchins (Strongylocentrotus). They are highly cannibalistic, remnants of cod being found in a large proportion of the stomachs. Otoliths were collected, but have not been read at the time of writing. They appear to remain in the lake all year round; this is inferred from the facts that cod are unknown to the Eskimos in Frobisher Bay itself, that they can be taken by hand-line through the ice in the lake in winter (Eskimo report), and that small young cod were taken by the "Calanus" party in the lake. There is also the evidence of the low vertebral count, and the observation of the high temperatures in the lake in August; any movement in or out of the lake would involve a great temperature shock, the water in Ney Harbour itself being between -1.23 and 4°C. in August. If any Atlantic cod enter Frobisher Bay from the south it must be in September, when the temperature difference would be of the same order. The nearest point at which Atlantic cod are known to be found is Resolution Island, where they appear in late August and September. The present evidence points to the conclusion that the cod in Ogac Lake are completely isolated, possibly since the last climatic optimum as much as four thousand years ago. Further study of these remarkable fish will be made in 1952 if time permits. The behaviour of the lake water itself calls for special study, which cannot be done by the "Calanus" party owing to the time required for it.

Frobisher Bay appears to be fairly rich in seal and walrus, the walrus being concentrated, as would be expected, in the eastern part of the bay, over the shallower bottom, and especially in the neighbourhood of Loks Land. The seal remain in some numbers even after the ice has left the bay, and bearded, harp and ringed seals are constantly seen in the open water throughout August. There is a marked contrast to the comparative barrenness of the open water of Ungava Bay. Three seal counts were made in Frobisher Bay by Mr. McLaren, a member of the "Calanus" party, resulting in estimates of three seal (all species) per square mile in the main body of the bay, and less than one seal per square mile at the extreme head of the bay.

The plankton of Frobisher Bay was amply sampled at all depths, by 45 horizontal hauls. These included a series made overnight in Jackman Sound, hauling every three hours from 5 pm. to 5 am., with three large-mesh plankton nets used simultaneously at 0, 50 and 100 metres. Littoral collections were made at all anchorages.

The "Calanus" was beached at Frobisher Bay, close to the airfield. For several reasons it was impracticable to use the cradle, and the ship was therefore taken in to a basin prepared by a bulldozer at high water mark, and the sand then bulldozed around her again.

From the 1951 work, it may be said that the probability of there being useful fish in Frobisher Bay (other than the arctic char in the rivers) is quite small, but it is still necessary to carry out fishing operations in September of next year to make certain of this. It is also clear that there is no need for any new marine fishery in the region, even were such a fishery possible, because the stock of sea mammals is ample. Furthermore, at present the seals and walrus are being used very little in summer, partly because of the great scarcity of native-owned boats, and partly because the population has quickly acquired the habit of squatting at the air-base and taking what employment there is available. During the whole of August, during which time the "Calanus" criss-crossed the waters of Frobisher Bay and entered numerous small inlets and harbours, not a single native boat, kayak or Eskimo was seen except at the base itself.

#### Arctic char investigation.

Mr. E.H. Grainger spent the whole summer of 1951, (from the middle of June to September 5) working on the arctic char (Salvelinus alpinus) in the Sylvia Grinnell River at the head of Frobisher Bay. It will be remembered that the Board had observers on commercial fishing boats in 1948 and 1950, also in Frobisher Bay, collecting material on the arctic char. Mr. Grainger has also been occupied in working out the data obtained then. Owing to the nature of those commercial undertakings, the material

collected was biased in favour of the size range which was commercially useful, although some of the smaller sizes were taken by the observer using non-commercial methods, such as minnow traps in the streams. The 1951 work has filled in the gaps in that material, and has furthermore shown the advantages of being able to work solidly through the period of migration, and for some time before the upstream movement began.

The material from the 1948 and 1950 field work (the larger 1951 material not yet being worked out) has shown that the rate of growth is very slow. There is an apparent acceleration of growth after the seventh winter, which possibly indicates that the first migration to the sea takes place at that point in the life cycle. Fish of 70-76 cm. length were found to be from 22 to over 24 years of age, and the growth rate was similar in males and females. The upstream migration begins on the Sylvia Grinnell River in late July, and finished, in 1951, at the spring tides early in September. Gonad and egg size were greatest during the first week of the run; during most of August the egg size was reduced and the external sexual characteristics of the males were considerably less developed than during the first week of the migration. Evidently those which ascend the river at the beginning of the migration are nearer to their spawning time at time of ascent than those which move up stream later.

#### Plankton copepods of Ungava Bay.

Miss Marion Fox has been engaged for more than a year on a study of the copepods of Ungava Bay. The 1947 collection has been carefully analyzed, and the summer biology of the three most abundant species, Calanus finmarchicus, C. hyperboreus and Pseudocalanus minutus, has been given special attention, Sub-samples have been sorted out into their various stages, from which it appears that Pseudocalanus, and possibly the Calanus species also, have extended breeding periods in summer. Only two of the species so far found, Pleuromamma robusta and Eurytemora americana, are not known from arctic waters, and are therefore to be regarded as probable evidence of the entry of Atlantic water into Ungava Bay. The copepod material from the 1948, 1949 and 1950 seasons is also in process of being worked out. In agreement with findings in Greenland waters, two quite distinct size-groups of adult Calanus, Pseudocalanus and Oithona are found in the present material.

#### Beaufort Sea.

Mr. A.H. Lawrie joined an expedition designed primarily for hydrographic work in the Beaufort Sea, in order to make biological observations and collections for the Fisheries Research Board Arctic Investigations. The expedition vessel arrived at Herschel Island, Yukon Territory, on August 16; the field work ended on September 19. The biological work took third

place to the hydrographic and oceanographic work, but Mr. Lawrie was able nevertheless to make 38 plankton hauls with open nets and 20 with the Clarke-Bumpus sampler. This material comprises the first considerable plankton collection from the area. Bottom samples were collected, also littoral fauna from seven stations, and there is a collection of fishes. Twenty-three arctic char were measured, sexed and otholithed, and will be valuable for comparison with the Frobisher Bay collection.

M. J. Dunbar.

STATEMENT OF COSTS  
EASTERN ARCTIC INVESTIGATIONS  
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1947-48		\$	12,806.00
1948-49			19,726.89
1949-50			16,849.41
1950-51	General	\$	13,491.31
	Calanus		<u>5,435.80</u>
			<u>18,927.11</u>
Estimated			68,309.41
1951-52			<u>19,320.00</u>
			<u>87,629.41</u>

## APPENDIX I.

E.H. Grainger.

### Sorting of 1950 field collection.

Collections of benthonic and littoral fauna and stomach contents, chiefly seals and fishes, made on the "Calanus" during the summer of 1950 in Ungava Bay and Hudson Strait were sorted into taxonomic groups in preparation for identification.

### Identification of polychaetous annelids.

Identification of polychaetous annelids collected in 1947, 1948, 1949 and 1950 by the "Calanus" in Ungava Bay and Hudson Strait was begun. This group, taken from the benthonic and littoral regions, has been shown to contain at least twenty species, from sixteen families, with much of the collection yet to be examined.

### Arctic char (*Salvelinus alpinus*)

Study was done on the collection and data resulting from Mr. John Wright's work on the Arctic char in Frobisher Bay, Baffin Island, from July 21 until August 28, 1950. Included in this material were stomach contents, gonads, otoliths, scales, parasites and data on size and appearance of the fish.

Length data on 341 char, from 4.8 to 85.4 cm. were included. Small fish, taken by hand and in minnow traps, and large fish, captured in large mesh gill nets, resulted in a somewhat artificial size frequency distribution, about 14% being from 10 to 15 cm. and 20% from 65 to 70 cm. in length. Readings were made of otoliths from 222 char, showing an age range from four to more than twenty-four winters. The 1950 age frequency follows the length frequency with the largest number of char in the 18 to 20 winters group, chiefly 60 to 70 cm. fish. Again this is a biased distribution due to the commercial meshes used. The following age-length relationship was shown: 4 winters - 10.6 cm. average length: 5 - 13.9; 6 - 14.6; 7 - 16.6; 8 - 29.4; 9 - 28.4; 10 - 36.7; 11 - 46.3; 12 - 47.6; 13 - 52.3; 14 - 56.9; 15 - 60.5; 16 - 61.6; 17 - 62.3; 18 - 63.6; 19 - 65.9; 20 - 67.5; 21 - 68.2; 22 - 70.6; 23 - 74.9; 24 - 73.9; 24 plus - 76.2.

From the relationship above is indicated a remarkable slow rate of growth. From the growth curve constructed from these data there is a suggestion of relatively slow growth until completion of the seventh winter, after which a marked increase in the growth rate occurs. Comparatively rapid growth takes place until about fifteen winters, followed by a gradual levelling off during subsequent years. Similar growth patterns are shown by both males and females, the former somewhat larger than the latter in all age groups. The 1950 collection is necessarily poor in certain age groups, particularly the 4, 6 to 10, 24 and 24 plus groups. Acquisition in 1951 of a large number of samples from 10 to 35 cm. in length may be expected to add reliability to this part of the series.

The reliability of the otolith method for char must be demonstrated before such readings may be used with complete confidence in interpreting the age of the fish. Analysis was made of longitudinal and transverse measurements of otoliths and fish lengths, and a straight-line relationship shown. Otolith growth rate (longitudinal measurement) was demonstrated as being distinctly similar to that of the fish. Ring diameter measurements were made of a number of otoliths, but these data have not yet been completely analysed.

Attempts to read the char scales were unsuccessful because of their extremely small size. Parasites taken from the char were sent to the Institute of Parasitology, MacDonald college, for identification.

The stomach contents of twenty-six char along with partial contents of many more (of the 1950 material), produced some 21,000 food organisms comprising about eighteen species. Thirty-five pairs of gonads were studied and data on others used in computing egg number, egg size and testis size. It was observed in the field that females taken in late July had larger eggs than those caught in August; a similar condition was found in 1951.

The writer spent the summer of 1951, from June 10 until September 5, studying the Arctic char in and near the Sylvia Grinnel River, Frobisher Bay, Baffin Island. The fish were taken principally by means of gill nets, also with hand nets, minnow traps, jigs and by hand. Particular attempts were made to obtain small char and those up to 35 cm. in length, not sampled sufficiently in previous fishing.

Approximately 1050 char were taken, of which 150 were tagged and released. Stomach contents were collected from 120, otoliths from 776, and 865 char were measured, sexed and described generally. Weighings were made of most of the fish taken. Gonads were taken from 285 char and measurements made of about 400. Internal and external parasites were collected. Counts were made on a number of vertebral columns, and dorsal, pectoral, pelvic and caudal fin rays. About fifty char were preserved entire or in part, and brought to the laboratory for further study.

Field observations in 1951 showed diminution in gonad size in early August about a week after commencement of upstream migration. During the last three weeks of August comparatively few large gonads (i.e. testes 2.5 cm. wide, eggs 5 mm. in diameter) were observed and few males showing external sexual characteristics (orange lower sides, hooked lower jaw, etc.) were seen. Evidently those which ascend the river at the beginning of migration are nearer to their spawning time at time of ascent than those which move upstream later.

Spring migration of most of the char to the sea was not seen, but some small char, up to about 20 cm., were observed moving into salt water in late June, after most had migrated. Upstream movement began about the first of August, at new moon spring tides, involving at first chiefly the larger fish. Upward movement continued until early September spring tides after which the number of char about the river mouth dropped suddenly. During the last week of August and early September the fish were almost entirely small, only rare large char appearing. There appears to be a definite correlation between migration and tides, which may be related to the presence of a water fall near the river mouth, the height of which is decreased greatly at high spring tides.

## APPENDIX II.

Marion Fox.

### Plankton of the Ungava Bay Region.

The first month of the summer of 1950 (May -June) was spent in microscopically sorting the plankton collected by the "Calanus" expedition during the three summers from 1947 to 1950. The plankton consisted mainly of Copepoda, coelenterate medusae, Sagitta, Amphipoda, decapod larvae, pteropod molluscs and green algae. A few hauls were composed almost entirely of diatoms and in one or two cases the copepods were greatly outnumbered by cirripede nauplii. Fish eggs, ostracods, fish larvae, mysids, tunicate larvae, ctenophores and a few cumaceans and cladocerans were also present, in smaller numbers.

From June 1950 until the first week in September, 1951 time was spent in sorting the stages in the life histories of the various species of Copepoda collected from June 24 - August 29, 1947. These included the calanoids which make up the bulk of the copepods, and also a few species of cyclopoids, particularly Oithona similis. In a few hauls, Oithona was the most common copepod, but in these cases the entire catch was very small. It is predominantly an upper water form in Ungava Bay, being rarely or never found below about 60 metres, and the greatest number being taken at the surface in a No. 18 net. The harpacticoids have been put away to be studied at some later date. Only a very few specimens of the species Monstrilla serricornis represented the monstrilloids.

Although all the calanoids have been identified and counted, specific analysis has been begun on Pseudocalanus and Calanus only, as these are by far the most common genera. The three species were treated separately (P. Minutus, C. finmarchicus and C. hyperboreus). Analysis of the data obtained is continuing at the time of writing this report, but it has been shown so far that there are in nearly every haul some adult male and egg-bearing female Pseudocalanus and the relative number of these to females without eggs is fairly constant. It is generally recognized that when there are adult males present the copepods are breeding (this is also implied by the presence of females with eggs) and since this is the case most of the summer, the breeding period is probably fairly long -- extending at least over July and August, probably longer.

Unfortunately there is a gap between July 20 and August 10, during which time no marine plankton hauls were made, so that it will be necessary to fill in from other years. The 1949 and 1950 collections will also supply information on the distribution of the copepods in deeper water -- All but a few of the 1947 hauls were made in the upper 50 metres.

Metridia longa, Pleuromamma robusta, Metridiopsis rostrata and Heterorhabdus norvegicus, as well as Calanus were found in the deeper layers of water. Pleuromamma, Heterorhabdus were found only in the deepest haul -- 230 metres; Metridia, Euchaeta norvegicus and Calanus were found here and in other deep hauls. Calanus is found at all levels but in very small numbers at the surface. In addition to the calanoids mentioned above appeared Microcalanus pygamaeus, Acartia longiremis, and what seems to be a variation of A. Clausii; also Eurytemora americana and another species of Eurytemora of which no record has so far been found. Of the cyclopoids there were found Oithona similis, Oncaea borealis, O. notopus, and a species of Cyclopina.

Several specimens have been found to be parasitized by Protozoa of the family Ellobiopsidae, and a few carry colonies of Vorticellida.

The remainder of 1951 and the early part of 1952 will be spent in counting and identifying copepods from 1949 and 1950 which will fill in the gaps left by the 1947 collection. After the analysis of the three most common species has been completed, the copepod collection from all years will be examined for any species (other than harpacticoids) not previously noted. The material will then be ready for publication.

## APPENDIX III.

A.H. Lawrie.

### Introduction

During the summer of 1951 the Defence Research Board of Canada sent into the Beaufort Sea a sea-borne expedition under the command of Mr. T.H. Manning. This mission was charged with the task of conducting exploratory hydrographic and oceanographic surveys, and the Fisheries Research Board of Canada was invited to send an observer with the party to make observations of the marine biological conditions in the areas visited.

The motor vessel "Cancolim II" arrived at Herschel Island, Yukon Territory, on August 16; field work continued from that date until September 19. Marine Biology was accorded third priority in the work of the expedition and it was understood that it should not interfere with the demands of the hydrographic and oceanographic programs. Of these two the former was the first concern and in consequence the ship was almost constantly at sea making sounding traverses. Only once, on the 15th of September, did the ship spend a day at sea in which she was not actively engaged in sounding, and on that day the writer was given the use of her for plankton work.

Under these circumstances two alternatives existed. The first was to remain with the ship and place emphasis on plankton studies, endeavouring to integrate these with the oceanography. The second was to go ashore at every opportunity and to remain there making collections of the littoral fauna while the ship carried out her work at sea. Conversations in the spring with Dr. Cameron of the University of British Columbia, the oceanographer, had suggested that the former might be more profitable. Once in operation this opinion was strengthened by several factors. In the first place the Beaufort Sea was abnormally free of ice during the summer of 1951 so that it was possible to make collections over a much wider area than would be the case in a normal year and it seemed too good an opportunity to waste. Secondly "Cancolim II" carried no professional crew, her scientific personnel doubling as seamen and it was apparent that the work as a whole would benefit by close co-operation and personnel sharing between oceanography and biology. Finally parties could not be left ashore for more than a short period and the writer's experience at Herschel Island suggested that work ashore would scarcely get under way before it would be broken off. In consequence of all these considerations the major effort was devoted to plankton work and shore collections were made only when the ship was not working at sea.

### Work Afloat

Radio aids to navigation do not exist in the Beaufort Sea and the weather is frequently overcast so as to preclude celestial navigation. Under these circumstances sounding traverses must be run by dead reckoning and it becomes essential to close these traverses as check on wind or current drift. Moreover, the

more rapid the traverse the less the possible error in positioning due to these factors. In consequence it was considered necessary to limit both the number and duration of the oceanographic stations and as plankton hauls were taken at these stations they came under similar restriction. Weather permitting, one haul, either vertical or horizontal, was taken at each station except in very shallow water. Bottom samples were also taken wherever possible. Long lining or other fishing, while on traverse was, however, impossible.

The sequence of events at an oceanographic station was as follows. The ship was stopped and a bathythermograph reading taken. This was followed by a bottle cast and then by either a vertical or horizontal plankton haul. Since the former was less time-consuming it was most often resorted to when the bottle cast had been deep and therefore long. Similarly vertical hauls were used in poor weather when every effort was made to speed up stations to minimize drift. Horizontal hauls were restricted to no more than ten minutes at depth and consumer somewhat better than twice that time including the oblique haul when recovering the net. A metre stramin and two one-foot nets, a No. 5 and a No. 18 mesh, were used on all but one occasion when a Clarke-Bumpus plankton sampler was employed. The depths of haul were determined from the wire angle and the amount of wire out and were chosen more or less at random. Upon completion of the plankton haul a bottom sample was usually taken. The samples were then preserved and catalogued, cross reference being made to the oceanographic station at which they were obtained. In this report no position can be stated for these stations since the hydrographic data have yet to be compiled.

Since the oceanographic stations were widely scattered and the sample at each restricted, an effort was made on September 15th to obtain more detailed information from one station. It was planned to make four series of hauls, each series to consist of hauls at increasing depths from the surface in an effort to determine the vertical distribution of the planktonic forms. One was to be made in the dark hours, one at midday, and the remaining two just before sunset and just after dawn. A dan buoy bearing a flag and a hurricane lantern was put down in 205 fathoms of water between Richards Island and Herschel Island and the hauls were made by running out from, and back to, the buoy. Hauls were made with a Clarke-Bumpus sampler with No. 0 net for ten minutes at depth. The first series of seven hauls was made between 0220 and 0613. At 0530 the sky was becoming perceptibly light and from that time on light readings were made at every haul with a Weston Master II photometer directed at the zenith. The second series of eight hauls was made between 0635 and 1008. The third series began at 1205 and had to be abandoned at 1433 after the fifth haul due to deteriorating weather. The weather continued to worsen and the fourth series could not be attempted.

Apart from the collections of plankton, observations of marine mammals were made and a polar bear, shot, September 1st off

De Salis Bay, was autopsied.

Work Ashore

The ship lay to briefly on a number of occasions during the summer for various purposes. As time permitted advantage was taken of these stops to make collections of littoral organisms. Collections of fish were made at Herschel and Holman Islands and at Tuktuyoaktuk and nets and lines were set unsuccessfully at at Capes Kellett and Parry, though some small Cottids were taken at the latter by seine. Invertebrates were collected along the shore by various means whenever opportunity offered and time was found to dredge the harbour bottom at Cape Parry and De Salis Bay. Some of the material obtained at Herschel and Holman Islands was procured from the nets of residents and an especial debt of thanks is due to Constables C.R. Mains and D.C. McDougall of the R.C.M.P. detachment at Herschel Island who made it possible for the writer to visit the Eskimo fishing camps on the adjacent mainland where both fishing methods and catch were observed. At Tuktuyoaktuk the R.C.M.P. and the R.C. Mission were both very helpful in providing specimens. Finally, while at Herschel Island five Ringed and a Bearded Seal were examined for parasites and the diaphragms preserved for histological examination.

Note on the fishes collected

With exception of some fish contained in stomach samples from char the fish collected during the summer have been identified. These identifications and the accompanying data are presented by localities below.

Herschel Island, Yukon Territory

taken by gill net and beach seine in 2-5' of very muddy water August 17 and 18, 1951.

Myoxocephalus quadricornis (Linnaeus)

Coregonus clupeaformis (Mitchill) (c. Kenn-  
cotti of Milner)

Salvelinus alpinus (Linnaeus)

Leucichthys autumnalis (Pallas)

Boreogadus saida (Lepechin)

Liopsetta glacialis (Pallas)  
from R.C.M.P. fish cache, August 16, 1951.

Leucichthys sardinella (Valenciennes)

" " autumnalis (Pallas)

" " sp.

Clupea pallasii (Valenciennes)Holman Island (western Victoria Island) NWT.

taken from native gill nets set round the shore of the harbour in four to five feet of water, August 3, 1951.

Myoxocephalus quadricornis (Linnaeus)Myoxocephalus groenlandicus (Cuvier and Valenciennes)Tuktuyoaktuk (Port Brabant) NWT.

taken from the R.C. Mission nets in the harbour, September 14 and by drift nets around the shores of the harbour Sept. 21, 1951.

Myoxocephalus quadricornis (Linnaeus)Clupea pallasii (Valenciennes)Camerus dentex (Steindachner)Platichthys stellatus (Pallas)Liopsetta glacialis (Pallas)Stenodus leucichthys (Guldenstad)Leucichthys sardinella (Valenciennes)" " autumnalis (Pallas)Coregonus clupeaformis (Mitchell) (C. Kennicotti of Milner)Cape ParryMyoxocephalus quadricornis (Linnaeus)" " groenlandicus (Cuvier and Valenciennes)Liparis ?herschelinus Scofield

In addition to the fish collected otoliths were taken from 23 arctic char (Salvelinus alpinus) at Herschel Island. The fish were weighed, measured (standard length) and sexed and the otoliths wrapped in a twist of cheesecloth, given a tag with field number and preserved in a 50% Glycerin solution (aqueous) with a few drops of formalin added. Six of these char were filleted and the flesh examined for parasites. Two specimens were found to have parasites encysted in pus-filled vesicles. In one of these, two such vesicles were found, one the size of the

terminal joint of the little finger in the flank just forward of the dorsal fin, the other, smaller in the "neck" just behind the gill cover. In the other the vesicle was pea-sized and just behind the gill cavity. Otherwise all these fish appeared fat and in good condition, though the flesh was uniformly soft.

#### Note on the Marine Mammals

##### Polar Bear (Thalarctos maritimus)

Only one bear was seen, on ice floes off De Salis Bay, Banks Island. It was collected and turned out to be a young adult female. A complete autopsy was performed and the diaphragm and a portion of the lungs were preserved. No evidence of parasitism was observed though the surface of the lung appeared slightly nodular. Blood smears were taken.

##### Ringed Seal (Phoca hispida)

No ringed Seal were collected by the party but an opportunity was had at Herschel Island to examine five seal which had been caught in the RCMP seal net. In the time available the autopsy could not be thorough and were restricted chiefly to examining the lungs and heart and collecting the diaphragm and stomachs and parasites.

Ringed seal were quite commonly observed by the expedition in all waters.

##### Bearded Seal (Erignathus barbatus)

A single Bearded Seal cursorily autopsied at Herschel Island had an empty stomach. The diaphragm was preserved.

## APPENDIX IV

M. J. Dunbar.

Future development of the Arctic Investigations of the Fisheries Research Board.

### I. 1952

Included in the 1952-53 estimates for the Arctic Investigations were the "Calanus" expedition, further reconnaissance in the Beaufort Sea area, and a littoral and inshore survey along the route of the Supply Vessel "C.D. Howe", from Churchill to the most northerly points of the voyage (northern Baffin Island and Ellesmere Island). Also considered here, for possible implementation in 1952, is an investigation of the Atlantic walrus.

#### "Calanus" expedition.

The immediate work that remains to be done in Frobisher Bay consists of trawling and line-fishing, especially on the Calanus Shelf. This should be done late in the season, in September. The cod at Resolution Island have also to be sampled, in September. The "Calanus" will probably be afloat about the middle of July, and the period between that time and the beginning of September will be spent between Frobisher Bay and Pangnirtung, working on the continental shelf, as early as the ice permits. Trawling, line-fishing and physical oceanography will make up the work program in that area, particularly in Cumberland Sound, where arctic flatfish are reported. There is a fuel supply at Pangnirtung, landed in 1951.

The coast of Baffin Island, north of Frobisher Bay, does not lend itself to the technique used in Ungava Bay, using a local base at which to beach the "Calanus". The open season is too short to allow for the time required in the launching and beaching operations. Frobisher Bay itself, in spite of the presence of an airfield, is not a good base for the "Calanus" owing to the great difficulty involved in using the cradle for beaching. The method used for beaching in 1951 is not ideal, and whereas it must perforce suffice for the present winter, repetitions of this rather rough treatment might damage the vessel. It is therefore proposed that for the winter of 1952-53, and for the winters following, the "Calanus" be beached at Churchill, where a marine railway is available, and that for the seasons of 1953 and 1954 the main region of work should be Hudson Bay. After the work is completed at Resolution Island and Frobisher Bay, therefore, in 1952, the "Calanus" should be sailed to Churchill in the latter half of September. A fuel cache will be landed at the western end of Hudson Strait for this purpose, earlier in the 1952 season.

### Littoral and inshore survey.

The littoral fauna of the arctic and subarctic is very interesting, and may perhaps be used as an indicator not simply of climatic conditions in any given region, but of the type of water present -- pure arctic, or mixed arctic, and Atlantic. Collections of littoral fauna at widely separated points in the eastern arctic can best be done by attaching to the Government party on the Supply Vessel "C.D. Howe" a Fisheries Research Board representative. Such a person could also (1) report on the availability, for future reference, of Peterhead boats for research purposes, (2) collect any local information that might be of value to the future planning of the Eastern Arctic Investigations, such as reports of the presence of arctic halibut, or shark, or of fluctuations in the abundance of sea mammals or arctic char. I would recommend here that the Departments of Transport and Resources and Development be approached with a view to our sending Miss Marion Fox on the "C.D. Howe" in 1952, on the voyage from Churchill to the most northerly stations. Quite apart from the work she would do on this voyage, it would serve a very useful purpose in familiarizing her with the country and conditions from which the planktonic fauna upon which she is working have been derived. Her travelling expenses for such a summer have been included in the estimates.

### Beaufort Sea area

If the Board wishes at this point to undertake investigations in the north-west on a scale comparable to the "Calanus" work in the eastern arctic (something which should certainly be started soon), it might be best to suggest to the Defence Research Board that the Fisheries Research Board take over responsibility for oceanographic work in that region, and that we use their vessel, "Cancolim II" for the purpose. If this course is considered or if a different vessel is used for this program, I would recommend that the headquarters for it be set up on the Pacific Coast, because such an added responsibility would seriously overload the Eastern Arctic Headquarters at McGill University. It is my view anyway that the Beaufort Sea work should be organized from the Pacific Coast, and that, once such a headquarters is set up, the two Arctic Investigations of the Board should co-operate in every way possible, and arrange for exchange of material for study.

I would not recommend that we send a representative of the Board on a repetition of the 1951 Beaufort Sea expedition. The Board's work in the field is full-time work, and it is not worth while to attempt to do it by any other means. The work to be done is very extensive, including an investigation of the status of the Pacific walrus, seals and whales; a study of the abundance of flounders and herring; and the biology of the arctic char in the north-west. The money ear-marked for the Beaufort Sea in the present estimates should be used in part for a fifth man in the "Calanus" crew, in view of the journey to be made in

September from Frobisher to Churchill, and in part for the Walrus investigation proposed in the next paragraph.

### Atlantic Walrus Investigation

The study of the sea mammals of the north is a full-time affair which the "Calanus", on her present program, can only touch upon en passant. Prolonged and intensive work is needed, and it is necessary to spend the winter in the north as well as the summer. Of all the mammals in the eastern arctic, with the exception of the bowhead whale, the walrus has been the most drastically reduced and it is certainly in most urgent need of study. We have no information on their present abundance or migrations, and our knowledge of their reproduction is extremely sketchy. There is no information on their growth rate or age-composition.

For some time it has been hoped that the walrus could be included in the Eastern Arctic program. Up to the present, no student has appeared who was willing, or who could be spared, to spend at least one whole year in the field for this purpose. A student at the University of British Columbia, Mr. Fay, is at present interested in making an intensive study of the walrus, but he will most probably carry out the work on the Pacific species, and in Alaska. The necessity of making a thorough study of the Atlantic species is however becoming urgent, and it is strongly recommended that a man to do the work should be found as soon as possible, and that the necessary money should be included in supplemental estimates. If possible, this study should be begun in 1952.

### II. Beyond 1952 (Eastern Arctic)

With the "Calanus" based at Churchill for the next few years it will be possible to begin operations in Hudson Bay and also, in due course, to take the vessel to Baffin Island for further work on the shelf in the south-east, and in Cumberland Sound. Under these circumstances, however, it will be some time before any work can be done north of Cumberland Sound, and the Board should take into consideration the possibility of sending two parties into the Eastern Arctic each year, from 1953 onward; one to work with the "Calanus", and the other to use a smaller craft for the most northerly areas. In many ways the use of a Peterhead boat for this work would be more efficient than the use of the "Calanus", because of the shortness of the season and the distance from Churchill.

It probably will not be possible, to charter Peterhead boats for this work in northern Baffin Island, and it may be advisable to build a small vessel of simple design, similar to the Peterhead type commonly used at present at northern posts. Such a boat would not be able to carry heavy trawling gear, and would not have the range or seaworthiness of the "Calanus", but it would be

quite adequate for everything else in coastal waters, and it would be comparatively inexpensive to build (about \$6,000). It is understood that the Geological Survey may be considering a proposal to build such a vessel for work in the same area; it might be suitable to suggest that the Board share the cost of the vessel, and that, for the region of northern and northeastern Baffin Island, the Geological Survey and the Fisheries Research Board join forces in the field.

However that may be, this appears to be a suitable time to summarize the work still to be done in the Eastern Arctic, and to show which parts of it can be done by the "Calanus" and which require special treatment.

1. Physical oceanographic work, the survey of the planktonic and benthonic fauna, trawling and line-fishing should be done everywhere. It can be done by the "Calanus" entirely, but the work in far northern areas would be accelerated by the use of a separate, and smaller vessel as suggested above. This is the ground-work of the whole investigation.
2. Sea mammals. The proper study of the biology of the sea mammals involves year-round work at suitable hunting centres, where material is readily available and where the investigator can accompany native hunting parties and become thoroughly acquainted with hunting methods and the part played by the mammals in the native economy. One man is enough on each separate project. The "Calanus" expeditions can supply useful information on distribution and abundance over a wide area during the summer, but all other work, the meat of the investigation, including marking experiments, must be done by the other type of organization. Most urgent on the list of sea mammals is the Atlantic walrus. Next come the white whale and the bearded and ringed seals, then the harbour seal and harp seal. Men working on the sea-mammals should have at least a whale boat at their disposal, and preferably also a dog-team during the winter.
3. Arctic char. A season's intensive study of the arctic char, similar to the work of Grainger at Frobisher in 1951, should be done at one station in Hudson Bay (Chesterfield may be the best) and at a station farther north, in northern Baffin Island or even Ellesmere Island. Not only would this show up any geographic variation in habit, growth rate, etc., but it would also enable the Board to make well-founded recommendations concerning the issuing or non-issuing of licenses to would-be commercial exploiters of the char, in other regions than Frobisher Bay.
4. Plankton of the Polar Sea. Matters of very great interest are the productivity of the Polar Sea, with its extreme ice conditions and unusual light relations, and the general behaviour of the plankton in that region. There is a meteorological station at Alert Bay, in northern Ellesmere Island on the shores of the Polar Sea, where it would be possible for a man to find quarters

for a year while studying the plankton. Using a whaleboat in summer and hauling through the ice in winter, the whole annual cycle of the plankton, and the chemical cycle, could be studied. This would be a notable contribution to the investigation of the northern seas, and would serve for comparison with similar or related work in other areas (for instance the plankton studies made by Digby at Scoresby Sound in East Greenland, and by the present writer at Godthaab, in West Greenland). It would cost little more than the salary of the investigator and the price of his equipment, which would not be elaborate. One important requirement upon which information is needed before undertaking this, is deep water (preferably over 200 metres) within reasonable distance from shore.

Other matters for field research will no doubt appear as the present work progresses, and many more could be added to this list. Those mentioned, however, are the most important and the most interesting. The total cost of them, per year, would be small. The present "Calanus" work, and the maintenance of the Eastern Arctic station at McGill, costs about \$21,000 to \$22,000 a year. Equipment, supplies, salary and travelling expenses for a man working on the walrus at Southampton Island or at Iglulik would come to about \$6,500, perhaps \$7,000. The arctic char work would cost approximately \$2,200 per season; and the study of the plankton at Alert would require about the same outlay as the year's walrus work. The total added cost would thus be in the region of \$16,000, for these three items. It should not be difficult to find the necessary personnel.

