SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 128, NUMBER 9
(End of Volume)

DISTRIBUTION AND ECOLOGY OF THE MARINE INVERTEBRATES OF POINT BARROW, ALASKA

(With 8 Plates)

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(Publication 4221)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
NOVEMBER 30, 1955

THE LORD BALTIMORE PRESS, INC.
BALTIMORE, MD., U. S. A.

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INTRODUCTION

ARCTIC EXPLORATIONS[1]

Our knowledge of the fauna of Arctic waters is fairly complete for some areas, scanty for others, and totally lacking for still others. The European Arctic and the eastern Canadian Arctic have been more thoroughly investigated than have the western Canadian Arctic and the Alaskan Arctic. The following partial recapitulation of expeditions and investigations gives some idea of the European research on the biology of the Arctic Ocean.

As early as 1587 the British, under John Davis, explored around west Greenland as far north as latitude 72°12′, and in the next two centuries the Dutch, under Willem Barents and Henry Hudson, and the British, under C. J. Phipps, explored around Spitsbergen to latitude 80°48′ N. From 1879 to 1882 the British continued explorations around Spitsbergen, Jan Mayen, and Franz Joseph Land. Such expeditions as the above and that of the *Maud* (see below) were more exploratory and oceanographical than biological in nature. The Second German Northpolar Expedition, under Capt. Karl Koldewey (1869-70), explored around east Greenland. Dredging excursions to Iceland were carried out under Verkruzen about 1872. The Danish *Ingolf* Expedition of 1879 also explored around east Greenland. Den Norske Nordhavsexpeditionen of 1876-78 worked in the European Arctic. The west coast of Greenland was explored in 1892. The

[1] The present study was made possible through contracts of the California Institute of Technology (summer, 1948) and The Johns Hopkins University (June 1949-August 1950) with the Office of Naval Research (Contract and Task Order No. N6-ONR 243-16; Project No. NR 162 911).

Second Norwegian Arctic Expedition in the *Fram* (1898-1902) went from northern Norway through the Barents Sea, the Kara Sea (between Novaya Zemlya and Russia), the Laptev Sea, and to the east around west Spitsbergen. Between 1879 and 1900 there were various Swedish expeditions to east Greenland and other regions. The Plankton Expedition of 1903 included the waters of Iceland. The Russians sent an expedition to Spitsbergen, and the Bremer Expedition of 1889 also explored around east Spitsbergen, the Kola Fjord, and the southwest parts of the Barents Sea. The Danish expeditions of 1906-08 did work along the northeast coast of Greenland. The Norwegian North Polar Expedition in the *Maud* from 1918 to 1925 wintered three times on the Siberian coast on their way to Alaska, spent two years drifting from Wrangell Island to the north of the New Siberian Islands, wintered at the Bear Islands at the mouth of the Kolima, and then went to Nome. The Godthaab Expedition did work along the west coast of Greenland in 1928, and there were Danish investigations in the Faroes between 1924 and 1927. Various Danish expeditions worked rather intensively along the east coast of Greenland from 1929 to 1933, in some instances leaving investigators over winter.

Nothing comparable to the work done along the coast of Greenland, Iceland, and the Faroes has been done in the American Arctic. The fauna of northeastern Arctic Canada is better known than that of Arctic Alaska or the western Canadian Arctic. Some work has been done in the American Archipelago, and at present the Canadians are carrying on investigations. Recently Dr. M. J. Dunbar has made excellent contributions from Ungava Bay and other waters in that region.

Lt. Ernest Belcher, on the voyage of the *Beechey* in 1825-28, did some collecting as far north as Icy Cape, but the majority of his work was south of Bering Strait. The *Vega* expedition did some work in the Kara Sea, Laptev Sea, the East Siberian Sea, the Chukchi Sea, Bering Strait, and Bering Sea. Lt. P. H. Ray and his party were stationed at Point Barrow and vicinity in 1881-83 (the International Polar Expedition to Point Barrow), but their work was largely meteorological and they lacked proper facilities for collecting. This is borne out by the fact that they collected only 180 species of animals. The Canadian Arctic Expedition of 1913-18 did very little work north of western Canada and Alaska. Of the various voyages and expeditions that visited Arctic Alaskan waters (such as the *Resolution* and *Discovery* under James Cook, the *Seniavine* under Lütke, and the *Vincennes* under Rogers) probably the most important from the standpoint of collections of invertebrates were those of the *Yukon* (U. S. Coast and Geodetic Survey schooner) under the leadership of Dall (1880) and the *Corwin* under Captain Healy (1884 and 1885).

These investigations were much less intensive than those of the Danes about Greenland; they were too spotty, and the animals collected were sometimes so poorly preserved as to be of little value. Such expeditions can give only a general picture of the fauna, and the research is usually more oceanographical than biological or ecological in character.

Only through continued intensive work in a small area can anywhere near an accurate picture of the fauna of a region be obtained. The present work was undertaken for the purpose of obtaining as much information as possible on the fauna of Point Barrow. As this is about midway between the areas that have been investigated to the east and to the west, it was a strategic locality for the study of circumpolar distribution of species, and the extension of our knowledge of the Arctic marine animal population and its environment far to the westward.

The work was carried out through the facilities of the Arctic Research Laboratory, which was maintained by the Office of Naval Research under contract with the Institute for Cooperative Research, a branch of the Johns Hopkins University.

LOCATION, GENERAL SURROUNDINGS, AND FACILITIES

The Arctic Research Laboratory is located within the base camp maintained by the Arctic Contractors (Arcon), who were under contract with the U. S. Navy to explore some 37,000 square miles of oil reserve. The personnel of the camp, both Navy and civilian, were very cooperative, and much of what was accomplished could not have been done without their aid.

The base is located 6 miles southwest of Point Barrow and 4.5 miles northeast of the village of Barrow at approximately latitude 71°20′ N. and longitude 156°41′ W., 4°50′ above the Arctic Circle, and 1,325 miles from the North Pole. It is on the beach at the edge of a great tundra plain, and no elevations over 10 feet are visible in any direction. The ocean there has no tide. The weather is stormy, but there is no snow for perhaps three months, though there may be flurries in July and August. There are about two months of perpetual daylight in summer and about two of perpetual darkness in winter, except for twilight at noon. There was plane service three days a week between the base and Fairbanks, and an operation called BAREX brought in supplies about the first of August of each year.

In 1948 the Arctic Research Laboratory consisted of a 2-story quonset building 40 by 100 feet (pl. 1, Bldg. No. 250) and a smaller 1-story quonset 20 by 60 feet (Bldg. No. 270). During 1950, while the writer was scientific director, another 40-by-100-foot quonset

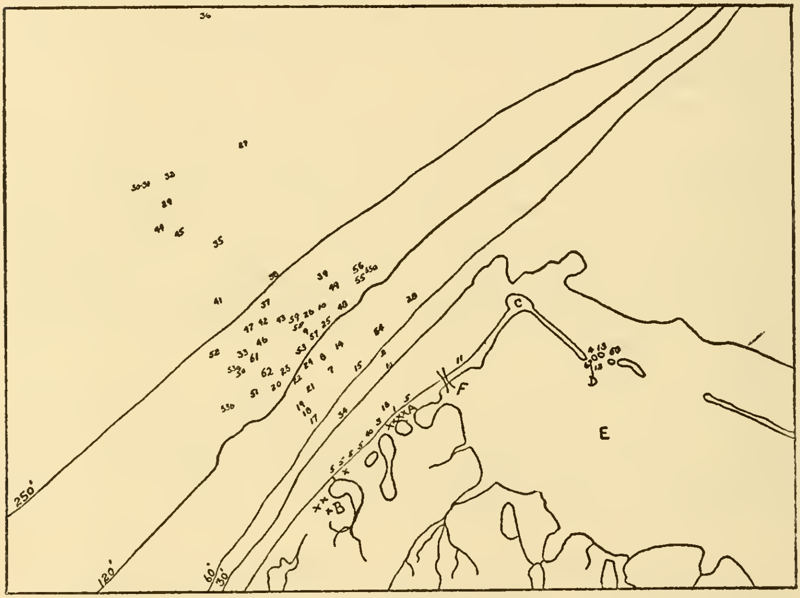
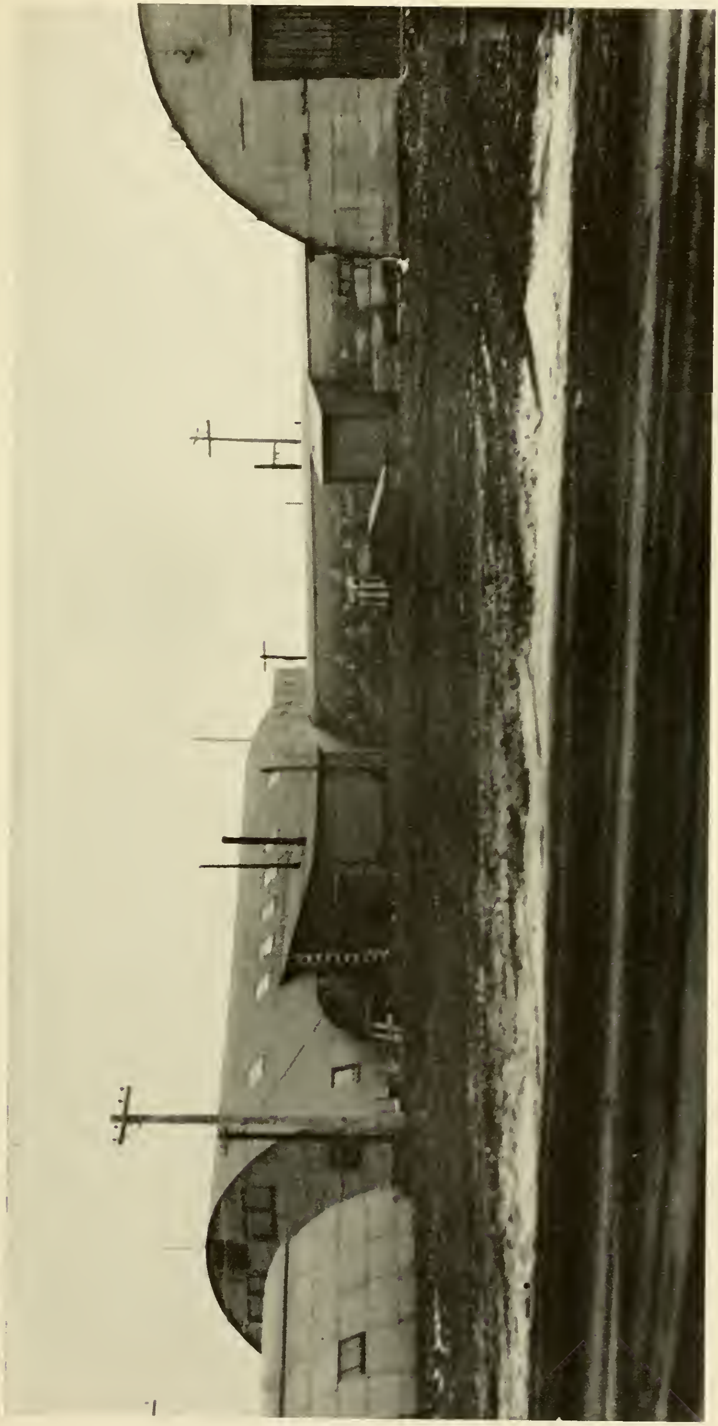


Fig. 1.—Map of Point Barrow. (Adapted from U.S.C.G.S. Map 9445.) *A*, Arctic Contractor's base. *B*, Barrow Village. *C*, Point Barrow. *D*, Eluitkak Pass. *E*, Elson Lagoon. *F*, Location of channel opened by Arcon each year. Nos. 1-62, Dredging stations.

(pl. 1, Bldg. No. 251) was added and Building No. 270 was turned back to the Arctic Contractors. The new 2-story building was connected to the older one (No. 250) by a 20-by-90-foot quonset (pl. 1), which served as a machine shop and storeroom. The upper story of No. 251 was divided into sleeping rooms, and the lower floor was made into laboratories. The upper story of No. 250 served as a library, chemistry storeroom, and offices for the scientific director, plant manager, and secretary. The laboratory contains 18 research rooms and has facilities for about 30 workers (pl. 2, fig. 1).

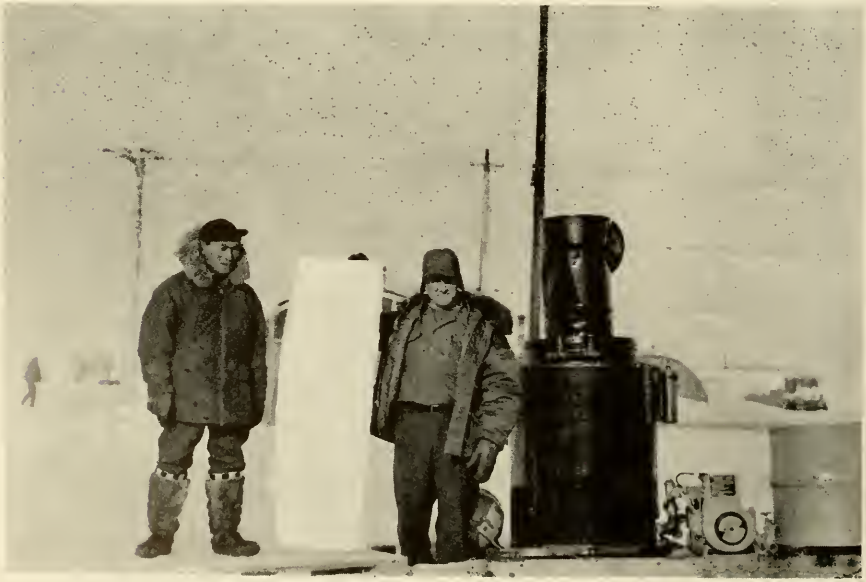
PERSONNEL

The group working on this project included the writer as principal investigator; Mrs. MacGinitie, research associate at Point Barrow;



Arctic Research Laboratory, north exposure. Building No. 250 on left, No. 251 on right, with connecting one-story shop and storehouse.

1. Personnel at Arctic Research Laboratory, summer, 1950.



2. Ice-cutting device. Jacob Stalker on left, John Huff on right.

1. The *Ivik*, 36-foot dredging boat, summer, 1949, before the cabin was added.

2. Working aboard the *Ivik*—starting to haul the dredge aboard.

1. Dredge haul on deck of *Ivik*, ready for field sorting.

2. Snow house over sampling hole in shore ice near base.

Dr. Marian H. Pettibone, research associate at the U. S. National Museum; Howard Feder, research assistant at Point Barrow from July 1949 until June 1950; and Gail Grodhaus, who came in July 1950 and stayed through September.

Mrs. MacGinitie and I spent three months at the Point during 1948, from July 10 to October 10, and a second period from June 30, 1949, to August 14, 1950. The contract for the first period was made by the California Institute of Technology with the Office of Naval Research, that of the second by the Johns Hopkins University. During the second period the writer also served as Scientific Director of the Laboratory.

EQUIPMENT

The Navy and the Office of Naval Research were generous regarding equipment. For two months during the summer of 1948 an Eskimo boat, with two boatmen, was rented, but in 1949 a 36-foot boat named the *Ivik,* meaning "walrus" (pl. 3, fig. 1), was furnished by the Navy and sent to the base by BAREX. This was equipped with a 25-hp. diesel engine, which was later changed to a gasoline engine. It was a seaworthy craft and the best imaginable for the purpose. Before it was taken to Point Barrow it was sent to the Kerckhoff Marine Laboratory of the California Institute of Technology, where it was equipped with winch, mast, boom, and other accessories, including a canvas hood. In the spring of 1950 the latter was replaced by a suitable cabin. In addition to cabin space and space in the stern, there is an open working space of approximately 10 by 14 feet (pl. 4, fig. 1). A 5-hp. outboard motor and a skiff were carried for safety in the event of breakdown or jamming in ice.

A meter wheel, dredges, towing nets, and other necessary gear, were part of the equipment. A set of Kohl hydrometers was purchased for use in determining the salinity of the water. One binocular microscope was furnished in 1948 and another in 1949. All necessary glassware, specimen bottles, and other laboratory equipment were procured.

PHYSICAL AND CHEMICAL FEATURES

CLIMATE AND VEGETATION

Some of the statistical information about weather contained in this discussion was taken from reports of the U. S. Weather Bureau offices at Point Barrow and Fairbanks.

The most interesting and perhaps the least known feature of the weather at Point Barrow is its aridity. The average annual precipitation is only about 4 inches. There is no building-up of the ice reserve on the northern slope of the Brooks Range, which is 250 miles to the south of Point Barrow. Therefore, one can estimate that, even after eliminating loss by evaporation, approximately 10 million acre-feet of fresh water empty annually into the ocean. At least four-fifths of this flows into the ocean east of Point Barrow, where currents carry it mainly westward to the Point and sometimes beyond.

Although the relative humidity is usually high, the temperature is so low that little moisture is held. It is cloudy 50 to 60 percent of the time. There are more clear days in winter just before, during, and just after those months when the sun is below the horizon. Any day of the year may bring a snow flurry, though during June, July, August, and September the precipitation is usually in the form of a drizzly rain. As one goes by plane between Point Barrow and the Brooks Range (250 miles) during the summer, one is almost certain somewhere to pass over a white strip where there has been a snow squall. Such strips are about 10 miles wide. In the afternoon of July 23, 1948, 3 inches of snow fell at Point Barrow.

February 1950 was the coldest month on record, with an average temperature of −23.8° F. The lowest temperature on record there is −56° F. The highest in 1946 was on July 10 with 73° F. and the lowest the same year was −37° F., which was recorded on three different days—February 25, March 10, and December 29. The highest temperature in 1949 was 63° F. on August 11, and the lowest that year was −51° F. on February 16. The highest temperature that Ray (1885) recorded during his stay near Point Barrow was 60.5° F., and the lowest was −52.6° F.

Much of the dredging I did was carried on in fog of such density that visibility was limited to one-fourth mile or less. An interesting phenomenon was the presence of a bright spot in the fog on the side opposite the sun. By knowing the time of day, the proper direction of the boat could be determined by this lighter area, which was a great help in navigation since compasses were unreliable because of the nearness to the magnetic pole and the consequent high angle of the magnetic dip, or the magnetic lines of force. I learned to depend for navigation more on my own senses and those of the Eskimo boatmen (particularly the latter) than on a compass.

Although many days are relatively calm, winds are changeable and at times come up quickly to gale force. The average velocity is 12 miles an hour, but winds of 40 miles are not uncommon. While the boat and its crew were returning from one dredging trip about

10 miles offshore, a blow of such violence came up that it was necessary to go to shore 6 miles below the landing and work slowly alongshore to the base, where the boat could be pulled out. Had the boat been forced directly to the landing it would have been swamped. That day the "No. 1 Boatman" (Max Adams) said, "I got a itta bit tsick."

The vegetation consists of lichens, mosses, grasses, sedges, and flowering plants. There are two species of low willows that grow in the Arctic tundra. The largest of these is a branching, decumbent plant that does not project more than 2 inches above ground and seldom covers an area of more than 3 feet in diameter. One of these willows may be found almost at land's end at the Point. Farther inland along streams another species of willow that may attain a height of 10 feet is abundant.

Plants in the Arctic grow slowly. Two different Government men, interested in reindeer propagation, told the writer that overgrazed land requires 50 years in which to regain fully its plant life.

The contribution of terrestrial plants to the economy of the sea is brought about mainly through shore erosion, though some plants are brought to the ocean by rivers. This relationship is further explained under "Currents" and "Food."

No account of the plants of the tundra would be complete without some mention of the summer flowers. Those who think of the Arctic waste as a dreary, uninviting area should visit the region in August and see the profusion of flowers and birds. All flowers are short-stemmed and small, but most of them are beautiful. A delightful memory is of a field of poppies on the bluff alongshore several miles southwest of Barrow Village, and the great fields of golden sedges of the tundra are a never-to-be-forgotten sight.

GEOLOGY

To understand the sediments of the ocean shore and bottom at Point Barrow and vicinity it is necessary to go a considerable distance to determine the source. Much of the shore and bottom materials has come from the Brooks Range to the south. These mountains, 7,000 to 8,000 feet high, extend east and west across northern Alaska (fig. 2) a distance of 600 miles. Some shore and bottom materials are ice-borne from great distances. More will be said about this under "Currents."

Geologically the north slope, i.e., that part of Alaska from the Brooks Range to the Arctic Ocean, may be divided into three general regions: (1) The mountains of the northern slopes are sedimentary formations. (The whole range, though sedimentary, shows granite intrusions, indicating an igneous core.) Shale and limestone predominate. (2) The mountain slopes verge into an undulating plain which includes most of the drainage basin of the Colville River (25,000 square miles). This second region is sharply set off from (3) the great wet tundra plains by an old beach escarpment which is 50 to 300 feet above the lake and pond area to the north—some 25,000 square miles that is more water than land. At the foot of this escarpment the elevation is about 400 feet above sea level. This gives a fall of 400 feet in about 100 miles to the coast at Barrow. The

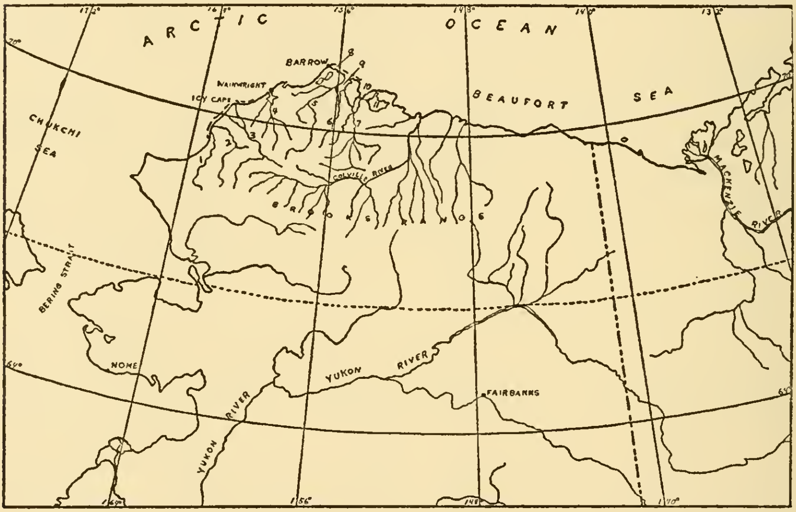


FIG. 2.—Map of northern Alaska. 1, Kukpoivruk River. 2, Kokolek River. 3, Utokok River. 4, Kuk River. 5, Meade River. 6, Topagoruk River. 7, Ikpikpuk River. 8, Elson Lagoon. 9, Admiralty Bay and Dease Inlet. 10, Smith Bay. 11, Teshekpuk Lake.

drainage surface thaws to a depth of 12 to 18 inches during summer, which is the only time of year when any movement of water occurs over the tundra. Throughout this plain the ground is frozen to a depth of nearly 1,000 feet (permafrost). All but the largest rivers freeze solidly in winter. Lakes are very numerous and in general are oriented north and south.

Many rivers in this third region flow northward to the Arctic Ocean (fig. 2); three large ones, the Meade, Topagoruk, and Chip, empty into Admiralty Bay, which in turn becomes Dease Inlet and Elson Lagoon. To the southwest is the Kuk River, which enters the ocean at Wainwright. Beyond Icy Cape are the mouths of three rivers, the Utokok, Kokolek, and Kukpoivruk. To the east of Elson

Lagoon is Smith Bay, into which flows the Ikpikpuk River. Teshekpuk Lake, the largest lake on the northern slope, empties into the same bay through a channel, the mouth of which joins the delta of the Ikpikpuk. These rivers are important to the marine life off Point Barrow for they affect the salinity of the water and carry to the ocean organic material that supplies some of the detritus on the bottom offshore.

As has been mentioned under "Climate," the average annual rainfall of the northern slope is only about 4 inches, so the runoff is not great. Because of the relatively slight variation in elevation, these rivers meander amazingly and the currents are slow. Occasionally one lake may break through into another, and the resulting flow of water thaws the permafrost and sometimes cuts a channel several feet deep.

The discharge from Elson Lagoon has more effect on the ocean water near Point Barrow than that from any other source. There are several reasons for this: (1) The fresh water from the rivers flowing into Elson Lagoon through Admiralty Bay and Dease Inlet is of considerable volume. (2) The lagoon is large and quite shallow. Reference to U. S. Coast and Geodetic Survey map 9495 shows that Elson Lagoon, Dease Inlet, and Admiralty Bay together form a body of water 90 square miles in area, and nowhere is the depth more than 12 feet. The bottom is a blue mud, which is stirred up by wind waves, and carried in large quantities into the sea, sometimes coloring it for miles alongshore and offshore. (3) The body of water under discussion has a shoreline (not including the chain of islands separating the lagoon from the ocean) of about 100 miles which is eroding very rapidly in summer. During the fall of 1949 not only was the ocean muddy but also great quantities of tundra (lichen masses and grasses, including roots) were floating in it. This large amount of organic matter, derived mainly from the eroding shoreline of the lagoon and from the rivers, furnishes the detritus of the ocean floor to a distance of 25 miles from shore, which was as far out as dredging was carried on. It is my opinion that such material from the shores of the Arctic Ocean and contributary rivers supplies detritus throughout the entire Arctic Basin.

Along the beach at Point Barrow and for hundreds of miles east and west, erosion is proceeding at a rapid rate. Point Barrow proper has receded 28 feet in four years—a rate of 7 feet a year. At one place in Elson Lagoon the shore has eroded inland 115 feet in four years. These figures were supplied by Dr. G. R. MacCarthy, of the U. S. Geological Survey, who obtained them by measuring the triangulation targets of the U. S. Coast and Geodetic Survey set in 1945 with reference to the beach line.

The beach is of gravel, composed of approximately 90 percent chert with an admixture of igneous and sedimentary pebbles of white, red, and gray sandstone, granite, and basalt, with a very small percentage of limestone, derived mainly from the Brooks Range. This gravel extends out to an irregular line where the water is 10 to 20 feet deep and is there replaced by a silty marine clay of extremely fine grain. This clay is spoken of as blue mud and extends inland under the tundra at a depth averaging 40 feet. It is so sticky that an hour or more is required to wash it out of a dredge. Where erosion has removed the clay from under the tundra, the dredge often brings up chunks of tundra from 50 to 75 yards from shore.

Beyond the blue-mud zone is the rubble zone, consisting of pebbles ranging from one-eighth inch or less in diameter to boulders that may weigh tons. This rubble is ice-borne and is rather spotty. Sometimes the dredge brings up gravel, but at others it jumps and jerks, showing the presence of large boulders. Rocks 20 pounds in weight are sometimes brought up. The composition of the rocks is approximately the same as that of the beach gravel. As one goes farther from shore the boulder-strewn bottom is replaced by finer gravel and shell beds, mostly *Hiatella* (=*Saxicava*). Inland there are, in the coastal plain, many old beach lines, showing that the area has been uplifted and depressed in relation to the sea, and tundra is sometimes encountered many feet under the surface.

ICE

Ice exerts a great influence on the shore and bottom fauna off Point Barrow. N. A. Transehe (1928) places the ice of the Arctic Ocean in three classes: Fast ice along shore, pack ice (more or less freely moving ice), and the Arctic pack. The first is 5 percent of the whole, the second about 25 percent, and the Arctic pack itself constitutes 70 percent of the Arctic Ocean ice.

None of this ice is stable. Papanin (1939) showed that the Arctic pack moved in the direction of the Atlantic off Greenland at the rate of 1,000 miles in nine months. In this pack, leads open and close or freeze over and are piled into new ridges. There is, therefore, no indication that any part of the Arctic ice is very old. Most of the pack flowing out past Greenland is probably not more than four years old, and much of it only two or three. If, as seems to be indicated, there is a gyral in the Beaufort Sea, it is possible that ice may last several years there, and some at Point Barrow may be more than four years old. There is good evidence for considering the Arctic pack as a great moving field, the direction of which is from northeast Siberia to the east of Greenland.

One factor that has not been given the attention it deserves is the rate of melting. The writer believes that if it were not for the piling up of the ice during storms and its subsequent incorporation in the Arctic pack there would be little ice in the Arctic Ocean by September of each year. Probably nowhere in the Arctic does the water freeze to a thickness of more than 6 feet (certainly not more than 7 feet) in any one winter. The winter of 1949-50 at Point Barrow was very cold. The average daily temperature for the month of February was the coldest on record, −23.8° F., yet the ocean ice alongshore was only 68 inches thick. The thousands of lakes and ponds freeze to a depth of about 7 feet and this ice melts entirely in summer. In cruising among the floebergs (pl. 6, fig. 2) one often sees floes that are only 1 or 2 feet thick. These are from leads that froze over without subsequent piling up of the ice, and such floes entirely disappear by September. However, there is no way of knowing how thick they were originally.

Ice can form deeper in regions where fresh water runs under the ocean ice—for example, in and near Elson Lagoon it may be as much as a foot thicker than nearby shore ice. Since fresh water floats on salt water, when it is carried out under the ice sheet the lack of wind disturbance allows it to spread out under the ocean ice for a considerable distance. However, fresh water freezes at a higher temperature than ocean water and, since the fresh water is between the cold ice above and the below-zero water beneath, it does not travel more than a few miles alongshore before freezing. Hence some of the alongshore ice near Elson Lagoon thickens more rapidly than that offshore.

A discussion of how the ice forms offshore, beginning in October and continuing until the ice goes out the following July, may be of interest. To begin with, ocean ice is different from fresh-water ice. A slush forms on the surface of the ocean alongshore and gradually creeps oceanward. When this slush becomes about 4 inches thick it begins to solidify on top and a great sheet of ice is formed for perhaps one-fourth to one-half mile seaward. Some time later an onshore wind, with or without swells in the ocean water, breaks up this sheet, and chunks of ice, large and small, are slid over the shoreward ice until they are piled up into a ridge. (In 1949 the first ice alongshore broke up and was carried in to the beach itself, forming a ridge

15 feet high.) New sheets form and the process is repeated until the ocean is covered with ridges of rough ice (pl. 5, fig. 2) to a considerable distance at sea. This distance varies with seasons but may be 6 or 8 miles. However, the outer few miles of ice over water more than 100 feet deep are never stable. Storms open leads and these close again. Leads remain open for varying lengths of time, but a layer of ice several inches thick usually forms within a few days, and if there are no onshore winds of sufficient force to pile it up, it continues freezing to a greater thickness. Eventually the pressure of the outer ice breaks it up and piles it up several layers thick (pl. 5, figs. 1, 2). Leads may be from a few feet to several miles wide, and from a few hundred feet to several miles long. The ice ridges may be 100 feet or more across, 20 feet or more in height, and a few hundred feet to several miles in length. Thus the shore ice presents a series of ridges of varying length, breadth, and height, and between these may be areas of varying size that are relatively smooth and level, where the vagaries of storms and currents have permitted the ice to form without being disturbed.

Nearly every fall the floating, drifting ice offshore, which is old ice sometimes almost equaling icebergs in size, comes shoreward and grounds. Since ice is about seven-eighths under water, this ice grounds offshore where the water is 60 to more than 100 feet deep and forms what is spoken of as "the big pressure ridge." Owing to the force of ice behind it, it may pile up as high as 30 feet or more.

The following are the days in the years 1941 to 1947, inclusive, on which the ice permanently formed an unopen ridge offshore:

1941	November	1	1945	October	20
1942	November	10	1946	November	9
1943	October	15	1947	October	13
1944	October	18			

In 1948 the ice broke up on July 23, and on only one day throughout the remainder of the summer was the pack ice not visible from shore and then it could be seen from any elevation of 20 feet, or a height above ground of 8 or 9 feet. A useful equation for the curvature of the earth, and, therefore, the distance objects can be seen at sea, is $\sqrt{h}+\frac{1}{3}\sqrt{h}$. The shore at Point Barrow base is 11 feet above sea level, so the horizon, to a man whose eyes are 5 feet above ground, is $\sqrt{16}+\frac{1}{3}\sqrt{16}$ or $5\frac{1}{3}$ miles. If the ice itself is 10 feet high, then it can be seen from shore when it is about 9 or 10 miles out.

Three times during the summer of 1948 the edge of the pack ice approached shore, and many small ice floes were grounded. One

1. Ice over Arctic Ocean. The dark strip along the horizon is caused by vapor condensing over a lead and is referred to as "smoke."

2. Another view of an ice field on the Arctic Ocean, also showing "smoke" over a lead in the distance.

1. Arctic Ocean. Ice offshore, summer, 1949.

2. Arctic Ocean. Floeberg from pressure ridge, summer, 1948.

1. Iceberg grounded offshore near Point Barrow. Note striations showing glacial origin. This iceberg undoubtedly came from the American Archipelago.

2. A crevasse in the iceberg shown in figure 1.

1. Ice pushed ashore by storms, winter, 1950.

2. Traveling by dog team over the ice on the Arctic Ocean.

could often jump from shore onto a floe. Pack ice is a loose aggregation of floes of all shapes and sizes often forming streaks of varying width with open leads between. However, these leads are never free from small pieces of ice, and the boat coxswain must be continually alert to avoid collisions. Among the writer's most pleasant memories are days in the summer of 1948, cruising about among the ice floes looking for leads of sufficient extent to allow dredging. Those days were made all the more enjoyable by the companionship of the two Eskimo boatmen Max Adams and Olaf Avenosook.

In the summer of 1949 the ice went out during the night of July 19, was in sight the following day, and then never came near shore again that summer. No ice floes of any kind were visible until July 29, when a few small floes grounded ashore and remained for a day or two. After that no ice at all was seen. At different times aviators reported the pack ice at distances 60 to 140 miles offshore. Since the big ice did not come in during the fall, no large pressure ridge formed. By inquiry from elderly Eskimos who had lived at Point Barrow all their lives, it was ascertained that this phenomenon has happened perhaps five times in the past 50 years, or on an average of perhaps once in 10 years.

Icebergs are formed by the breaking off of high pieces of glaciers extending into the sea. The nearest glaciers to Point Barrow are to the east in the Canadian Archipelago and in Greenland. In the summer of 1948 a large iceberg (pl. 7, figs. 1, 2) grounded off Point Barrow. It was at least 25 feet high and was stratified, looking like no other ice ordinarily seen at Point Barrow. It had fairly straight sides and was grounded in about 200 feet of water. The dimensions were about 70 by 100 feet and the top was fairly flat. This berg was viewed from a PBY by Commander Paton of the U. S. Coast and Geodetic Survey, Dr. Dobrin of the Naval Ordnance Laboratory, the two pilots, a newspaper correspondent, and the writer. The pilot flew alongside the iceberg and said his altimeter showed it to be 25 to 30 feet high.

During the following winter two of these large icebergs grounded about 25 miles northeast of Point Barrow base. Because of the strong prevailing northeast current flowing past the Point and meeting the northwest current out of the Beaufort Sea, the water is shallow for miles northeast of Point Barrow, which accounts for the bergs' grounding so far from shore. These icebergs undoubtedly came out of the Beaufort Sea with the northwest current mentioned above. If this supposition is true, it brings up problems of great interest. How did they get into the Beaufort Sea? Where did they originate? How long were they on the way to Point Barrow?

Anywhere inshore from the big pressure ridge smaller floes ground and freeze into the layer forming from shore to ridge. This occurs only in those years in which the big pressure ridge forms, which, as has been said, is at least nine out of ten. These big pieces of ice ground at different depths and crush any animals living on the surface of the ocean bottom.

If there were no folding of the ice into ridges as it freezes, it would reach a yearly average thickness of about 6 feet. From the big pressure ridge toward shore there is usually a great deal of unbroken ice. For a distance of 3 to 5 miles offshore, animals are continuously covered by an ice sheet, except for occasional leads, from about November 1 to July 1 each year. From shore to a depth of over 100 feet offshore the bottom is rubbed and gouged by ice.

The underside of the ice is as rough as, or rougher than, the surface and, in addition, during most of the time from November to April, is covered underneath by 3 or 4 inches of slush as the water continues to freeze. When freezing stops, the slush disappears, and from May to October little or none exists.

Ice serves as a refuge or resting place for many animals, particularly amphipods, worms, and the Arctic cod. The floating ice is as important in this respect as that which is frozen solidly together. No animals use the ice as a place of attachment in the sense that sessile animals use rocks, but they can cling to it, and find shelter in the cracks.

CURRENTS

Not much is known about the currents in the Arctic Ocean. Evidently there is a general flow across the Pole from somewhat off the eastern Siberian coast out past Greenland. Apparently no large gyral is concerned with the circulation of Arctic Ocean water. There are, no doubt, some large eddies, one of which is within the Beaufort Sea. The waters probably flow westward alongshore, turning oceanward at Point Barrow and returning toward shore at a point perhaps as far eastward as Banks Island. Because of the rapid lessening of the lengths of degrees of longitude, the Cariolis force has much more effect in Arctic regions than in lower latitudes, but just how great this is near shore at Point Barrow is unknown.

A great deal of driftwood lands on the beach at Point Barrow. This wood comes either from the east from the Mackenzie or from the southwest from the Yukon, which empties into Norton Sound south of Bering Strait. The Mackenzie is probably the major source, and the wood is carried westward to Point Barrow by the current mentioned above. However, the kelp *Nereocystis,* which does not grow north of Bering Strait, was found on the beach at Point Barrow.

The iceberg (pl. 7) mentioned under "Ice" must have come either from below Bering Strait or from the Canadian Archipelago; it could not have come from Greenland, if the theories presented above are correct.

A few facts regarding the currents in the vicinity of Point Barrow have been ascertained. Along the shore from the Point to the southwestward the prevailing current is northeast; to the east it is northwest. These two currents meet off the Point and flow northward, or, more correctly, north-northeast, for the current to the northeast is the stronger, having at times a speed of 3 miles an hour, or more. They are not steady and are somewhat subject to change by winds. In fact, either may be completely reversed, in which case they are never so strong.

At times in going from shore directly to sea, three definite currents were encountered in succession: first, a slow southwest current perhaps half a mile in width; next, a strong northeast current 6 or 8 miles in width; and then a slow westward current 10 or more miles offshore. The extent of the latter was not determined. Many times it was necessary to give up dredging because the current was stronger than winds of 15 to 20 miles an hour and would set the boat at right angles to the wind and broadside to the waves. This occurred especially during offshore winds.

That all water movement is in general to the northeast can be verified by reference to U. S. Coast and Geodetic Survey map 9445, which shows that the ocean bottom to the north and east of Point Barrow is very shallow, owing to the deposition of materials from the eroding shores, for a long distance oceanward.

As mentioned above, the point at Point Barrow has washed back 28 feet in the last four years. At this rate it is reasonable to suppose that the land extended 504 feet farther north in 1880. That it actually did is borne out by the fact that there is now nothing left of the village of Nuwuk, which was inhabited in 1880, but the remains of two sod houses.

Dall, in his report of 1882 (p. 327), corroborates the above observations regarding currents. He states that the currents along the coast from Point Barrow westward are to the northeast with a velocity of

0.75 to 2 knots an hour. The following tabulation was compiled from his data:

Ship	Date	Rate of drift Knots	Remarks
Contest	8-16-71	1.5	
Jireh Perry........	8-16-72	2.5	15 miles northeast of Point Barrow
" "	7-20-73	2.0	Off Point Belcher. Strong currents.
" "	8-14-73		Could barely get around Point Barrow because of the strength of the current.

In August 1878 the bark *Coral* experienced a 12-day blow from the east, with a resulting current toward the west-southwest. On the twelfth day, when the wind changed from east to southwest, the current also changed within a few hours, running strong toward the northeast, indicating the general tendency of the current to run toward the northeast alongshore at and to the southwest of Point Barrow.

One day when my boatman Max Adams and I had landed at the Point, I mentioned that the current was very strong toward the northeast. Max, who had spent his life boating and hunting at Point Barrow said, "Oh, yes, sometimes he run like river same way."

Ernest F. Chafe (1918) states that the whaler *Karluk* drifted northwest 2 miles an hour from Camden Bay past Point Barrow. Upon reaching the 75th parallel of latitude, it began a southwesterly drift. The ship was abandoned at 73° N., 178° W., at a 38-fathom depth, 80 miles north of Wrangell Island, 200 miles from Siberia.

Dall also mentions logs of whalers that told of shifting from one side of the Point to the other, depending on wind direction, to escape rough seas. That Dall missed no reference to conditions at Point Barrow that could be obtained from logs of whaling vessels and other sources is shown by his reference to an article in the *Daily Alta Californian* of San Francisco, in which Captain Fisher of the *Sea Breeze* is quoted as saying, "Off Point Barrow a 3- or 4-knot current sets regularly along the land northeastward which does not exist 50 miles off shore."

An interesting phenomenon that was noted by the writer, and one that warrants more study, is the current at Eluitkak Pass (fig. 1, *D*) between the mainland spit and Doctor Island. As was mentioned under "Geology," nowhere is Elson Lagoon deeper than 12 feet. Yet the Pass is 46 feet deep in the center, and the current through it is sufficiently strong to scour out all mud from the bottom, leaving only stones and boulders. To the eastward, however, there are openings everywhere, but no sign of currents between the islands. Why does the current run out only at Eluitkak Pass? Although each year the Arctic Contractors cut a channel through the mainland sandspit near the west end of Elson Lagoon almost directly opposite Eluitkak Pass, this channel (see *F*, fig. 1) soon fills in.

Currents are important to the animals of the ocean because they have a great effect on the bottom. If there is little current there is mud; if the current is strong, there is rubble. Each of these bottoms supports a different fauna. The entire bottom has ice-borne gravel and boulders, but only where there are strong currents are the gravel and stones bared so that sessile animals may attach to them.

Currents are also of importance in distributing larvae, though there is reason to believe that they play a less important role in distribution in the Arctic than elsewhere. Evidence for this belief will be discussed under "Distribution."

The possibility of a correlation between currents and weather also exists.

TEMPERATURE (OCEAN)

Daily surface temperatures were kept from July 12 to October 8, 1948, and from July 1, 1949, to September 1, 1950. During this time the extremes were a low of −1.8° C. and a high of 7.2° C. (the latter for only a few hours on August 17, 1949), a difference of 9° C. While the ice was out these temperatures were taken from shore by using a long-handled dipper, but during the winter they were taken through a hole in the ice. The water in the hole was always stirred up from below to get the temperature of the water under the ice or, during melting in spring, by taking water from 10 feet below the surface in order to avoid the fresh water. All deep recording thermometers and bathythermograph records show the ocean water below 100 feet to approximate 0.0° C.

The Bering Sea is somewhat warmer than the Chukchi Sea, and it is possible that currents from the Chukchi may affect the temperatures at Barrow from year to year, but much more work is necessary to establish any such effects.

In his report Dall (1882) gives the average month-by-month temperature of the ocean water at St. Michael in Norton Sound. Between October and July this varied from 0.0° to 1.7° C., but the average for July was 13.3° C., for August 13.4° C., and September 9.8° C. It would be expected that these high summer temperatures would affect the Point Barrow region, but there was no warming of the waters there for the 3- or 4-month period. It is possible that most of the warm water from the region of St. Michael goes to the northwest toward Wrangell Island.

The extremes of temperature experienced by the marine invertebrate animals at Barrow below a depth of 50 feet during the summer of 1948 and the period from June 30, 1949, to September 1, 1950, ranged from a high of 4.1° C. to a low of −1.8° C. recorded, respectively, on September 6, 1949, and July 27, 1950. The variation in temperature at the surface is a few degrees more than that of deeper water. The highest surface temperature in 1948 was 7.0° C. on August 17, but that year floating ice was always present in greater or lesser amounts. In 1949, a surface temperature of 7.0° C. was recorded on August 11, 12, 13, 14, and 16; the highest that year was 7.2° C. on August 17. These temperatures were taken at approximately 5 p.m.; the morning temperature on these days was 6.7° C. These dates were just after the sun began dipping below the horizon. The higher temperatures were very fleeting, usually lasting only a few hours.

The coldest temperature recorded, taken through a hole in the ice, was −2.1° C. from November 13, 1949, until March 22, 1950. From March 23, 1950, to April 16 the temperature was −1.9° C.; on May 30, 1950, it reached −1.5° C., and from then until the time the ice went out it gradually warmed to 0.5° C. In 1949 the surface temperature jumped from −0.4° C. on July 30 to 4.5° C. on July 31. The ice had been gone since the night of July 19.

As explained under the discussion of the natural history of marine invertebrates, there are few animals that are affected by surface temperatures. In general it can be said that the extremes to which the invertebrate animals in the vicinity of Point Barrow are subjected are from −1.8° to 4.0° C., as shown by the writer's records for an entire year and for three summers. This is a range of less than 6.0° C. The following table gives the average monthly records for the time that this investigation was carried on. The twice-daily records for this period were considered too extensive for inclusion in this report, especially since, with the possible exception of some planktonic forms, surface temperature has little effect on the invertebrates of the region.

Table 2 gives the extremes of temperature during the same period covered by table 1.

While the temperature may be 7° C. at the surface, 10 feet down it will be at least 3° or 4° colder. Time and facilities did not permit the routine taking of temperatures at the two most useful depths—50 feet, and on the surface of the bottom.

The frozen ground (permafrost) extends approximately 1,000 feet

TABLE 1.—*Average surface temperature records, Arctic Ocean, Point Barrow, Alaska, August-September 1948, and July 1949 to August 1950*

Year	Month	Temperature °C	Remarks
1948	August	3.30	Floating ice all during summer
	September	—1.06	
1949	July	0.90	No summer ice
	August	5.50	
	September	2.85	
	October	0.02	
	November	—1.80	
	December	—2.00	
1950	January	—2.00	
	February	—2.00	
	March	—1.95	
	April	—1.90	
	May	—1.80	
	June	—0.90	
	July	1.30	No summer ice
	August	5.70	

TABLE 2.—*Highest and lowest surface temperatures, Arctic Ocean, Point Barrow, Alaska, August-September 1948, and July 1949 to August 1950*

Year	Month and day	Highest °C	Month and day	Lowest °C
1948	Aug. 17	7.0	Aug. 28, 30, 31	—0.5
	Sept. 1, 2, 3, 27	—0.5	Sept. 18, 23, 24, 25	—1.5
1949	July 31	4.5	July 29	—1.3*
	Aug. 17	7.2	Aug. 27	2.3
	Sept. 1	6.0	Sept. 26, 27	—0.1
	Oct. 1	1.6	Oct. 24, 27, 31	—1.8
	Nov. 3	0.1	Nov. 17	—2.1
	Dec. 17	—1.9	Dec. 2, 8, 11	—2.1
1950	Jan. all month	—2.0	Jan. all month	—2.0
	Feb. " "	—2.0	Feb. " "	—2.0
	Mar. 1 and 22-31, incl.	—1.9	Mar. 2-21, incl.	—2.0
			Apr. 1-16, incl. and 26-30, incl.	—1.9
	Apr. 17-25, incl.	—1.8		
	May 30, 31	—1.5	May 3-10, incl.	—1.8
	June 20-30, incl.	0.5	June 1, 9	—1.5
	July 24	2.5	July 31	—0.2
	Aug. 19	6.5	Aug. 29	1.2

* Ice floes grounded alongshore.

down. In a well on the beach near Point Barrow it was 960 feet deep. How far this permafrost extends out under the ocean is not known, but as the shoreline at and adjacent to Point Barrow is evidently receding southward and as the ocean water is generally colder than freezing, it ought to be as far out as the shore has receded.

A strong offshore wind would cause considerable upwelling, and on one occasion when it lasted nearly three days, the continuous upwelling brought several deep pelagic animals, including two specimens of the octopus *Cirroteuthis* sp. near shore.

SALINITY

The salinity of the water of the Arctic Ocean is slightly lower than that of other seas. This is attributable to several factors, chief of which are the vast amounts of fresh water flowing into the Arctic and the low rate of evaporation.

Drainage from 4.5 million square miles of territory affects the salinity of the water, but not so much as would be expected with so many large rivers emptying into the sea. It may have more effect to the north of the Siberian coast, where there apparently is a tendency for the waters of Bering Strait to turn out toward Wrangell Island and thus counterbalance the effects of the fresh water from the Siberian streams. Also, it should be remembered that the Arctic Zone is a desert, the precipitation at Point Barrow being only about 4 inches a year, including the snowfall.

Table 3 gives the highest and lowest salinities recorded for each month covered by this investigation.

A comparison of the highest and lowest salinities during August of 1948, 1949, and 1950 is of interest. Ice floes, which were present all summer in 1948, kept the salinity lower than in the summers of 1949 and 1950, when no ice was present. These melt from the bottom and unexposed sides as well as from the top and exposed sides, so that the salinity of the water would be lowered around the floes to the depth that they extend below the surface.

However, the majority of the invertebrates of the Arctic Ocean appear to be adapted to considerable change in salinity and it is only when they come in contact with surface water of very low salinity as the result of melting ice that they succumb. Under "Phylum Chaetognatha" it will be noted that the arrowworm *Sagitta elegans* was able to survive when the salinity of the water reached 15.22 parts per thousand but was killed when it dropped to 5.81. Also, under Annelida mention is made of the polychaetes that were killed during the short time required to haul the dredge through the few feet of surface water of very low salinity. The lower salinity of the water at Eluitkak Pass is probably the main reason for the absence of echinoderms in that locality. It would be interesting to test the tolerance to lowered salinities of a number of Arctic marine invertebrates and of the same species in the North Atlantic and the North Pacific, and compare the results.

The average of the highest salinities is 33.54 parts per thousand. This no doubt approximates, or is perhaps a little higher than, the salinity of the deeper waters of the ocean off Point Barrow. The average for these deeper waters can be determined only by extensive deep-water sampling by a ship with oceanographic equipment.

TABLE 3.—*Highest and lowest surface salinities, Arctic Ocean, Point Barrow, Alaska, July-September 1948, and July 1949 to August 1950*

Year	Month and day	Highest	Month and day	Lowest
1948	July 28	32.37	July 17	5.26
	Aug. 7, 9, 11, 20	30.43	Aug. 4	23.79
	Sept. 27	34.30	Sept. 1	27.67
1949	July 26	35.00	July 13	4.20
	Aug. 24	34.30	Aug. 3	30.40
	Sept. 26	34.20	Sept. 1, 12	32.00
	Oct. 1	34.20	Oct. 21	30.11
	Nov. 8	34.52	Nov. 2	31.10
	Dec. 25, 29	34.30	Dec. 6	30.90
1950	Jan. 6	34.00	Jan. 3	32.60
	Feb. 2	33.40	Feb. 1	28.60
	Mar. 16	32.60	Mar. 2, 5, 6	31.80
	Apr. 7	32.50	Apr. 19	31.80
	May 3, 24	32.40	May 14, 21, 26	32.00
	June 6	33.40	June 16	1.40*
	July*			
	Aug. 4	33.70	Aug. 7	28.00

* Because of the melting ice, the surface water during the latter half of June and until the ice went out in July did not give a true picture of the salinity of the ocean, for it was only slightly salty while the water 10 ft. or more below the surface was much more saline. It was impossible to get out more than once or twice where samples of deeper water could be taken.

LIGHT

On March 22 and September 21 the length of time the sun is above the horizon is equal to the time it is obscured. There are, however, many more than 12 hours of daylight. The sun rises and sets at such a small angle to the horizon that there are 16 hours of daylight on these dates. On June 22 there are 24 hours of daylight, and on December 21 there are about 2.5 hours of twilight. When the sun is on the meridian at noon on June 22 it is 42°10′ above the horizon and at midnight it is still 4°50′ above the horizon. It is continually above the horizon from May 17 to July 24 and continually below it from November 19 to January 20. Because of the refraction of light at the horizon, the sun can still be seen when it is actually below the horizon. Twenty-four hours of daylight does not mean that there are 24 hours of sunlight. During much of the summer of 1948 there was sunshine on the average of about one day a week. The sun may be obscured by clouds all day and appear at 2 a.m. The amount of light depends on the time of day the sun shines as well as on the length of time it shines. If the sun is obscured during the time it is highest and shines when it is near the horizon, there is less light than if it were visible when at its highest and obscured when near the horizon.

There are several factors that influence the amount of light in the ocean waters off Point Barrow:

1. The amount of sunlight.
2. The amount of daylight.
3. The angle with which light enters the water.
4. The wind.
5. The weather ceiling.
6. The amount of ice.
7. The amount of plankton.
8. The amount of sediment in the water.

1 and 2.—Light may be one of the major factors affecting the life of planktonic invertebrates in the Arctic Ocean. Though higher than generally supposed, the metabolic rate of marine invertebrates is relatively slow, thus enabling these animals to live longer under adverse conditions than many other animals. Many of the more active animals, for example certain crustaceans and gastropods, store oil droplets during the optimal conditions of late summer and early fall to tide them over the winter.

Light has little or no effect on the invertebrate bottom animals, because most of this fauna is below 100 feet. The detritus on which these animals feed is not greatly affected, if at all, by light, bacterial action being more dependent upon temperature. As temperature is so uniform in the Arctic, these animals have a constant supply of food independent of light, and are therefore adapted to continuous darkness. The planktonic animals are adjusted to a long period of semi-darkness.

In general the light entering the waters of Point Barrow is by no means so intense as that in more southern regions, but, being present over longer periods, it is sufficient for the photosynthesis of diatoms, which proceeds at an optimal rate in subdued light. Light is exactly the same for any given latitude in all parts of the Arctic Ocean. Even at the Pole, where the sun alternately shines for six months and is below the horizon for six months, periods of twilight help to shorten the time of total darkness to the extent that the growth of diatoms can proceed throughout eight or nine months of the year.

3.—The angle at which the sunlight enters the water ranges from 0° to 42°10′. The greater the angle of the waves to the horizontal the higher the angle at which light penetrates on the side toward the sun.

4.—The wind blows almost constantly at Point Barrow. Since wind causes waves, the stronger the wind, the higher the waves, and consequently the more the light penetration, to a limited extent. When waves are sufficiently high to form whitecaps, light penetration no longer increases with the strength of the wind. Prevailing northeast winds set up wave surfaces toward the sun when it is at or near its maximum height.

5.—The weather is nearly always cloudy during the months of most daylight. This low ceiling has considerable effect on the penetration of light. The fog layer over the ocean is seldom over 20 or 30 feet high. However, since the optimal condition for metabolism in diatoms is subdued light, it is evident that the Arctic is an excellent place for this group, at least during nine months of the year. Certain diatoms were found all winter long under the ice but during midwinter even those that were present were not abundant.

6.—As has been said under "Ice," a considerable amount of the ocean surface is frozen over. In addition to the shore ice, which extends 3 to 5 miles to sea, there is a great deal of floating ice, in which leads come and go. Nevertheless, during winter the ice cover ranges from almost 100 percent over a great portion of the Arctic Ocean to at least 75 percent alongshore, that is, to a distance of 25 miles—the limit of the present investigations. In summer, however, there is a great deal of open water alongshore, and seldom, if ever, is more than 25 percent of the surface covered by ice. The ice, like the weather, is never the same from day to day or from season to season.

At least in the upper surface of the water the ice has much less effect on light than might be supposed. In this investigation both ice houses and tents were used in work on and through the ice. Within a tent in January, even when the ice is 5 feet thick, a greenish glow comes through it from below. The snow cover reflects light but at the same time glows with transmitted light, and much light enters through it into the ice and water below.

7.—The effect of the penetration of light on plankton has been discussed in too many oceanographic papers and books to need elaboration here. Plankton is very abundant at Barrow for that period when there is open water, usually from May to October. In winter, after a hole is made in the ice, the bottom of the ocean can be seen plainly through 16 feet of water.

8.—Sediment is more important than at first might be supposed, for it is a factor in decreasing the penetration of light. The water is muddy to a varying degree almost all summer. This muddiness extends out to sea for a distance of 20 miles or more; at least it is visible to this distance from a plane, and bush pilots flying to the east and west of Point Barrow report this muddy water along the coast for several hundred miles in each direction.

OXYGEN

Oxygen is probably never a problem in the Arctic. Cold water can hold more than warm water, and the high photosynthetic rate of diatoms in summer, waves in the open water, and convection currents keep all parts of the Arctic Ocean well supplied with oxygen.

TIDES, WINDS, AND STORMS

There is no Coast and Geodetic Survey record for tides at Point Barrow, but they are not supposed to exceed 6 or 8 inches. However, wind tides of 3 feet or more are experienced on occasion. Ray (1885) made a 112-day record without missing a day beginning February 26 and ending June 17, a total of 5,376 observations. His gauge was 100 yards from shore in 17 feet of water (no allowance for vertical movement of ice). The average daily variation was 6 to 7 inches, but the level did vary up to 3 feet. Wind tides are mainly responsible for breaking up the ice sheets and piling the ice into ridges.

Because of the unpredictability of windstorms, wind tides may occur at any time, particularly at Point Barrow. As one Arcon employee said when someone spoke of the highly variable character of the weather, "Oh, yes, we make it here and try it out before we send it to all parts of the country."

Windstorms were of importance for two main reasons. No dredging could be done in open water when the wind was above about 15 miles or when it drove the ice to or from shore or piled it up into ridges. The combined effect of wind and current might cause the ice near shore to move in one direction while that farther from shore moved in the opposite direction (see "Currents").

The greatest effect of the wind tides was on the animals within the surf zone. Though few in species, these animals were washed out in great numbers and many of the records of alongshore marine animals were obtained by patrolling the beach after a windstorm.

In winter, stations could be located exactly by survey lines run over the ice, but in summer, because of the prevalence of fog, strong currents, and wind, it was much more difficult to go to a station or to return to a former site.

The northwest current, which turns north at Point Barrow, may have a great deal to do with the deep channel that always exists at Eluitkak Pass. The tendency to turn right, with back pressure from the Beaufort Sea gyral, fills Elson Lagoon, and its only outlet is through Eluitkak Pass. The channel that is dug every year by the Arctic Contractors closes quickly because of the strong alongshore current northeast toward the point. During the writer's stay at Barrow base, the heaviest swells and resulting heavy surf came from the general direction of north-northwest to northwest.

GENERAL DISCUSSION

DISTRIBUTION

One of the main objectives of the study of the marine animals was to determine the species common to Point Barrow and other regions of the Arctic and those common to the Arctic and the North Atlantic and to the Arctic and the North Pacific.

Distribution is to a great extent dependent upon currents (see "Currents"). However, currents are not the only major factor involved. Most students of marine ecology fail to give due credit to the vast scope of geological time for the role it plays in the distribution of species; they have had sufficient time—a billion years of it—to spread to all similar parts of all oceans. Of course, not every species will be found in every part of every ocean. Environments are so different that speciation proceeds with adaptive deployment. If it were not for environmental differences and habitat preferences, no doubt all species would be found in every ocean. After all, most phyla, classes, and orders are worldwide in distribution. Even some species (see "Nemertea") are practically worldwide in their distribution, indicating a very stable inheritance.

The concern here is with the distribution of Arctic Ocean animals where environmental factors are the same, or nearly the same, for all localities of the continental shelf. All species conform to the curve of normal distribution for any factor and the curve is different for each factor. Species of marine animals that have a wide range of tolerance to temperature, for example, would become distributed from the Arctic to North Atlantic and North Pacific regions more readily than a species that has a very narrow range of tolerance to the same factor. When the same species of marine animal is found in both the Atlantic and Pacific, it has migrated through the Arctic unless brought around on a ship bottom or sent overland with oyster spat or other transplants.

The usually accepted premise is that the populations of Arctic marine animals have come from more southern waters. Is this supposition justified? Time is so vast in its scope that little is known of conditions in the Arctic in ages past. Certainly it has been warmer in the Arctic than now—also colder. Perhaps most Arctic marine species did come from the southward, but it is possible that some North Atlantic species and some North Pacific species came from the Arctic; at least, if they are identical in both these regions they must have migrated through the Arctic Ocean. Distribution of marine invertebrates is one phase of the process of evolution, and the collection of data that will support or disprove theories of distribution in the Arctic is essential to determine what part it has played in the establishment of present-day deployment and species. It is hoped that this report will offer some evidence that will assist in arriving at conclusions.

Within a human generation animals introduced to new coasts have become distributed 1,000 miles or more. For example, within about 25 years since it was introduced from Europe, a littorine snail has spread along much of the east coast of the United States. If it deployed but 5 feet a year, how long would it take a species to become circumarctic? The 75th parallel is approximately 1,250 miles long. Since deployment takes place in all directions (in this surmise only two, east and west, are considered), the time required for meeting on the opposite side would be equal to 625 miles times 5,280 feet divided by 5 feet or approximately two-thirds of 1 million years. There are 1,000 million in 1 billion, or 1,500 times two-thirds of a million—in other words, the required time would be 1,500 times as long as is necessary.

Practically all marine invertebrates have either swimming larvae or means of locomotion as adults, and for such animals 5 feet a year is far too low an estimate of the rate of distribution. Even those sessile animals without free-swimming larvae certainly can average, over a period of years, more than 5 feet a year. At some stage the larvae become detached from the parent, and as tiny animals they are moved about by the activities of other animals before becoming sessile. In the Arctic such larvae or even small to adult animals may be pushed many yards by ground ice. To a depth of 100 feet or more in the bottom off Point Barrow there are holes (that have been gouged out by ice) 6 feet or more below the surrounding bottom level. Although they are uncommon off Barrow, icebergs (pl. 7) grind and shove material along the bottom for a mile or more to where the water is about 200 feet deep. No doubt if one were able to live among the animals on the floor of the Arctic Ocean shelf, other factors contributing to distribution would be found.

Today ship bottoms provide a medium for the dispersal of species. This factor is more important outside the Arctic Ocean than within it, although whalers have been anchoring off Point Barrow and farther east for over a hundred years. Some whaling vessels froze in at Herschel Island for three winters in succession before obtaining a cargo of oil and whalebone. A ship bottom can become quite foul in six months. How many Arctic animals would such a ship carry into the Pacific?

The conditions in the Arctic Ocean are so stable and show such a small degree of variation that an animal living in one place on the Continental Shelf could find equal optimal conditions at any other point with similar bottom within the ocean on the shelf. Nothing is known of the fauna of the deeper Arctic Ocean bottom.

To verify my theory that the Continental Shelf of the Arctic Ocean is a unit environment, it would be necessary actually to measure ecological factors and sample the animal population at a sufficient number of places to show that all equivalent parts of the shelf support the same associated types.

A common practice among marine ecologists is to consider the ocean bottom as unchanging aggregations of animals. Nothing is farther from the truth. In checking the bottom off Newport Bay, Calif., near the Kerckhoff Marine Laboratory, the writer has found that between 1948 and 1952 the type of animals once found in certain regions has entirely changed. At Point Barrow there was an indication of why the bottom there would change materially over considerable areas (see "Winter Dredging"), although the general picture of the region and the whole Continental Shelf of the Arctic Ocean would remain the same. In the fall of 1949 a layer of mud killed off what most people would call an anemone-*Strongylocentrotus–Psolus* association. Whether it will come back the same or as a *Strongylocentrotus–Psolus*–anemone, or a *Psolus*–anemone–*Strongylocentrotus,* or some other combination of the three is anybody's guess. Perhaps it will become something entirely different, such as a *Balanus crenatus–*

Hiatella association. However, the proportions of these animals throughout the Arctic shelf will remain fairly constant over long periods of time—for a million years or more if no great climatic change takes place. Establishing a balance among the fauna of the Arctic Ocean has required many millions of years, and what occurs in a small locality like Point Barrow has little or no bearing on this balance. If one is to have a better understanding of the evolutionary processes concerned with the marine animal population, distribution and deployment from the point of view of the entire Arctic shelf must be considered.

A comparison of the records obtained at Point Barrow with those of other investigators of the Arctic Ocean shows that such factors as climate, vegetation, geology, ice, currents, temperature, salinity, light, oxygen, tides, wind, and storms are quite uniform for the entire area of the shelf. Therefore a marine animal adapted to one place on the shelf is adapted to all regions of the shelf. If it can be proved that animals found in one locality of the Arctic shelf are found in all similar localities, then a knowledge of distribution is most important to our understanding of how the fauna of the Arctic shelf became established and what to expect in future evolutionary trends.

The greatest merit of the Point Barrow investigation has been its contribution toward verifying these theories. The distribution of all adapted forms is proving to be quite uniform, although many more localities around the basin need thorough investigation. An intensive survey of the Continental Shelf bordering the Laptev Sea would be of value equal to the one done at Barrow.

If a comparison can be made with Scandinavian collections in order to eliminate uncertainties regarding names, a table could be made showing species common to both Point Barrow and the North Pacific and those common to Point Barrow and the North Atlantic. Such a table would be of great value in furnishing evidence of the rates of distribution between the three areas. It would help to answer such questions as the following:

1. Does the continuous flow of ocean water northward through Bering Strait inhibit the distribution into the North Pacific?
2. Is the rate of distribution into the Arctic from the Atlantic greater than from the Pacific into the Arctic?
3. Is there any distribution of strictly Arctic animals from the polar regions into the North Atlantic?
4. Is there any evidence that ship bottoms play a part in distribution?
5. Is there evidence to show that it is easier for distribution to proceed from a warmer to a colder habitat or vice versa?

Distribution depends more on the larvae's than the adults' becoming acclimatized to new environments. If marine animals can do anything well it is to reproduce—sometimes at the rate of half a billion per year (Galtsoff, 1930; MacGinitie, 1934). Because of the advantages of constant immersion in sea water and an enormous rate of reproduction the distribution of marine animals into or out of the Arctic should not require a long evolutionary process. However, this would be different for each species just as the rate of reproduction is different for each species; and the rate of evolutionary change is not necessarily proportional to the number of offspring. Some groups of animals are much more adaptable than others in their ability to evolve into new species. Some species live a few years; others many. Some groups (e.g., brachiopods) are in general inclined to stick to an orthogenetic line while others (e.g., certain snails) become adapted readily to a new environment. In other words, evolution is a slow process in some groups and relatively rapid in others, with corresponding effects on distribution. Distribution, therefore, furnishes as much information regarding evolutionary development as do almost any other data.

FOOD

The writer classifies the food of marine animals under five headings, which are listed in the order of their relative abundance: 1, Plankton; 2, detritus; 3, other animals; 4, debris; 5, seaweeds. Actually a sixth could be given—self-cultured algal cells, used by the flatworm *Convoluta roscoffensis* and the clam *Tridacna*.

Plankton furnishes food for one great group of marine animals—the pelagic or free-moving marine animals living in the ocean above the bottom. This group, from the tiny microscopic larvae to great sharks, is dependent directly or indirectly on the diatom pastures (which form an important part of the plankton) of the oceans. In the waters off Barrow base plankton is extremely plentiful in summer and great swarms of euphausiids (krill), mysids, pteropods, and copepods are present. This abundance of food accounts for the migration of the baleen whales into the Arctic each summer. Since plankton is not so abundant in winter, many invertebrates as well as vertebrates of the Arctic store food in the form of oil or fat.

Another great group feeds on detritus. It includes the burrowers and semiburrowers of the ocean bottom, together with many sessile animals that are anchored in the mud. In rocky regions where the bulk of animal life is sessile, both plankton and detritus may be used indiscriminately, for both consist of finely divided food particles.

Plankton is mainly diatoms, and detritus is mainly bacteria and microscopic plant material being used for food by bacteria. Seaweeds per se are little used as food, but when they are broken down to microscopic or nearly microscopic size and are decomposing they, along with the great bulk of bacteria feeding on them, form detritus. Practically all bottom-dwelling animals feed on detritus. Detritus even forms coatings on the surfaces of sand grains. Therefore any mud- or sand-ingesting animals live on detritus, and many are equipped with special devices for straining this from bottom surfaces with a minimum intake of mud or sand. The more finely divided the sediment, the greater the surface, and, since marine bacteria live only on surfaces, the greater the opportunity for bacteria to exist. Therefore it can be said that in general mud is richer in detritus than sand. The richness of the detritus depends on the settling out from the water of organic material and, therefore, detritus is richer close to shore, especially in the vicinity of river mouths. The suspended material in the muddy water of the ocean bottom is mainly detritus, which is constantly being stirred up by the movements of animals, by currents, or the activities of the detritus feeders themselves. Near shore it is churned up by the surf. Even some vertebrates, such as the shovel-nosed shark or bat stingray, are indirectly dependent on detritus for food, as they dig for and feed on clams and worms that feed directly on detritus.

As there are no seaweeds to speak of in the region of Barrow, the writer wondered where the detritus came from, but in the fall of 1949 this question was answered by the entrance of great quantities of tundra plants into the ocean waters from the eroding shores. Any plant material will form food for marine bacteria and, therefore, will produce detritus. Within a month enough plant material to supply detritus for several years was washed into the ocean and drifted over a great area. There is certainly an overabundance of detritus in the Arctic off Barrow, and the food of Arctic animals is far in excess of their needs.

The feeding habits of Arctic invertebrates, with examples of animals living on the different types of food, may be summarized as follows:

All free-moving invertebrates surrounded entirely by water above the bottom are *plankton feeders,* directly or indirectly. Conspicuous among these are jellyfishes, ctenophores, and certain amphipods.

The majority of the bottom dwellers are *detritus feeders,* directly or indirectly. These include echiuroid and sipunculid worms; certain polychaete worms such as *Arenicola,* cirratulids, and terebellids; clams, bryozoans, and Foraminifera.

Predators, or those feeding on *other animals,* are either pelagic or bottom-dwelling, but seldom, if ever, both. The first are indirectly dependent on diatoms, and include jellyfishes, ctenophores, and chaetognaths. The latter are indirectly dependent on detritus, and include starfishes, flatworms, sea anemones, certain isopods, amphipods, and crabs, and certain snails such as *Natica* and *Polinices.*

Debris feeders, or scavengers, are bottom dwellers feeding at the surface on larger particles of plant or animal debris. These are exemplified by sea urchins, crabs, hermit crabs, and some snails.

Seaweed feeders are very rare.

No *commensal algal* feeders are known to live in the Arctic.

ABUNDANCE OF ANIMALS

The abundance of marine animal life at Point Barrow, especially in the rubble zone, was little short of astonishing. There are far fewer species of marine invertebrates in the Arctic than in the equatorial, tropical, or temperate regions, but in general individuals of species occur in far greater numbers. For example, as has been mentioned elsewhere, there are swarms of mysids, euphausiids, pteropods, and copepods. In addition to these, there are great numbers of jellyfishes (*Aurelia* and *Cyanea*), ctenophores (*Beroë* and *Mertensia*), and chaetognaths, although the last are probably often as abundant in the north-temperate waters as they are in the Arctic. Individuals of a number of species of bottom dwellers are numerous; and in certain areas of the rubble zone there are large numbers of sea anemones, sea urchins, sea cucumbers, bryozoans, barnacles, and sponges. Where the stones of the rubble are small, the clam *Hiatella arctica,* barnacles, and bryozoans are extremely abundant.

Because of the difficulty of dredging in the blue-mud zone it is impossible to give any estimate of the abundance of animals living within the mud, but on the surface were found two species of crabs, *Chionocetes opilio* and *Hyas coarctatus alutaceus,* and one hermit crab, *Pagurus trigonocheirus,* that were particularly abundant. During the summers of 1949 and 1950 when the ice was far offshore, the heavy surf disturbed the bottom sufficiently to furnish some idea of the marine population in this mud zone, for certain burrowing forms were washed ashore in large numbers. Among these were the echiuroid worm *Echiurus echiurus alaskanus,* the polychaete *Arenicola glacialis,* two species of burrowing anemones, and two species of mud-dwelling tunicates.

Two species of amphipods, *Melita formosa* and *Anonyx nugax,* were washed ashore in such immense numbers that they formed windrows along the beach.

In order to obtain a more objective idea of the abundance of marine invertebrates at Point Barrow, a rock with an average amount of growth was measured, and the animals living on it were removed, preserved, and then identified and counted. This rock, which was dredged on September 6, 1949, from a depth of 217 feet, was 22.5 cm. long, 13.5 cm. wide, and 6.7 cm. thick. The following is a list of the animals taken from this rock:

Animals from measured rock	Number and description
Coelenterates (4+ sp., 11+ spec.)*:	
Hydroids	Several colonies
Eunephthya rubiformis	7 colonies (measuring, in mm., when contracted, 8 x 4, 8 x 3, 7 x 4, 6 x 5, 5 x 5, 4 x 4, and 4 x 3)
Sea anemone	1 (9 mm. high by 10 mm. diam.)
Nemerteans (3 sp., 6+spec.):	
Tetrastemma sp.	2+
Amphiporus pacificus	3+
Micrura alaskensis	1
Bryozoans (several sp.):	Several encrusting colonies
Annelids—Polychaetes (21 sp., 65 spec.):	
Polynoidae	
Gattyana cirrosa	3
Harmothoë extenuata	4
Sigalionidae	
Pholoë minuta	1
Syllidae	
Autolytus alexandri	1
A. fallax	1
Eusyllis blomstrandi	1
Exogone dispar	2
Sphaerosyllis erinaceus	12
Syllis cornuta	5
S. fasciata	5
Phyllodocidae	
Eteona flava	1
Mystides borealis	1
Spionidae	
Polydora caulleryi	4
Cirratulidae	
Chaetozone setosa	6
Cirratulus cirratus	7
Capitellidae	
Capitella capitata	3
Terebellidae	
Amphitrite cirrata	1

* sp. = species; spec. = specimens.

Animals from measured rock	Number and description
Annelids—continued	
Terebellidae—continued	
Lanassa venusta	1
Proclea graffi	2
Sabellidae	
Chone duneri	2
Sabella crassicornis	2
Echinoderms (1 sp., 1 spec.):	
Ophiuran	1 (young, with disk 1.5 mm. diam.)
Crustaceans (7 sp., 14+ spec.):	
Cirripedes	
Balanus crenatus	Numerous specimens 1 mm. across base; 2 (4 mm. and 2.5 mm. across base)
Copepods (1 sp., 2 spec.):	
Doropygus sp.	2 (1 female in each of two tunicates, *Boltenia echinata*, measuring 25 x 17 mm. and 18 x 14 mm.)
Amphipods (5 sp., 53 spec.):	
Maera danae	2 (1 male, 1 ovig. female)
Protomedeia fasciata	1
Ericthonius hunteri	4 (2 males, 2 females with young just ready to hatch)
Unidentified	1
Caprellid	1
Mollusks (2 sp., 3 spec.):	
Hiatella arctica	2 (4.3 mm. and 7.5 mm. long)
Lepeta caeca	1 (8.5 mm. long)
Tunicates (6 sp., 41 spec.):	
Didemnum albidum	8 colonies (measuring, in mm., 18 x 12, 17 x 10, 14 x 8, 12 x 7, 11 x 8, 11 x 7, 8 x 7, 5 x 5
Dendrodoa sp.	1 (52 x 22 mm.)
Styela sp. (or *Dendrodoa* sp.)	4 (15, 11, 10, and 7 mm. high)
Styela sp. (or *Dendrodoa* sp.)	13 (20, 17, 15, 15, 14, 11, 10, 9, 8, 7, 2.5, 1.5, and 0.75 mm. high)
Chelysoma macleayanum	3 (21 x 14, 18 x 14, and 5 x 4 mm.)
Boltenia echinata	12 (length x height, 28 x 19, 25 x 17, 19 x 15, 18 x 22, 18 x 14, 17 x 21, 15 x 20, 11 x 18, 7 x 7 mm., and 3 young individuals from 5 to 6 mm. long)

One face and four sides of this rock formed the habitat for more than 200 individuals and colonies representing over 53 species. These were growing on a surface of 786.15 square centimeters or approximately 125.78 square inches, a surface equivalent to an 11-inch square.

Another indication of marine invertebrate abundance was the identification by Dr. Osburn of 21 different species of bryozoans from two faces of a single valve of *Pecten islandicus*.

With such a dense population, attachment space is at a premium; consequently almost no sessile animal or colony of animals is without its quota of other animals growing upon it. Hydroids commonly have other hydroids, bryozoans, foraminifers, and tunicates, such as *Molgula griffithsi* and *Boltenia ovifera,* growing on them. The asexual form of the syllid worm *Autolytus fallax* was frequently found with its tube attached longitudinally to the chenille-like stems of the hydroid *Lafoeina* (possibly *maxima* Levinsen). The long, straw-colored stems (up to 150 mm. in length) of a species of *Tubularia* were often supported by the mud-tube nests of the amphipod *Ericthonius tolli* forming a mass surrounding the stems. In one such mass a sipunculid, *Golfingia margaritacea,* was living in one of the mud tubes, and an annelid, *Thelepus cincinnatus,* was living in its coarse-sand-encrusted tube twining among the stems of the hydroid.

Both erect and foliaceous, as well as encrusting, bryozoans are favorite places of attachment for foraminifers, hydroids, other bryozoans, and tunicates. A colony of *Eucratea loricata,* dredged from 213 feet, had the following animals growing on it: Foraminifers; the bryozoans *Hincksina nigrans* and *Costazia nordenskjoldi;* caprellids; a tunicate, *Styela rustica macrenteron,* that was 6.1 mm. long; and a small clam, *Hiatella arctica.*

Tunicates also afford a place of attachment for a variety of animals. The tunic is sufficiently plastic for foraminifers to form depressions to fit their tests. On a specimen of *Dendrodoa* measuring 35 by 16 mm., taken from a depth of 130 feet, the following animals were found: One colony of the bryozoan *Eucratea loricata* 22 mm. high; several colonies of the compound tunicate *Didemnum albidum,* 3 to 5 mm. in diameter; nematodes; foraminifers on the tunic of *Dendrodoa* and on the attached *Eucratea;* two small *Dendrodoa;* one cirratulid, *Chaetozone setosa;* one colony of the bryozoan *Tubulipora flabellaris;* one hydroid colony; one sponge spreading over *Eucratea;* one sponge on the *Dendrodoa;* one small clam; and several species of encrusting bryozoans.

Even nonsessile animals often furnish a place of abode for other animals. Snails of the genera *Buccinum, Neptunea, Volutopsius,* and *Boreotrophon* seldom are without a colony of hydroids (*Hydractinia*), bryozoans, or barnacles growing on their shells.

The legs and carapaces of the crab *Hyas coarctatus alutaceus,* especially the ovigerous females, furnish places of attachment for many sessile forms, which in turn furnish refuge or places of abode for still other animals. An ovigerous female taken on September 9, 1948, at 80 feet was carrying on its carapace colonies of the bryozoan *Dendrobeania murrayana,* colonies of three or four species of calyptoblastic hydroids, and at least one species of gymnoblastic hydroid. From two other ovigerous females taken in this same haul the following animals were taken: 2 species of amphipods (4 or 5 individuals); 1 pycnogonid; 1 four-legged pycnogonid larva; 3 or 4 small annelids, *Eusyllis blomstrandi* and *Exogone naidina* (one in the eye socket); colonies of the bryozoans *Tricellaria erecta* and *Eucratea loricata;* 3 caprellids; and colonies of several species of hydroids. The crabs were completely covered and concealed by their epifauna. A male with a carapace 17 mm. long that was taken on September 6, 1949, at 217 feet had several small colonies of the octocoral *Eunephthya rubiformis* on its carapace. An ovigerous female taken on October 14, 1949, at 175 feet, had the following on its carapace and legs: Young barnacles 1 mm. in diameter; 1 *Balanus crenatus* 10 mm. in diameter; nematodes; caprellids; the annelids *Spirorbis spirillum, Pista maculata* (small), and *Harmothoë extenuata;* colonies of several species of hydroids; foraminifers; and the bryozoans *Tricellaria erecta, Dendrobeania murrayana, Scrupocellaria scabra* var. *paenulata, Hincksina nigrans, Lichenopora verrucaria, Eucratea loricata,* and *Callopora craticula.*

STORAGE OF OIL

A common occurrence among Arctic marine animals is the storage of oil within their bodies for the purpose of tiding them over the winter or for producing during the winter sperm and eggs that can be laid at the beginning of the open season. This phenomenon was especially noticeable among the copepods, for they are small and often so transparent that the oil droplets could be seen through the integument. Toward the end of the open season more and more oil droplets were observed within the copepods, and, conversely, in April the oil droplets began to decrease in number and size. Some copepods taken on May 2 were still well supplied with oil droplets. By the latter part of June these animals were so transparent that they seemed to consist of nothing but the integument—not a single oil droplet remained.

The practice of storing oil is no doubt as common among the amphipods as among the copepods, but the larger size and usually more opaque integument of the amphipods make the oil droplets invisible or more difficult to see. On October 4, 1949, many females of *Anonyx nugax* washed ashore. They had just molted, and the new integument was sufficiently transparent to reveal many oil droplets in their bodies. In three out of six females of this species taken on January 27, 1950, oil droplets were conspicuous. Similarly, of three females of *Weyprechtia heuglini* taken on June 23, 1950, the two largest were developing marsupiums and their bodies were filled with oil. This oil was undoubtedly being used in producing eggs that could be laid when the marsupiums were fully developed.

The shrimp *Eualus gaimardi* was an excellent animal in which to observe the storage of oil and its subsequent use. It was present in practically every dredge haul and in sufficient numbers to lend value to the observations made on it. Its integument is always more or less transparent, but in the fall specimens of this shrimp were so filled with stored food that they were quite opaque. From February until July specimens were taken through the ice by means of screen traps. The first specimens taken showed small ovaries in the process of developing. In specimens taken on subsequent months the ovaries were larger and larger and the shrimps became more and more transparent as the amount of stored oil diminished. By the end of June the ovaries were filled with well-formed, distinct eggs and the bodies were so transparent that there seemed to be nothing within them except the masses of eggs. A soft-shelled female was taken on July 22, 1950, and on August 1, 1950, a total of 15 ovigerous females with eggs in very early stages of development and another female that was obviously just ready to lay its eggs were collected.

An analysis of the oil content of various animals throughout the year would undoubtedly reveal that the storage of oil is a common practice and is developed to a high degree among Arctic marine invertebrates.

REPRODUCTION PHENOMENA

Although years would be required to obtain a knowledge of the methods of reproduction, the egg-laying season, and the size of the eggs of the animals collected, a few facts became evident in the short time devoted to this phase of the project.

Perhaps the most noticeable of these reproductive phenomena is the tendency among Arctic marine invertebrates to brood their eggs or to provide some other method of protecting them until the embryos develop either into large larvae or young animals similar to the adult. Thorson (1936) has already observed the practice among Arctic gastropods of laying eggs in capsules or in masses of jelly in which the young develop either to the crawling stage or to a late embryonic state with a shortened pelagic life, in marked contrast to the tendency among temperate, equatorial, and tropical species to lay smaller eggs that produce embryos requiring a relatively long pelagic life. Growth of nonpelagic embryos to an advanced stage is accomplished by the production of large eggs, or eggs from which the embryos develop within the mother, or by the feeding of embryos on nurse eggs or on a nutritive white material.

Capsules and masses of jelly containing snail eggs were abundant and varied at Point Barrow. Few gastropod larvae were observed in the plankton. Most of the data collected on the breeding season of the gastropods are contained in table 4 (p. 41).

At Point Barrow other invertebrates besides snails brood their eggs. The large chaetognath *Eukrohnia hamata* was observed brooding its eggs until the young were 3 mm. in length. No other instance of the brooding of eggs has been reported in this group of animals.

Several of the polychaete worms carry their eggs or incubate them in some manner. *Autolytus fallax* carries its eggs ventrally in an egg sac (usually one, sometimes two), and *A. alexandri,* according to Wesenberg-Lund (1947), carries its eggs ventrally in two egg sacs. *Sphaerosyllis erinaceus* carries its eggs attached to its dorsal surface between the neuropodia and dorsal cirri (1 to 4 eggs per segment on setigers 8 to 24). *Exogone naidina* carries its eggs attached to its ventral surface on about 7 to 14 segments (usually 4 per segment, but sometimes 1 to 3 per segment). In all four of these worms the eggs are retained until they hatch into young worms. *Potamilla neglecta* deposits its eggs on the inner surface of its tube, about one-third of the way down, and then secretes a thin, transparent membrane between itself and its eggs. *Spirorbis granulatus* incubates its eggs in a large brood pouch in the operculum, and *S. spirillum* incubates its eggs within its tube.

The leech *Crangonobdella murmanica* lays a large egg in a capsule that is attached singly to the host. The egg develops into a young worm before hatching.

The clam *Musculus corrugatus* lays large eggs within the byssal capsule with which it surrounds itself prior to spawning. The eggs remain inside the capsule until they develop into young clams. Although no individuals of *M. laevigatus* were found with eggs within their capsules of byssus threads, it is obvious that this clam also retains its eggs, for none of the younger specimens were within a net, or capsule, whereas individuals 20 mm. or more in length that were surrounded by such a byssal net were not uncommon.

It also appears probable that the clam *Cardita crassidens* has some arrangement for caring for its eggs, probably retaining them within the mantle cavity until young clams are formed, for unusually large eggs—from 753 to 761 microns in diameter—were found in several individuals. These eggs were largely yolk.

Brooding of eggs was practiced by the tunicates also. On October 6, 1949, a specimen of *Dendrodoa grossularia* was found in which the atrial cavity was filled with eggs of a large size.

The production of large eggs by Arctic marine invertebrates is essential to brooding, for if the embryo is to develop to the crawling or other advanced stage before hatching, it must be supplied with a large yolk for growth.

Among the most surprising of these large eggs were those of the echiuroid worm *Hamingia arctica,* which were 900 microns in diameter and which perhaps accounted for the unusually large trochophore larvae that were occasionally found in the plankton.

Although the eggs of *Eukrohnia hamata* were not seen, they must, in order to produce embryos that were 3 mm. in length, have been large for a chaetognath. The same deduction can be made for the eggs of the leech mentioned above.

Several of the polychaete worms produce large yolky eggs, e. g., *Autolytus fallax. A. alexandri, Sphaerosyllis erinaceus, Exogone naidina, Eusyllis blomstrandi, Capitella capitata, Nicolea venustula, Lanassa venusta, Polycirrus medusa,* and *Potamilla neglecta.*

Many of the amphipods have exceptionally large eggs for the size of the animal. For instance, females of *Unciola leucopis* only 12.5 to 14 mm. in length produce eggs that are 0.7 mm. in diameter and from which emerge larvae 2.7 mm. in length; and *Photis reinhardti,* with females from 4.5 to 5 mm. in length, has eggs 0.5 mm. in diameter. In *Ischyrocerus commensalis* one female 3 mm. long was carrying 3 eggs 0.3 mm. in diameter, and another 5 mm. long was carrying 15 eggs that were nearly 0.5 mm. in diameter; in *Eurystheus melanops* females from 3.5 to 8 mm. long were carrying from 3 to 10 eggs from 0.4 to 0.5 mm. in diameter.

The eggs of the clam *Musculus corrugatus* measuring about 500 microns in diameter, and of the clam *Cardita crassidens* measuring from 753 to 761 microns in diameter, have been mentioned above.

In the gastropods large embryos may result from the production of large eggs or from the production of a large number of small eggs in which only a few hatch into embryos that feed on the undeveloped eggs. In still other instances eggs are provided with a nutritive substance similar to egg white upon which the developing embryos feed. Some of the species produce large eggs that are retained, probably within the pallial cavity, until the embryos are in the crawling stage. By any of these methods the end result is large embryos. Snail embryos from 3 to 15 mm. in height are not uncommon.

The tunicate *Dendrodoa grossularia* produces eggs that are 0.25 mm. in diameter.

Although many of the marine invertebrates lay eggs at the beginning of summer, preparation for egg laying at this time must take place during the winter. Such preparation consists in the development of functional eggs and sperm. And this in turn must be preceded, in many instances at least, by the storage of oil during the summer for use in the production of eggs during the winter (see *Eualus gaimardi* under "Storage of Oil").

As soon as the ice goes out there are snail egg capsules in abundance. These must have been deposited during spring. The only other alternative is that they were deposited in the fall and development was slow or delayed until spring.

Although most of the egg capsules could be identified as to genus, only a few of them could be assigned to their proper species. In several instances in which the species could be recognized, it was noted that capsules with well-advanced embryos were present as soon as the ice went out and that freshly deposited capsules appeared throughout the summer and as late as the middle or end of October. It is possible that those capsules that were deposited in October were the ones containing well-advanced embryos late in July or early in August. Whether the same individual snail lays eggs more than once a year was not determined. It is possible that a snail that lays eggs in October could lay again in June or July provided that during the summer, at the same time it was producing eggs to be laid in October, it could also be storing oil to be used during the winter for producing eggs to be laid in June or July, or that it could find sufficient food during winter to produce eggs. But it seems improbable that any one snail reproduces more than once a year. From the slowness with which gonadal development took place in certain species that could be watched (the shrimp *Eualus gaimardi,* for instance) it seems doubly improbable that many species of the higher invertebrates, at least, could be capable of reproducing more than once a year.

Throughout the winter of 1949-50 the larvae of the pteropod *Clione limacina* were always present in plankton tows. During the entire winter there was no perceptible increase in size of these larvae, but in June larger larvae appeared, and on July 20 larvae 7 mm. long and adults 30 mm. long were taken. The 7-mm. larvae were still using cilia, for the wings were not sufficiently developed for locomotion.

In some of the pelagic invertebrates, such as jellyfishes, ctenophores, and chaetognaths, there are undoubtedly several generations a year, although the same individuals probably do not reproduce more than once. In all three of these groups both larval forms and adults, with all intermediate stages, were often present at one time.

Both budding and sexually mature hydromedusae were found throughout the summer months. Plankton tows during winter were not extensive enough for obtaining information on the development and reproduction of these forms during that season.

The jellyfish *Chrysaora* sp. contained eggs and swimming larvae on November 19, 1949. The commonest sea anemone (*Stomphia coccinea*) of the region was filled with large eggs on October 14, 1949. Would these develop into swimming larvae during the winter or would they be retained within the sea anemone until spring before becoming swimming larvae?

A large percentage of the bryozoans collected during February contained eggs. It is probable that these eggs were produced from food stored during summer and that the larvae would be released at the beginning of the open season.

The development of one species of polychaete worm was followed sufficiently to give information on how long the eggs are carried inside the body. The syllid *Autolytus fallax* Malmgren was found with large eggs inside the body on October 11, 1949. On January 25, 1950, a few specimens were found carrying egg sacs in which there were developing embryos, and on March 29, 1950, and April 7, 1950, there were hundreds of these worms swimming around with their egg sacs. The egg sacs from individual worms contained eggs and embryos in varying stages of development. Thus from the time large eggs were seen within the bodies of *Autolytus fallax* to the time when the majority of these worms were carrying sacs containing eggs, or developing embryos, a period of 5 to 6 months had elapsed.

Data on related forms are given in table 4.

Female stolons of the related *Autolytus prismaticus* were found on August 6 and 30, 1948, with eggs massed inside their bodies. A female stolon of *Autolytus alexandri* with swimming setae and with the body filled with eggs was dredged on February 18, 1950. Females of *Cirratulus cirratus* with eggs inside their bodies were found from the first week in August until the first week in September. A male of the sabellarid *Idanthyrsus armatus* Kinberg spawned August 9, 1949. The terebellid *Terebellides stroemi* M. Sars had ripe eggs and sperm on September 26, 1949, and *Potamilla neglecta* M. Sars was found incubating eggs on September 6, 1949. The terebellid *Thelepus cincinnatus* (Fabr.) had ripe eggs and sperm on October 11, 1949.

Developing worms were found in the egg capsules of the leech *Crangonobdella murmanica* Selensky on October 11, 1949. Would these emerge during the winter or would they remain in the capsules and emerge about the beginning of the open season? Three species of cumaceans were found with eggs in the marsupiums in September and October, and a number of amphipods were ovigerous during the winter (see table 4 for data). Numerous amphipods, certain isopods, and the mysid *Mysis oculata* were carrying freshly deposited eggs about the middle of October or later.

The fact that the clam *Cardita crassidens* had large eggs within its dorsal mantle cavity on October 11, 1949, suggests that this clam broods its eggs during the winter and releases young clams at the beginning of the open season or before. That the tunicate *Dendrodoa grossularia,* which was found filled with large eggs on October 6, 1949, also broods its eggs during the winter and releases large larvae at the beginning of the open season is also a possibility.

Data obtained on the eggs and breeding seasons of the animals are included in the discussion of the various groups of animals beginning on page 115. However, the principal information there presented is summarized in table 4, below. In some instances too few animals of a species were taken to provide information on the breeding season. In other instances the impossibility of identifying the animals prevented the keeping of records. When all the animals collected are identified, future workers will be enabled to keep more complete records on habits and breeding seasons.

TABLE 4.—*Data on eggs and breeding seasons*

Animal	Date	Remarks
Coelenterates:		
Hydroids		
Hydractinia sp.	8-10-48	Gonophores present
Corymorpha sp.	7-21-48	" "
Garveia sp.	10- 6-49	" "
Sertularella sp. ?	9- 6-48	" "
Sertularia sp.	10- 6-49	" "
	10-14-49	" "
Thuiaria elegans	8- 9-49	" "
	8-30-49	" "
T. lonchitis ?	8-21-48 to	" "
	9-15-48	" " (not so plentiful)
Hydromedusae		
Bougainvillea superciliaris	7-23-50	Appeared to be sexually mature
Rathkea octopunctata	8- 6-48	Budding
	7-13-50	"

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Coelenterates—continued		
Hydromedusae—continued		
Obelia sp., medusa	8- 6-48	Spawned eggs
Aglantha digitale	8- 6-48	Mature gonads
Scyphomedusae		
Cyanea capillata	8- 2-48	Ephyra stage
	8-16-48	" "
	9-30-49	" "
	10-17-49	Postephyra stage
	11- 4-49	" "
Chrysaora sp.	11-19-49	Eggs and larvae
Anthozoans		
Stomphia coccinea (sea anemone)	10-14-49	Many large eggs (697 microns) visible through body wall
Nemerteans:		
Amphiporus lactifloreus	9- 9-48	Large eggs within body
Echiuroids:		
Hamingia arctica	8-10-50	With large eggs (900 microns)
Chaetognaths:		
Sagitta elegans	July	Gonads immature (possibly others with mature gonads)
Eukrohnia hamata	9-27-48	Brooding young
Brachiopods:		
Diestothyris spitzbergensis	2-18-50	9 with eggs (195-227 microns), 1 with sperm
Bryozoans:		
Eucratea loricata	8- 6-48	With eggs
Carbasea carbasea	10- 6-49	With active sperm
Tricellaria erecta	10- 6-49	" " "
	2-18-50	With brown bodies
	8- 5-50	" " "
Dendrobeania murrayana	10-14-49	Full ooecia
	10-14-49	With brown bodies
Costazia ventricosa	8-17-49	With eggs
	10-11-49	Ovicells present
Alcyonidium polyoum	10-14-49	Eggs 112 microns in diameter
	2-14-50	Ovicells present
Crisia cribraria	8-10-48	With eggs
Annelids:		
Polychaetes		
Melaenis lovéni	10- 4-49	Developing eggs
Castalia aphroditoides	4- 7-50	Apparently mature eggs inside body

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Annelids—continued		
Polychaetes—continued		
Autolytus fallax	10-11-49	Eggs inside body
	1-25-50	Egg sac with developing embryos
	3-29-50	Hundreds with egg sacs
	4- 7-50	" " " "
	4-15-50	Many with egg sacs
	5-17-50	Several with egg sacs
A. alexandri	2-18-50	Female stolon with swimming setae, and body filled with eggs
A. prismaticus	8- 6-48	Female stolon with eggs massed inside body
	8-30-48	Female stolon with eggs massed inside body
Polydora caulleryi ?	8- 2-48	Larva in plankton
Sphaerosyllis erinaceus	9- 9-48	Eggs fastened to dorsal surface
	10- 6-49	Developing larvae fastened to dorsal surface (swimming setae visible in larvae)
Syllis fasciata	3-29-50	2 male stolons
S. cornuta	2-14-50	2 epitokes
	2-18-50	1 epitoke
	3-29-50	10 epitokes with eggs inside body
	4-15-50	2 epitokes with eggs inside body
Cirratulus cirratus	8- 6-48	2 with eggs inside body, 1 male with apparently mature sperm
	8-10-48	1 with apparently ripe eggs inside body
	9- 2-48	1 with apparently ripe eggs inside body
Idanthyrsus armatus	8- 9-49	1 male spawned
Lanassa venusta	8- 5-50	Large yolky eggs inside body
Nicolea venustula	8-21-48	Large yolky eggs inside body
	9-15-48	Large yolky eggs inside body
	8- 8-49	Large yolky eggs inside body
Thelepus cincinnatus	10-11-49	Ripe eggs and sperm
Polycirrus medusa	9-15-48	Large, reddish, yolky eggs inside body

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Annelids—continued		
Polychaetes—continued		
Polycirrus medusa—continued		
	10-11-49	Large, reddish, yolky eggs inside body
Terebellides stroemi	9-26-49	Ripe eggs and sperm
Potamilla neglecta	9- 6-49	Large, yellow, yolky eggs incubating in tube
Spirorbis granulatus	8-17-49	Eggs incubating in operculum
	2-18-50	Eggs incubating in operculum
S. spirillum	9- 9-48	Eggs incubating in tube
	8-30-49	" " " "
Leeches		
Crangonobdella murmanica	9-12-49	Developing worms in egg capsules
	10-11-49	Developing worms in egg capsules
Echinoderms:		
Ophiurans		
Gorgonocephalus stimpsoni	8- 9-49	Spawned freely. Swimming larvae developed
Amphiura sundevalli	August	Probably late August or early September
Holothurians		
Myriotrochus rinki	8-10-50	Eggs looked mature
Crustaceans:		
Copepods		
Copepod from sponge	8- 6-50	50 percent of females ovigerous
	8- 1-50	50 percent of females ovigerous
Herpyllobius arcticus	August	With eggs
Cirripedes		
Balanus crenatus	8-30-49	Young sets (1-1.5 mm. in diameter)
	10- 6-49	Young sets (1-1.5 mm. in diameter)
Mysids		
Mysis oculata	10-31-49	2 ovigerous females
Cumaceans		
Leucon sp.	10- 6-49	1 female with eggs
Petalosarsia sp.	10-14-49	1 " " "
Diastylis bidentata	8- 8-49	1 " " marsupium
D. dalli	9-16-48	1 " " eggs
Isopods		
Idotaega entomon	8-19-48	3 with marsupiums

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Isopods—continued		
Idotaega entomon—continued		
	9- 2-48	15 with marsupiums, 2 with eggs (early stages), 1 just lost brood
	7-20-49	1 with freshly deposited eggs, 2 with young embryos, 1 with young
	9- 8-49	1 with eggs (early stages)
	10- 2-49	1 with marsupium, 1 with eggs (early stages), 1 with embryos
	10-28-49	1 with freshly deposited eggs
	7-13-50	2 with young
I. sabini	8- 6-48	1 with young ready to be released
	8-10-48	3 with marsupiums
	9-26-49	1 just lost brood
	9-30-49	1 with freshly deposited eggs
Synidotea bicuspida	10-11-49	1 with young
Idarcturus murdochi	9- 9-48	1 with eggs
Phryxus abdominalis	10- 6-49	1 " "
Amphipods		
Hyperia medusarum	7-20-49	2 with eggs
	10- 5-49	Females with eggs
	3-20-50	1 with eggs
	7-19-50	5 " "
	7-21-50	13 with eggs; 72 with developing marsupiums; juveniles
Themisto libellula	9-12-49	Many females molting. Eggs visible through integument
Anonyx nugax	8- 8-49	1 with eggs
	9-22-49	Many freshly molted. Eggs visible through integument
Paronesimus barentsi	8-21-49	1 with young
	10- 5-49	1 with eggs (early stages)
Onisimus normani	9- 8-48	1 " "
O. affinis	8-17-49	1 just lost brood
	9-26-49	1 " " "
Orchomenella pinguis	1-27-50	1 with eggs (late stages)
Socarnes bidenticulatus	10-11-49	1 " " (medium early stages)
	10-14-49	1 with young embryos

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Amphipods—continued		
Stegocephalus inflatus	8- 9-49	1 with eggs
Stegocephalopsis ampulla	9- 9-48	1 with marsupium
Ampelisca eschrictii	8-21-48	Ovaries full of eggs
A. birulai	10- 6-49	1 with eggs (early stages)
Byblis gaimardii	9- 9-48	3 with developing marsupiums, 3 with eggs, 1 just lost brood
	10-11-49	2 with eggs (medium stages)
	2-18-50	8 with full ovaries, 1 with eggs (early stages), 2 with embryos (early), 2 with embryos (late stages)
Haploops laevis	10- 6-49	2 with developing marsupiums
	2-14-50	1 with eggs
	2-18-50	1 just lost brood
Pontoporeia femorata	9-22-49	1 ready to lay eggs, 1 with eggs (early stages), 2 just lost brood
Acanthostepheia behringiensis	9- 8-48	1 with developing marsupium
	9-22-49	4 had just molted
Pleustes panoplus	3-10-50	1 with eggs
Sympleustes pulchellus	9- 9-48	3 " "
S. uncigera	9-15-48	9 with eggs, 1 just lost brood
Paramphithoë polyacantha	8- 6-48	Females with developing marsupiums
	8- 9-49	Females with developing marsupiums
	8- 1-50	Females with developing marsupiums
Atylus carinatus	8- 1-50	2 with young, 1 just lost brood
Eusirus cuspidatus	8-23-48	1 just losing brood
	9- 9-48	1 " " "
	8- 9-49	2 with eggs (very early stages)
	9- 6-49	1 with young ready to escape
	10- 6-49	1 with young ready to escape
	10-11-49	1 soft-shelled and ready to lay eggs

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Amphipods—continued		
Eusirus cuspidatus—continued		
	10-11-49	7 with young ready to escape
	10-14-49	1 just lost brood
Rhachotropis aculeata	8-21-48	1 with fully developed marsupium
		1 with eggs (early stages)
	8-23-48	1 with eggs, 3 with fully developed marsupiums
	9- 9-48	1 with eggs (medium early)
	10- 6-49	1 " " " "
	7-27-50	1 just lost brood
Melita formosa	8-21-49	47 with developing ovaries (eggs immature)
		57 with developing marsupiums
		17 with eggs
Maera danae	9-15-48	1 pair mating, 1 with eggs
	9- 6-49	1 with eggs (very early stages)
	10-14-49	1 with eggs
	8- 1-50	1 " " (very early stages)
Gammarus locustus var. *setosus*	10- 4-49	2 just molted, 3 pairs mating, 1 with eggs
	7-27-50	1 with developing marsupium
Gammaracanthus loricatus	8- 6-48	1 with eggs
	9- 2-48	1 with young nearly ready to escape
	9- 8-48	1 with developing marsupium
	9-12-49	1 just lost brood
	10- 4-49	1 " " "
	8- 1-50	1 with eggs (early), 2 just losing brood
Photis reinhardi	8- 3-48	1 just lost brood
	9- 9-48	1 " " "
	10-11-49	8 with eggs or young or just lost brood
	2-18-50	2 with eggs (late stages)
Eurystheus melanops	8-23-48	1 " "
	8-30-48	2 " "
	9- 8-48	12 " " , 1 with embryos
	9- 6-49	8 with eggs or young
	10- 6-49	3 " "
	10-11-49	5 " " or young

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Amphipods—continued		
Eurystheus melanops—continued		
	10-14-49	5 with eggs or just lost brood
Protomedeia fasciata	8-21-48	2 with eggs
	9- 8-48	Many with eggs (advanced embryos)
Ischyrocerus commensalis	8-23-48	3 with eggs
	9- 9-48	All females with eggs (7)
	9-15-48	" " " "
	8- 9-49	1 with eggs (early stages)
	8-30-49	1 " " (early to medium)
I. latipes	8-23-48	Females with eggs
	9- 9-48	" " "
	9-15-48	1 just lost brood
	8- 8-49	1 " " "
	10-14-49	1 " " " , 1 with developing marsupium
	2-18-50	1 just lost brood, 1 with developing marsupium
	3-17-50	1 just lost brood
	8- 1-50	6 with marsupiums
Ericthonius hunteri		Ovigerous females were taken from the first of August to the middle of October
	10-14-49	2 with developing marsupiums
		5 with eggs (early), 1 with young
	2-18-50	3 with developing marsupiums, 3 with empty marsupiums, 1 with eggs (early), 1 with eggs (late), 1 with young leaving, 1 with embryos (medium)
E. tolli	9- 9-48	Ovigerous females
	10-11-49	" "
Unciola leucopis	8-17-49	1 with eggs
	9- 6-49	1 " "
	10- 6-49	1 with young, 1 with young just leaving
Dulichia spinosissima	9-10-50	1 with eggs (very early stages)
D. porrecta	3- 9 48	2 with eggs (early stages)

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Decapods		
Pandalus goniurus	9- 9-48	1 with eggs
Spirontocaris arcuata	9-15-48	1 " "
S. phippsi	10-14-49	1 " "
S. spina	9- 9-48	1 " "
	8- 9-49	1 " " (embryos, very early)
Eualus gaimardi	8- 9-49	6 with eggs (pre-eye)
	8-17-49	1 " " (" ")
	9- 6-49	14 " " (" "); 4 (later stage)
	10- 6-49	1 with eggs (with eyes); 2 juveniles
	10- 6-49	5 with eggs (pre-eye); 1 (with eyes); 1 just lost brood
	10-14-49	14 (pre-eye); 17 (with eyes)
	7-22-50	1 soft-shelled female
	8- 1-50	15 (pre-eye); 1 with eggs ready to lay
E. fabricii	10-14-49	1 with eggs
E. suckleyi	9- 6-49	2 " " (early)
Lebbius polaris	9- 9-48	1 " "
Heptacarpus flexus	9- 9-48	1 " " (very early)
Sabinea septemcarinata	8- 9-49	1 " " (" ")
Argis lar	9- 8-48	1 " " (with eyes)
Sclerocrangon boreas	9-12-49	1 " "
	9-30-49	1 " "
Pagurus splendescens	8-21-48	4 " "
	8-23-48	2 " "
	9- 8-48	2 " " ; 2 just lost brood
	9-15-48	1 with eggs
	10- 5-49	1 " " (about 200, early)
P. trigonocheirus	8-23-48	1 with eggs (early)
	9- 2-48	2 " " (")
	9- 8-48	1 " " (")
	9- 9-48	1 " " ("); 2 with empty egg cases; 14 juveniles
	8-17-49	1 with eggs (early)
	9- 6-49	1 " " (")
	10- 6-49	2 " " ("); 1 with eye spots
	10-11-49	1 with eggs (early)
	8- 1-50	1 " " (very early)

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Crustaceans—continued		
Decapods—continued		
Hyas coarctatus alutaceus	8-21-48	Several with eggs, 1 soft-shelled
	8-23-48	1 with eggs (early); 1 (advanced)
	9- 9-48	3 with eggs (early); 1 ready to lay; 1 soft-shelled male, 1 soft-shelled female
	9-15-48	4 with eggs (early); 1 (advanced)
	8- 9-49	11 with eggs
	8-17-49	1 " " (early)
	10- 6-49	1 " " (with eyes)
	10-11-49	1 " " (very early)
	10-14-49	1 " " (early); 1 with eyes
	8- 1-50	1 with eggs (very early)
		1 " " (early)
Paralithodes camtschatica	8-12-48	1 with empty egg cases
	9- 4-48	1 with eggs
Chionocetes opilio	8- 2-48	1 soft-shelled female
Arachnids:		
Pycnogonids		
Nymphon grossipes	9- 9-48	1 male carrying eggs
	8- 8-49	1 " " "
	9-26-49	2 males " "
	10- 2-49	1 male " "
N. brevirostre	9- 9-48	1 " " "
N. longitarse	9-12-49	1 " " "
	9-26-49	1 " " "
Pseudopallene circularis	9- 9-48	1 male carrying young just ready to escape
Mollusks:		
Pelecypods		
Musculus corrugatus	8-30-49	Embryonic clams within byssal net
Astarte montagui	10-11-49	Eggs 292 microns in diameter
	2-14-50	Eggs 282-288 microns in diameter
	2-18-50	Eggs 282-288 microns in diameter
Cardita crassidens	10-11-49	Several with eggs from 753-761 microns in diameter, mostly yolk

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Mollusks—continued		
Gastropods		
Clione limacina		Larvae throughout winter with no apparent growth until June
	7-20-50	Larvae (7 mm.) and adults (30 mm.)
Aldisa zetlandica ?	9- 8-48	Coiled rose-colored egg ribbon
Admete sp.	8-23-48	Egg capsules
	9- 6-49	" "
	10-16-49	" " with embryos with shells
Admete sp. No. 2	9- 9-48	Egg capsules
Volutopsius stefanssoni ?	10-21-49	Empty egg capsule
Jumala sp.	8- 6-48	Capsules with large embryonic snails ready to escape, others still with nurse eggs
	9- 9-48	Capsules with large embryonic snails ready to escape, others still with nurse eggs
	10-17-49	Freshly deposited capsule
Plicifusus sp.		Capsules from Aug. 1 to Oct. 14
	10-14-49	Capsules with recently laid eggs
		Capsules with young embryos
		Capsules with 5-9 young snails
Neptunea sp.		Capsules from July to October
Buccinum sp. (9 or 10 sp.)		Capsules of different types from the time the ice went out until Oct. 16
	10- 3-49	Type 1. Mass of capsules with empty capsules and others containing eggs
	10-16-49	Type 2. 3-5 embryos (1.8 to 4 mm.) per capsule still feeding on nurse eggs
	9-28-49	Type 3. Capsules with eggs
	10-16-49	Type 4. 10-12 embryos without shells

TABLE 4.—*Data on eggs and breeding seasons*—continued

Animal	Date	Remarks
Mollusks—continued		
Gastropods—continued		
Buccinum—continued		
	10-16-49	Other capsules with eggs only
		Other capsules with 4-5 larger embryos with nurse eggs
		One capsule with 14 embryos in earlier stage
		Capsules with 15-17 embryos with eye spots
Boreotrophon sp.	8-30-48	2 capsules, each with 2 embryos
Trichotropis bicarinata ?	9- 1-49	3 capsules, with 13, 14, and 24 embryos, respectively
Natica clausa		First of open season until last of October egg rings present
	10-11-49	One egg ring had young snail in each egg space
Polinices sp.		Egg rings present from first dredge hauls until end of October
	8-21-49	Some egg rings with eggs, others with embryos
	10-28-49	Recently deposited egg rings
Margarites costalis ?		Egg masses on the bryozoan *Alcyonidium disciforme* throughout entire season
M. frigidus	8-17-49	Large eggs (0.4 mm.) in ovaries
M. vahli	8-17-49	Ovaries with fairly well-developed eggs
Tunicates:		
Dendrodoa grossularia	10- 6-49	Atrial cavity filled with eggs (0.25 mm. in diameter)
Molgula griffithsi	8- 1-50	Eggs appeared ripe
Molgula sp.	8-30-49	Eggs with larvae showing "tadpole" tail

The records for some of the above animals are too isolated to be of much value in themselves, but by adding these to the records of future investigators, it will be possible eventually to compile sufficient data to present the entire picture of the breeding habits and breeding seasons of these Arctic invertebrates.

METHODS OF COLLECTING AND PRESERVING SPECIMENS

DREDGING, SUMMER, 1948 AND 1949

Since the beach and subbeach region at Point Barrow is of gravel and there are no rocks for the attachment of animals, and as the ocean freezes over and ice grounds out to a depth of 90 to 100 feet, there is no such thing as tidal fauna, so conspicuous in many beach areas. The majority of invertebrate animal life along shore occurs 100 feet or more beneath the surface of the water. Dredging had to be employed almost exclusively for exploring the bottom, although a certain amount of trapping was done through the ice (see "Trapping Through the Ice"), and some grab sampling was undertaken.

Even in summer, dredging at Point Barrow is not so simple as in many regions. There is no harbor and no pier or dock, and it is not possible to leave the boat anchored offshore. Consequently, each time the boat was used it was necessary to push it into the water and pull it ashore again. This was done with a caterpillar tractor lent by the Arctic Contractors. The dates on which dredging activities began and ceased were dependent on the time the ice went out in the summer and the time the gravel of the beach froze, for after the gravel was solidly frozen the boat could not be hauled ashore without injuring the bottom. Dredging was therefore usually limited to a period beginning not earlier than the last week in July and ending early in October. Hand dredging from a skiff may be possible in the second or third week of July. More of the problems of dredging in the Arctic are mentioned under "Currents."

A large waterproof canvas was placed on the 10-by-14-foot working space on deck and the contents of the dredge were emptied onto it (pl. 3, fig. 2; pl. 4, fig. 1). The material was given a preliminary sorting in order to rescue the more delicate and perishable animals, which were placed in jars or pails of ocean water. During October 1949, many of the dredged animals froze on the deck before they could be taken to the laboratory.

DREDGING, WINTER, 1949-50

The Danes devised a method (see Thorson, 1946a) of dredging through the ice by lowering a dredge to the bottom before freeze-up.

Two lengths of coir rope (selected because of its resistance to a long stay in the water) were attached to the dredge and extended loosely along the bottom in opposite directions, with the dredge at an angle of 180° to the ocean bottom. A small anchor was attached to keep the rope taut from the bottom to the surface. Buoys were placed at the surface and each buoy was connected to the vertical portion of the rope by means of a solid wire about 15 feet in length. When the sea froze over, a hole was made around each buoy and a dredge haul could be made by drawing the dredge back and forth between the holes. A locality had to be selected where the ice would not break.

This last requisite precludes the use of the above method of winter dredging at Point Barrow. There is no location where the ice does not break. It may break up several times before the final freeze-up, and sometimes great ridges are piled up and carried ashore (pl. 8, fig. 1). It was therefore necessary to originate a method that could be carried out after freeze-over occurred.

At first a few dredge hauls were tried between holes in the ice about 30 feet apart. Then holes were made at greater intervals with the ice-cutting device (pl. 2, fig. 2) so that a line could be threaded between them. But a distance of even 100 feet between the two most distant holes was insufficient to allow enough horizontal drag on the dredge, with the result that very little animal life was obtained. It was also necessary to select a location that could be reached by a weasel in order to haul the ice-cutting machinery to the site. This precluded dredging more than 2 miles from shore by this method.

Unsuccessful attempts were made to use a prairie ice jigger or creeper such as is used by Canadian fishermen to carry a line under the ice of lakes. Also valuable time was lost trying to perfect a creeper that would work under ocean ice, the underside of which is covered with a slush 3 or 4 inches thick that piles up ahead of the creeper and makes the ice uneven.

The only recourse was to select a location in a lead that had recently frozen over so that the ice was thick enough to support workers and equipment but thin enough to make the digging of holes by hand not too laborious or time-consuming. Two large holes were made 300 feet or more apart. (See fig. 3, *a* and *b*.) A crew of three Eskimos was employed to thread a line between these holes. One (fig. 3, *5*) held the line, another (*7*) dug holes on a slant at 15 feet apart, and the third (*6*) grappled the line by means of a pole with a hook on the end. The end of the line extending under the ice from *a* to *b* was attached to the dredge line (*9*) at *a* and drawn through to *b*. The dredge was then lowered straight down to the bottom through *a*. A team of seven dogs was hitched to the slack dredge line at *b*, then driven ahead, drawing the dredge along the bottom and finally up to the opening at *b*, where the specimens collected were taken out and transferred to 5-gallon thermos jars. This transfer had to be made quickly to prevent the animals from freezing solid in the open air, the temperature of which was usually −25° to −30° F. The tent (*4*) with a stove was necessary to warm the hands occasionally to pre-

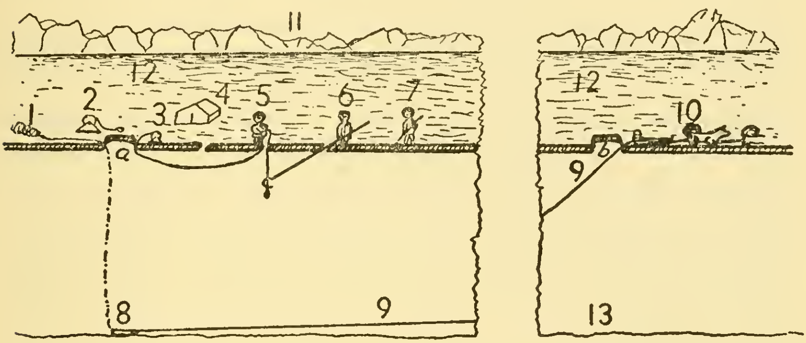


FIG. 3.—Dredging by dog team. 1, Backhaul line releasing dredge in case of fouling. 2, Dredge line and reel. 3, Cod line and reel. 4, Tent with stove for making coffee and warming hands. 5, Eskimo dropping weight for next Eskimo (6) to hook. 7, Eskimo digging hole. 8, Dredge dropped ready for towing. 9, Dredge line. 10, Dog sled and nine dogs. 11, Old ice. 12, New ice 4 or more inches thick, depending on age. 13, Ocean bottom. *a* and *b*, Large holes 345 feet apart; missing portion represents 240 feet.

vent them from freezing. After the dredge was emptied it was hauled back from *b* to *a* by means of the stern line (*1*), and the procedure was then repeated. In making each haul an attempt was made to swing the dredge sufficiently far to one side or the other to prevent its dragging along a previous course.

This was a laborious method but it accomplished the purpose. Much time was consumed by the trip out to a suitable site and the return trip to the laboratory. Travel in the Arctic at 30° below zero is invigorating, but working with gear and marine animals at such a temperature while the hands are wet with ocean water is extremely difficult and even painful. Some of the gear could be hauled by dog team; the remainder had to be carried. The dog team was hired from Eskimos in the village of Barrow, and arrangements had to be made the preceding day to have the team at the laboratory the morning of the day the dredging was to be done. Despite the difficulty of this method of collecting, good results were obtained, as can be seen from the list of animals collected on February 18, 1950, at a depth of 162 feet, 3.2 miles from shore.

In preparation for winter dredging, several good places over rubble bottom with rich fauna had been located by triangulation during the summer of 1949. However, storms during October of that year carried great quantities of mud containing vast amounts of tundra vegetation and debris from Elson Lagoon into the ocean, and large quantities of mud from the mud-zone bottom were stirred up and carried out to sea. This finer material was still floating when the ocean froze over, causing the top 8 inches of ice to be muddy. By the time the ice was 8 inches thick, this fine mud had settled below the freezing point and was deposited to a depth of 3 or 4 inches over the bottom, covering many of the animals. Instead of a rich rubble-bottom fauna there was obtained a mixture of those animals that had not been completely covered by the mud, or that had come to the surface, and a few that had been carried from their normal mud-zone habitat and had become established in the mud layer over the rubble. No doubt quantities of sessile rubble-zone animals were smothered by the mud. Under normal circumstances rubble bottom could have been found at depths of 125 feet and, in certain places, even at 110 feet.

Dredging through the ice during the winter of 1948-49 would have yielded a hundred times more marine fauna than did the operation in 1949-50, and probably much more information regarding the winter activities of the animals, but knowledge of the vicissitudes of life to which these arctic animals are subjected would not have been obtained.

This is another example of the necessity for several years of continuous work on any ecological survey, which the writer has always advocated. It is hoped that someone will be able to do sufficient dredging to determine how long the mud covering lasts and how much time is required for the animals to reestablish themselves.

BOTTOM SAMPLING, WINTER, 1949-50

Innumerable samplings were taken through the ice by means of grabs in order to get some idea of the extent of the mud covering and in the hope of finding a spot that was not so covered. Several miles of coast were explored in this manner to a distance of 4.5 miles from shore, but no area was found free from the blanketing mud. Dredging and sampling were extended to a depth of 185 feet, but the conditions there were no better, and it was impossible to try greater depths because the ice did not extend out far enough.

Two sizes of grabs, neither of which brought up a very large sample, were used. The smaller brought up about a third of a cupful of material and the larger a cupful or more. Sampling could be done only where the ice was thin after the freezing over of a lead. As winter progressed and such places formed farther and farther at sea, searching began about 3 miles from shore. The farthest winter station on the ice was 4.5 miles from shore. After a suitable lead was located it could not be used more than two to four days before the ice became too thick to make holes through it for the grabs.

Holes were made by hand with an ice-boring tool or an Eskimo-type narrow-bladed tool. The very efficient ice cutter (pl. 2, fig. 2) developed by John Huff, the mechanic at the laboratory, could be used only nearer shore in places that could be reached by a weasel, which was used to haul the ice cutter and furnish power to run it. A weasel could not be driven over thin ice, and it could not go over or around certain ice ridges. Consequently, sampling locations had to be reached on foot, for the inconvenience of securing a dog team ruled out that form of transportation. Heavy clothing, ice-digging gear, sounding gear, thermos jars, and a rifle made traveling difficult. Thermos jugs were essential for taking the collected animals to the laboratory without freezing. The grab with its contained material could not be left in the water near the surface more than a few moments without freezing, for the water temperature averaged about −1.5° C.

Had the layer of mud not been deposited over the rubble zone, grab sampling would have yielded more animals and more data concerning them. As it was, such sampling made possible a survey of several miles of shoreline out to 4.5 miles from shore and established the fact that mud had been deposited over the entire rubble bottom in this area.

DREDGING, SUMMER, 1950

Because of the deposition of mud mentioned above, dredging operations in the summer of 1950 were unsatisfactory. These activities showed that the mud gradually became thinner until at 20 miles from shore only a thin layer was encountered. Since this distance was considered the limit of safety with the *Ivik* (pl. 3, fig. 1), even under the most favorable weather conditions there was little opportunity to dredge except where a thick layer of mud still blanketed the normal fauna. Hours were required to work through a haul of this sticky mud, and the proceeds were disappointing.

PLANKTON SAMPLING, SUMMER

During the summer of 1948 plankton hauls were made from a skiff propelled by rowing, or from a grounded ice floe. During the summers of 1949 and 1950 plankton tows were taken from a skiff, but launching a skiff was not always feasible or practicable, as the surf was often too heavy. Consequently, tows had to be made when conditions were favorable rather than at stated intervals or at the most desirable times. Sometimes ice floes were grounded in such a manner that by walking to the outer edge and throwing a plankton net as far as possible satisfactory plankton samples could be obtained.

Occasionally samples could be taken on calm days by casting a net from the shore, but this method was not satisfactory because the gradual slope of the bottom made it almost impossible to get the net into water of sufficient depth.

PLANKTON SAMPLING, WINTER

After the ocean froze over, plankton samples were taken through holes in the ice. Several stations were maintained throughout the winter at various distances from shore (see "Trapping Through the Ice"), but the one most frequently used was over 80 feet of water at 1.6 miles from shore. This station was used from January to the first part of July 1950, inclusive. Holes farther from shore were destroyed by the movement of ice and in some instances could not be used more than a few weeks.

In order to make the sampling as uniform as possible and thus obtain information on the relative quantitative changes taking place in the winter months, a definite procedure was followed. First, if the hole had frozen over, the ice had to be broken and removed with a large sieve-dipper; or if not completely frozen over there was always slush ice to be dipped out. A plankton net with a flask attached was then lowered to the bottom and towed vertically to the surface. This was done three times. When the flask was brought up it had to be thickly wrapped in insulating material for transportation to the laboratory.

There was also the problem of preventing the net from freezing solid as soon as it became wet, thus closing the meshes so that the water would not drain out. The only satisfactory method of preventing this was to pour into the hole a pailful of hot water, which warmed the surface water sufficiently to keep the net from freezing when lowered, and another pailful just before the net was withdrawn. A stove for heating the water was housed in a snow house (pl. 4, fig. 2) which not only protected the flame of the stove from the wind, but also provided shelter for the workers.

The advent of late spring brought another problem—dilution of the ocean water with the fresh water from the melting ice. With several feet of fresh water floating on top of the salt water, practically all the planktonic animals were killed when the net was drawn to the surface. In an attempt to overcome the lethal effects of the fresh water, a water-sample bottle was lowered by means of a long pole to a depth of 10 feet and the salt water thus obtained was poured into the flask at the end of the plankton net before the latter was lowered. The heavier water in the flask prevented the fresh water from entering, so that the majority of the planktonic forms could be brought to the surface alive. The dead ones, mostly chaetognaths, were probably those that had ventured into the upper layer of water and were already dead when taken in the net.

CARING FOR ANIMALS IN THE LABORATORY

As mentioned above, dredged material was partially sorted on the deck of the boat (pl. 4, fig. 1). The material was then carried to the laboratory, where it was carefully separated. Because of the higher temperature and the absence of running salt water, the specimens could not be kept alive in the laboratory for any great length of time. They were sorted into pans and large and small finger bowls and placed in an unheated anteroom until they could receive further attention. Toward the end of the dredging season the anteroom would become too cold, especially at night, and the containers were placed on the floor near a door inside the laboratory room. A thin coating of ice over the pan or bowl was not fatal to the animals.

In 1949 a kerosene-operated refrigerator was available. It formed an excellent storage place for specimens—when it worked. Unfortunately, it could not be relied upon, and during the night it might become fatally warm, or it might freeze solid the contents of pans and bowls. A walk-in refrigerator that became available for use later in 1949 made it possible to keep some of the animals for several weeks, thus allowing more time for anesthetization and preservation and for examination of living animals.

When time permitted, colored 2-by-2-inch slides were made of the live specimens and later sent to the taxonomists working with the subjects. Taxonomists seldom see living specimens of the animals with which they work, and consequently have no idea of their color or appearance before they are preserved.

Also, when possible, some of the animals were examined in an attempt to determine their breeding season from the state of development of the gonads. It was not feasible to try to fertilize the eggs as they were all too often cooked or frozen, depending on the vagaries of the refrigerator.

Plankton samples were also kept in the refrigerator and, later, in the reefer (a walk-in refrigerator), which prolonged the life of the specimens, thereby allowing more time to work on them.

DREDGING STATIONS AND COLLECTING DATA

ZONATION

In general there are three types of bottom off Point Barrow. From the shore out to a depth of 10 to 20 feet there is gravel, which is continuous with the beach; 20 to about 100 feet, fine, blue, compact, sticky mud; and beyond 100 feet, rubble, in which there may be streaks of boulders, gravel (coarser than the beach gravel), or shell (mainly *Hiatella*), and regions in which there are mixtures of some or all of these. In general, the farther one proceeds oceanward, the less likelihood there is of boulder streaks, but there are stones of varying sizes everywhere.

For miles out to sea there is an annual deposition of mud, the amount depending on whether the ice stays near shore; when the ice is "in" there is less shore erosion because there is less surf. In 1948 the bottom was free of mud beyond a depth of 100 feet, but in October 1949 the entire ocean bottom offshore was covered with 3 or 4 inches of mud.

These three regions have their respective faunas. In the gravel along shore *Rhizomolgula globularis* occurred in patches where the sand had been segregated from the coarser gravel, and in places as many as 50 pounds of this tunicate could be brought up in a single dredge haul. Quantities of the washer-shaped bryozoan *Alcyonidium disciforme* were also taken all along the gravel zone. These two were by far the most abundant surface animals of this zone. An occasional white dorid, probably *Aldisa zetlandica,* and certain annelids, such as *Phyllodoce groenlandica,* were dredged.

The animals living within the mud at the shoreward edge of the mud zone encroached upon the gravel zone where the gravel was not so thick as to close the burrows or allow them to collapse. Comparatively little is known of the animals living beneath the surface in the mud zone, for sampling in that region is a tedious, time-consuming process, but good collections were made of the surface and near-surface dwellers and those living on the shoreward border. The following is a list of the animals of this region in the order of their relative abundance:

Echiurus echiurus alaskanus (echiuroid worm)
Arenicola glacialis (polychaete—lugworm)
Myriotrochus rinki (sea cucumber)
Antinoë sarsi (polychaete)
Melaenis lovéni (polychaete)
Harmothoë imbricata (polychaete)
Hamingia arctica (echiuroid worm)
Halicryptus spinulosus (priapulid worm)
Burrowing anemones (2 species)
Burrowing tunicates (2 species)
Mya truncata, small (clam)
M. japonica, small (clam)

Living within the mud in the mud zone farther out, the following were found:

Cerianthus sp. (burrowing anemone)
Macoma calcarea (clam)
Astarte montagui (clam)
Myriotrochus rinki (burrowing sea cucumber)
Nucula tenuis (clam)
Musculus discors var. *laevigatus* (clam)
M. corrugatus (clam)
Nuculana sp. (clam)
Macoma oneilli (clam)

On the surface in the mud zone the following were common:

Foraminifers
Dulichia porrecta (amphipod)
Pagurus splendescens (hermit crab)
P. trigonocheirus (hermit crab)
Hyas coarctatus alutaceus (crab)
Serripes groenlandicus (clam)
Liocyma fluctuosa (clam)

Not strictly confined to the bottom was the ubiquitous amphipod *Apherusa glacialis,* which might be found on the undersides of ice cakes, among the gravel, or on the bottom.

The rubble zone varied greatly in different areas, depending on the size of the rubble and the amount of shell, gravel, and mud. In general, the farther from shore the more often patches of mud were encountered, perhaps because of the weaker currents in this area, at least along the bottom. Fauna was most abundant in those regions containing large boulders—a conservative estimate, based on the number of animals collected, would indicate about 1,154 tons per acre.

Occasionally large stones and boulders comparatively free of sessile animals, except juveniles, were brought up. This would indicate that these stones and boulders had recently been dropped out of the ice or had been rubbed by some deep floe, which killed the animals.

The predominant invertebrates in the rubble zone were bryozoans, sea anemones, sea cucumbers (*Psolus stimpsoni*), sea urchins (*Strongylocentrotus drobachiensis*), the octocoral *Eunephthya rubiformis,* and barnacles, all varying in abundance at the different stations. For lists of representative animals from stations in this zone, see below under stations 20, 37, 44, 46, and 47.

DREDGING STATIONS AND REPRESENTATIVE ANIMALS

Table 5.—*Dredging stations*

No.	Date	Depth in feet	Type of bottom and remarks
1	7-20-48	10	Gravel
1a	7-26-48	22	Mud
2	7-26-48	50	Mud
3	8- 2-48	30	Mud
4	8- 6-48	40	Stones, mud, gravel (Eluitkak Pass)
5	8- 9-48	10-20	Gravel (alongshore from base to village)
6	8-10-48	40	Stones, mud, gravel (Eluitkak Pass)
7	8-21-48	80	Gravel
8	8-21-48	100	Gravel, small stones
9	8-21-48	140	Small stones (up to 4 inches), gravel
10	8-23-48	150	Gravel, small stones
11	8-23-48	20	Mud
12	8-30-48	40	Eluitkak Pass
13	9- 2-48	40	Eluitkak Pass
14	9- 8-48	110	Incomplete haul; rough current and wind
15	9- 8-48	60	Mud (out from radio masts)
16	9- 8-48	15	Sandy (out from radio masts)
17	9- 9-48	80	Mud
18	9- 9-48	100	Mud
19	9- 9-48	110	Mud, gravel
20	9- 9-48	125	Stones (sea urchins, *Psolus,* sea anemones)
21	9-15-48	110	Stones, mud, gravel (*Psolus,* sea anemones)
22	9-15-48	120	Stones (*Psolus*)
23	9-15-48	130	Stones (sea anemones, *Psolus,* sea urchins)
24	9-16-48	110	Shells, pebbles, mud
25	8- 8-49	120	Gravel, stones (large), mud
26	8- 9-49	130	Stones, gravel
27	8- 9-49	420	Stones, gravel
28	8- 9-49	70	Mud
29	8-17-49	438	Stones
30-31	8-17-49	522	Stones (sea urchins)
32	8-17-49	741	Mud (worm tubes)

TABLE 5.—*Dredging stations*—continued

No.	Date	Depth in feet	Type of bottom and remarks
33	8-30-49	184	Stones, boulders (*Psolus* and sea urchins—many)
34	8-30-49	30	Mud
35	9- 1-49	328	Gravel (coarse), stones (few large)
36	9- 6-49	477	Rocks (few) (worm tubes)
37	9- 6-49	217	Stones, large perforated rocks
38	9- 8-49	246	Pebbles, gravel, mud
39	9- 8-49	148	Mud
40	9- 8-49	10	Gravel, mud (alongshore)
41	10- 6-49	295	Rocks, stone, gravel (*Psolus*)
42	10- 6-49	216	Rocks, stones (*Psolus* and sea urchins)
43	10- 6-49	213	Gravel, mud
44	10-11-49	453	Rocks, stones, gravel (small amount) (*Psolus*)
45	10-11-49	341	Rocks (few), stones, gravel (sea urchins)
46	10-14-49	152	Stones, mud, rocks (few)
47	10-14-49	175	Gravel, stones (small) (sea urchins)
48	2-13-50	129.5	Mud (bottom sampler)
49	2-14-50	149	Mud, stones (small) (haul made by dog team)
50	2-18-50	162	Mud, gravel, stones, rocks (few small) (haul made by dog team)
51	3- 9-50	135	Mud (very sticky) (haul made by dog team)
52	3-18-50	185	Mud, gravel, stones (bottom sampler)
53	3-21-50	120-130	Mud (small bottom sampler)
53a	4-11-50	170	Mud (bottom sampler) (off radio mast)
53b	4-11-50	175	Mud (bottom sampler) (off Browerville)
54	7-21-50	72	Mud
55	7-22-50	132	Mud, gravel, shell, stones
55a	7-22-50	134	Mud, gravel, shell, stones
56	7-22-50	141	Mud, gravel, shell, stones
57	8- 1-50	118	Mud, gravel, shell, stones
58	8- 1-50	122	Mud, gravel, shell, stones
59	8- 1-50	138	Mud, gravel, sand, shell, stones (few small)
60	8- 1-50	40	Mud, stones (Eluitkak Pass)
61	8- 5-50	204	Mud, stones, gravel
62	8- 5-50	151	Mud, gravel

In the following discussion the animals listed under each station were selected largely on the basis of their relative abundance. Unless it occurred at the station in such profusion as to be counted in multiples of ten an animal is not ordinarily listed. Occasionally a single animal is listed because of its special significance. Unfortunately, since the hydroids, sea anemones, and many of the bryozoans have not been identified, and the taxonomist did not correlate the bryozoans named with depths and dates, data for these groups may not be representative.

STATION 1 was in the gravel zone. Special techniques employed here might yield more animals, especially small ones such as amphipods, which were frequently observed near shore crawling in and out of the gravel. The presence in this zone of an animal such as the dorid *Aldisa zetlandica* (?) is amazing. Since it was present as soon as the ice went out it could not have migrated from deeper water, and the only explanation for its existence here is that it burrows into the gravel. But it seems incredible that a single specimen could survive the grinding to which the gravel is subjected when the ice breaks up and piles up in ridges, as it does in the early winter.

Representative animals from a dredge haul from this station are as follows: Hydroids—*Corymorpha* sp., 2. Nemerteans—*Amphiporus lactifloreus,* 1; *A. macracanthus,* 1. Bryozoans—*Alcyonidium disciforme,* 10. Polychaetes—*Phyllodoce groenlandica,* 14. Amphipods—*Atylus carinatus,* 4. Gastropods—*Aldisa zetlandica,* 1; *Cylichna occulta,* 1.

STATION 1a was in the mud zone where it is difficult to obtain a true sampling because it is impossible to dredge to the depth at which most of the animals live. The following were among those obtained: Bryozoans—*Alcyonidium disciforme,* 16. Holothurians—*Myriotrochus rinki,* 9. Polychaetes—*Pectinaria granulata,* 8.

STATION 2 was in the typical mud zone and the most important animal in the hauls was *Hydractinia* sp. on snail shells.

STATION 3 was also in the typical mud zone. Nemerteans—*Amphiporus pacificus,* 1; *Lineus ruber,* 1; *Micrura alaskensis,* 1. Bryozoans—*Alcyonidium disciforme,* 13. Holothurians—*Psolus fabricii,* few (probably washed in from the rubble zone); *Myriotrochus rinki,* 15.

STATIONS 4, 6, 12, 13, and 60 were at Eluitkak Pass, where the depth is given on U. S. Coast and Geodetic Survey maps as 40 feet, but a sounding made in the summer of 1949 gave 46 feet. No doubt the depth varies somewhat, for a strong current sweeps through the Pass. The amount of mud found in a dredge haul is somewhat variable. At this depth one should expect to encounter a mud bottom, for in the open ocean no rubble bottom is found in less than 100 feet of water, but the current here keeps the mud washed away and the surface of the stones exposed so that animals may grow on them.

On the whole the fauna of Eluitkak Pass is like that of the rubble bottom in the open ocean at depths of 110 feet or more. One striking difference is the total absence of echinoderms, owing undoubtedly to the dilution of the ocean water by the fresher water from Elson Lagoon. At Eluitkak Pass the octocoral *Eunephthya rubiformis* was especially abundant, and the flared-goblet-shaped sponge *Echinoclathria beringensis* was found in greater numbers and larger size than in any other locality.

Important animals from Eluitkak Pass: Sponges—*Cioxeamistia* sp., 2; *Halichondria lambei* (C).[2] Hydroids—*Hydractinia* sp., 2; *Clytia* sp., 6-10; *Obelia* sp., several; *Lafoeina maxima* (C-A). Anthozoans—*Eunephthya rubiformis* (AA); *Halcampa duo-decimcirrata* (?), 1; *Stomphia coccinea*, 4. Turbellarians—*Notoplana atomata* (A, 20 in one haul). Nemerteans—*Amphiporus lactifloreus,* 6. Priapulids—*Halicryptus spinulosus,* 1. Bryozoans—*Eucratea loricata* (C); *Carbasea carbasea* (A), perhaps more abundant here than at any other station; *Tegella armifera* (C); *Scrupocellaria scabra* var. *paenulata,* several; *Cystisella bicornis,* n. sp., few; *Crisia cribraria* (C); *Alcyonidium pedunculatum* (A). Polychaetes—*Harmothoë imbricata,* 25; *Castalia aphroditoides,* 12 (nearly one-half of the 28 specimens of this species collected came from three hauls from Eluitkak Pass); *Eusyllis blomstrandi,* 25; *Cirratulus cirratus,* 14. Copepods—*Herpyllobius arcticus,* 8; unidentified copepod from sponge *Echinoclathria beringensis* (A). Cirripedes—*Balanus crenatus* (AAA). Isopods—*Idotaega entomon* (A); *I. sabini* (A). Amphipods—*Acanthostepheia behringiensis,* 3; *Paramphithoë polyacantha,* 4; *Atylus carinatus,* 19 (the only place this species was taken except for four at 10 feet and one that washed ashore); *Gammarus locustus* var. *setosus,* 4; *Gammaracanthus loricatus,* 6; *Ischyrocerus latipes,* 21. Decapods—*Pagurus splendescens,* 4; *P. trigonocheirus,* 8. Pelecypods—*Musculus niger,* 2; *Astarte borealis,* 16; *Hiatella arctica* (AAA). Gastropods—*Neptunea* sp., 5; *Buccinum angulosum,* 6. Tunicates—*Molgula griffithsi* (AA).

Station 5, in the gravel zone, yielded very little animal life: Hydroids—*Obelia* sp., 1 col. Echiuroids—*Echiurus echiurus alaskanus,* tail end of one specimen. Bryozoans—*Alcyonidium disciforme,* 1. Amphipods—*Weyprechtia heuglini,* 3. Isopods—*Idotaega entomon,* 1 (1.5 inches). Fishes—*Limanda aspera,* 1 (1.5 inches).

Station 7 was evidently where a tongue of gravel extended into the mud zone from the rubble zone. Animals: Bryozoans—*Rhamphostomella gigantea,* n. sp., 1 large. Amphipods—*Protomedeia fasciata,* 3; *Dulichia porrecta,* 9. Decapods—*Pagurus splendescens,* 14;

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[2] In this discussion (C) = common, (A) = abundant, (AA) = very abundant, (AAA) = exceedingly abundant, (R) = rare, and col. = colony or colonies.

P. trigonocheirus, 11; *Hyas coarctatus alutaceus,* 4. Pelecypods—*Serripes groenlandicus,* 3; *Liocyma fluctuosa,* 5.

STATION 8 was in a transition area marking the beginning of the rubble zone and was not very productive of animal life: Bryozoans—*Costazia nordenskjoldi,* 3; *Alcyonidium polyoum* (C) (on snail shells containing hermit crabs). Amphipods—Caprellid sp. No. 2, 10. Decapods—*Pagurus trigonocheirus,* 3.

STATION 9 was in a small-stone and gravel area of the rubble zone. The animal life was abundant: Sponges—*Choanites lütkeni,* 3. Hydroids—*Obelia* sp., few col. Nemerteans—*Amphiporus lactifloreus,* 6; *Tetrastemma* sp., 7. Bryozoans—*Tricellaria erecta* (C); *Scrupocellaria scabra* var. *paenulata* (C); *Pachyegis princeps* (C); *Rhamphostomella fortissima,* few; *R. gigantea,* n. sp., 1 large; *Cystisella fragilis,* few; *Costazia nordenskjoldi,* 5; *Cauloramphus cymbaeformis* (C). Decapods—*Hyas coarctatus alutaceus,* 8. Pelecypods—*Hiatella arctica* (AA). Gastropods—*Dendronotus frondosus* (?), 2; *Dendronotus* sp. (white), 2. Tunicates—*Styela coriacea,* 4; *S. rustica macrenteron,* 6.

STATION 10 was in a region of abundant animal life in the rubble zone (even though half the material brought up in the dredge was dead *Hiatella* shells): Sponges—*Halichondria lambei* (C). Hydroids—*Obelia* sp., few col.; *Lafoeina maxima* (A); *Thuiaria* sp. (C); unidentified calyptoblast (C). Anthozoans—Sea anemones (C). Turbellarians—*Notoplana atomata,* 4. Nemerteans—*Amphiporus lactifloreus,* 3; *A. macracanthus,* 4. Brachiopods—*Diestothyris spitzbergensis,* 6, plus shells. Bryozoans—*Eucratea loricata* (C); *Bidenkapia spitzbergensis,* several; *Tegella magnipora,* n. sp., few; *Dendrobeania murrayana,* 4; *Hippothoa hyalina* (C); *Pachyegis princeps* (C); *Parasmittina alaskensis,* n. sp., few; *Cystisella fragilis,* few; *C. bicornis,* n. sp., few; *Mucronella abyssicola,* few; *M. ventricosa,* few; *Costazia nordenskjoldi,* 9; *Diplosolen obelium* (C); *Cauloramphus cymbaeformis* (C). Entroprocts—*Barentsia gorbunovi,* 2. Cirripedes—*Balanus crenatus* (A). Isopods—*Phryxus abdominalis,* 2 pairs. Amphipods—*Rhachotropis aculeata,* 7; *Ischyrocerus commensalis,* 3; *Ericthonius hunteri* (C). Decapods—*Sabinea septemcarinata,* 2; *Pagurus trigonocheirus,* 9; *Eualus gaimardi,* 21. Pelecypods—*Hiatella arctica* (AAA). Gastropods—*Dendronotus frondosus* (?), 1.

STATION 11, at the shoreward edge of the mud zone, yielded nothing but holothurians—*Myriotrochus rinki,* 8.

STATION 14 was obviously in a good area but because of a strong current and wind working at cross purposes the dredge had to be taken in before the haul was complete. Animals: Bryozoans—*Rhamphostomella gigantea,* 1 large; *Alcyonidium polyoum* (C). Amphipods—*Eurystheus melanops,* 23; *Protomedeia fasciata,* 125; unidentified caprellid, sp. No. 2, 12. Decapods—*Pagurus splendescens,* 4; *P. trigonocheirus,* 33; *Chionocetes opilio,* 5. Pelecypods—*Cardita crassidens,* 3; *Hiatella arctica* (AA). Gastropods—*Volutopsius stefanssoni,* 1; *Buccinum tenue,* 2; *B. angulosum,* 2; *Boreotrophon* sp., 3.

STATION 15 was in the typical mud zone and few animals were taken: Bryozoans—*Borgiola pustulosa,* n. sp., encrusting on shell. Amphipods—*Sympleustes uncigera,* 5. Decapods—*Argis lar,* 2. Pelecypods—*Macoma calcarea* (C).

STATION 16 was in the area of the gravel zone but it was a region in which the sand had become segregated from the gravel and it formed a special habitat for certain animals: Amphipods—*Acanthostepheia behringiensis,* 2. Gastropods—*Aldisa zetlandica* (?), 2. Tunicates—*Rhizomolgula globularis* (AAA). (The dredge came up one-third full of these spherical, sand-encrusted animals.) Fishes—flatfish, 7 (about 1.5 in. long).

STATION 17 was in the typical mud zone. Animals: Hydroids—*Tubularia* sp., 1. Nemerteans—*Amphiporus pacificus,* 1; *Tetrastemma aberrans,* 2. Bryozoans—*Alcyonidium disciforme* (C). Amphipods—*Byblis gaimardii* (C); *Pleustes panoplus,* 1; *Weyprechtia heuglini,* 6; caprellid sp. No. 2, 17. Tunicates—*Styela rustica macrenteron,* 4.

STATION 18 was also in the mud zone. Since an attempt was being made to locate the border of the rubble zone, only a short haul was made. Animals: Bryozoans—*Costazia nordenskjoldi,* 3; *Alcyonidium polyoum* (C). Amphipods—caprellid sp. No. 2, 10. Decapods—*Pagurus trigonocheirus,* 3.

STATION 19 was also in a muddy area, so only a short haul was made. Animals: Amphipods—*Sympleustes karianus,* 1 (2d record for this species); *Rhachotropis aculeata,* 5; *Eurystheus melanops,* 6. Decapods—*Pandalus goniurus,* 2; *Sabinea septemcarinata,* 3.

STATION 20 was in the rubble zone and was one of the richest in animal life. No other station yielded so many echinoderms as this one. Animals: Sponges—*Leuconia ananas,* 3; *Myxilla incrustans,* 2 lots (around barnacles); *Topsentia disparilis,* 3. Hydroids—*Tubularia* sp., 3; unidentified gymnoblast (A); *Obelia* sp. (C); *Thuiaria* sp. (C); unidentified calyptoblasts, 3 species (C). Anthozoans—sea anemones (AA). Turbellarians—*Notoplana atomata,* 4. Nemerteans—*Amphiporus macracanthus,* 4. Sipunculids—*Golfingia mar-*

garitacea, 10. Bryozoans—*Bidenkapia spitzbergensis* (C); *Scrupocellaria scabra* var. *paenulata* (C); *Dendrobeania murrayana* (C); *Hippothoa expansa* (C); *Posterula sarsi* (C); *Pachyegis princeps* (A); *Porella compressa* (C); *Rhamphostomella gigantea* (C); *Costazia surcularis* (C); *C. ventricosa* (C); *Myriozoella plana* (C); *Myriozoum subgracile* (A); *Diaperoecia intermedia* (C), on shells and rocks; *D. johnstoni* (C); *Lichenopora verrucaria* (A). Ophiurans—*Gorgonocephalus stimpsoni,* 6; *Amphiuri sundevalli,* 16+; *Ophiopholis aculeata* (A); *Ophiura robusta* (A). Asteroids—*Crossaster papposus,* 2; *Henricia sanguinolenta,* 1. Echinoids—*Strongylocentrotus drobachiensis,* 173. Holothurians—*Psolus fabricii,* 118. Polychaetes—*Eusyllis blomstrandi,* 17; *Amphitrite cirrata,* 5; *Lanassa venusta,* 10; *Nicolea venustula,* 12; *Polycirrus medusa,* 6. Ostracods—*Philomedes globosus,* 2. Cirripedes—*Balanus crenatus* (C); *B. rostratus apertus* (C). Amphipods—*Aristias tumida* (from atrial cavity of tunicate *Molgula retortiformis*), 4; *Stegocephalopsis ampulla,* 1; *Gitanopsis arctica,* 2; *Acanthonotozoma serratum,* 3; *Sympleustes pulchellus,* 3; *S. uncigerus* 25; *Maera danae,* 6; *Photis reinhardi,* 7; *Eurystheus melanops,* 29; *Ischyrocerus latipes* (A); *I. commensalis,* 16; *Ericthonius hunteri,* 30; *E. tolli* (C); caprellids, sp. No. 1 (C), species No. 2 (A). Decapods—*Eualus gaimardi,* 87; *Lebbius polaris,* 2; *Pagurus trigonocheirus,* 36; *Hyas coarctatus alutaceus,* 21. Pelecypoda—*Astarte montagui* (C); *Serripes groenlandicus,* 3; *Hiatella arctica* (AAA). Gastropods—*Volutopsius stefanssoni,* 2; *Plicifusus kroyeri,* 1; *P. verkruzeni,* 3; *Colus spitzbergensis,* 2; *Buccinum glaciale,* 9; *B. morchianum,* 2; *B. plectrum,* 3; *Boreotrophon clathratus,* 8; *Boreotrophon* sp., 5; *Crepidula grandis,* 3. Tunicates—*Amaroucium fragile,* several; *Aplidiopsis pannosum,* 2; *Didemnum albidum,* 8; *Ascidia callosa,* 3; *Dendrodoa pulchella* (C); *D. grossularia,* 9; *Styela coriacea,* 16; *S. rustica macrenteron* (C); *Boltenia echinata,* 8; *B. ovifera,* 5; *Halocynthia aurantium,* 6; *Molgula* sp. No. 2, 10. Enteropneusts—Unidentified balanoglossid, 3.

Station 21 was in the rubble zone but there was more gravel than in typical rubble bottom. Animals: Anthozoans—Sea anemones (C). Bryozoans—*Rhamphostomella gigantea,* 1 large col.; *Myriozoella plana* (C); *Myriozoum subgracile* (C); *Crisia eburnea* (C); *Lichenopora verrucaria* (A). Echinoids—*Strongylocentrotus drobachiensis,* 37. Holothurians—*Psolus fabricii* (AAA). Decapods—*Spirontocaris arcuata,* 3; *Pagurus splendescens,* 3. Gastropods—*Plicifusus kroyeri,* 1; *Boreotrophon clathratus,* 2. Tunicates—*Molgula* sp. No. 1, 2, sp. No. 2, 9.

STATION 22 was in the typical rubble zone and yielded an abundance of species and individuals: Anthozoans—Sea anemones (C). Turbellarians—*Notoplana atomata,* 2. Nemerteans—*Amphiporus angulatus,* 3. Bryozoans—*Tricellaria erecta* (C); *Porella compressa,* 1 large; *Costazia ventricosa,* 1; *Flustrella corniculata* (C). Entoprocts—*Barentsia gorbunovi,* few. Ophiurans—*Gorgonocephalus stimpsoni,* 2. Echinoids—*Strongylocentrotus drobachiensis,* 33. Holothurians—*Psolus fabricii* (AA). Isopods—*Janiralata* sp., 9. Amphipods—*Mesometopa gibbosa,* n. sp., 6; *Stenothoides angusta,* n. sp., 8; *Sympleustes uncigerus,* 13; *Guernea nordenskiöldi,* 6; *Eurystheus melanops,* 7; *Dulichia porrecta,* 2. Decapods—*Sclerocrangon boreas,* 2; *Eualus gaimardi,* 11; *Pagurus splendescens,* 6; *Hyas coarctatus alutaceus,* 8. Pelecypods—*Hiatella arctica* (AA). Gastropods—*Margarites frigidus,* 9; *M. vahli,* 5; *Lepeta caeca,* 2. Tunicates—*Dendrodoa pulchella* (C); *Boltenia echinata,* 5.

STATION 23 was also in the typical rubble zone, about 6 miles from shore—as far as it was possible to go on account of the ice. Animal life was abundant: Hydroids—*Tubularia* sp., 2. Anthozoans—Sea anemones, 123. Turbellarians—*Notoplana atomata,* 2. Nematodes—*Thoracostoma* sp., 9 (from rocks broken apart). Nemerteans—*Amphiporus groenlandicus,* 2. Bryozoans—*Eucratea loricata* (C); *Bidenkapia spitzbergensis,* 2; *Euritina arctica,* n. sp., few; *Ragionula rosacea,* 3; *Pachyegis princeps,* 6; *Rhamphostomella gigantea* (C); *Costazia ventricosa* (C); *Myriozoella plana* (C); *Lichenopora verrucaria* (C). Polychaetes—*Gattyana cirrosa,* 11; *Potamilla reniformis,* 11. Ophiurans—*Gorgonocephalus stimpsoni,* 4; *Amphiura sundevalli,* 17+; *Ophiopholis aculeata,* 29; *Ophiura robusta,* 15. Echinoids—*Strongylocentrotus drobachiensis,* 73. Holothurians—*Psolus fabricii,* 86. Copepods—*Herpyllobius arcticus,* 2. Amphipods—*Ericthonius tolli* (C). Decapods—*Hyas coarctatus alutaceus,* 6. Gastropods—*Pyrulofusus deformis,* 1; *Neptunea* sp., 4. Tunicates—*Aplidiopsis pannosum,* 3; *Chelyosoma macleayanum,* 3; *Dendrodoa pulchella,* 6; *D. grossularia,* 9; *Halocynthia aurantium,* 3.

STATION 24 was at the very edge of the rubble zone and was characterized by pebbles rather than stones, a large quantity of old broken shells (largely *Hiatella*), and considerable mud. It was over a mile nearer shore than Station 21, and it was not nearly so rich in animal life. Animals: Hydroids—Unidentified calyptoblast (C); *Obelia* sp., few col.; *Lafoeina maxima* (A); *Sertularella* sp. (?) (C). Bryozoans—*Carbasea carbasea,* 6; *Tricellaria erecta* (C); *Porella compressa,* 3 large; *Rhamphostomella fortissima,* 2 large; *Costazia nordenskjoldi* (C); *Alcyonidium pedunculatum,* several. Cumaceans—2 large. Decapods—*Argis lar,* 3; *Eualus fabricii,* 3. Pelecypods—*Hiatella arctica* (AA). Tunicates—*Aplidiopsis pannosum,* 2; *Halocynthia aurantium,* 2; *Molgula* sp. No. 1, 2.

Station 25 was in the rubble zone but the large stones that came up in the dredge were not so covered with animals as were the smaller stones at most of the stations in the rubble zone. Animals: Ophiurans—*Amphiodia craterodmeta,* 2. Amphipods—*Ischyrocerus latipes,* 14. Decapods—*Eualus gaimardi,* 11. Pelecypods—*Nucula tenuis,* 14. Gastropods—*Neptunea* sp., 2. Tunicates—*Boltenia ovifera,* 5.

Station 26 was in the rubble zone and although it was 5 feet deeper than Station 20 it yielded far fewer species and individuals than did the latter. Animals: Bryozoans—*Plagioecia ambigua,* n. sp., 1. Amphipods—*Stegocephalus inflatus,* 1. Decapods—*Pandalus goniurus,* 2; *Spirontocaris spina,* 2; *Hyas coarctatus alutaceus,* 16. Pelecypods—*Astarte montagui,* 12. Gastropods—*Neptunea* sp., 2; *Boreotrophon clathratus,* 1; *B. beringi,* 2. Tunicates—*Boltenia echinata,* 4.

Station 27 was rich in both species and individuals. Mollusks were prominent in the hauls. Animals: Sponges—*Halichondria lambei* (C). Hydroids—*Tubularia* sp., 3. Nemerteans—*Tubulanus annulanus,* 3+. Sipunculids—*Golfingia margaritacea,* 5. Bryozoans—*Tegella magnipora,* n. sp., few; *Pachyegis princeps* (A). Polychaetes—*Gattyana cirrosa,* 10; *Syllis cornuta,* 11; *Cirratulus cirratus,* 15; *Idanthyrsus armatus,* 4; *Potamilla neglecta,* 5. Ophiurans—*Ophiura robusta,* 3. Asteroids—*Solaster endeca,* 1. Isopods—*Janiralata* sp., 3. Amphipods—*Pleustes medius,* 3; *Eusirus cuspidatus,* 5; *Sympleustes uncigera,* 4; *Paramphithoë polyacantha,* 2. Decapods—*Hyas coarctatus alutaceus,* 6. Pelecypods—*Nuculana* sp., 3; *Pecten islandicus,* 2; *Musculus corrugatus,* 7; *Astarte borealis,* 2; *A. montagui* (A); *Lyonsia norvegica,* 1. Gastropods—*Plicifusus verkruzeni* 2; *Colus spitzbergensis,* 3; *Neptunea* sp., 3; *N. ventricosa,* 3. *Buccinum glaciale,* 5; *Onchidiopsis glacialis* (?), 1; *Margarites costalis* var. *grandis,* 17; *Lepeta caeca,* 2. Amphineurans—*Trachydermon albus,* 7. Tunicates—*Chelyosoma macleayanum,* 9.

Station 28 was in the typical mud zone and yielded the usual small number of animals: Anthozoans—*Halcampa duo-decimcirrata* (?), 1. Decapods—*Chionocetes opilio,* 35. Pelecypods—*Macoma calcarea,* 5.

Station 29 was on the shoreward side of Station 32 (see below). The rubble bottom of this station was rich in animal life: Sponges—*Craniella* sp. nov., 1. Hydroids—*Hydractinia* sp. (C). Bryozoans—*Eucratea loricata* (A); *Ragionula rosacea,* 3; *Hippodiplosia cancel-*

lata, R; *Porella compressa*, 1 large; *Costazia surcularis*, several; *Diplosolen obelium* (C). Cirripedes—*Clistosaccus paguri*, 1; *Peltogaster depressus*, 1; *Balanus balanus* (C); *B. rostratus apertus* (C). Cumaceans—*Diastylis dalli*, few. Amphipods—*Onisimus affinis*, 3; *Eusirus cuspidatus*, 4. Pelecypods—*Pecten islandicus*, 2; *Musculus discors*, 30 (up to 9 mm.). Gastropods—*Ptychatractus occidentalis*, 2; *Pyrulofusus deformis*, 1 small; *Beringius stimpsoni*, 2; *Colus spitzbergensis*, 2; *Neptunea* sp., 3; *Buccinum plectrum*, 5; *Trichotropis bicarinata*, 2. Amphineurans—*Symmetrogephyrus vestitus*, 5.

Station 30-31 was on the oceanward side of Station 32 (see below). The rubble bottom here was not quite so rich in animal life as that on the shoreward side of Station 32. Some of the largest sea urchins found were taken at this station but there were only a few specimens. Animals: Sponges—*Polymastia andrica*, ½ (the only specimen taken of this red, cylindrical sponge). Anthozoans (octocoral)—*Eunephthya rubiformis*, several col. Bryozoans—*Hincksina gothica*, n. sp. (C); *Emballotheca stylifera* (C); *Porella minuta* (C); *Cystisella fragilis*, few; *Lichenopora canaliculata*, few; *L. verrucaria* (A). Ophiurans—*Gorgonocephalus stimpsoni*, 2. Echinoids—*Strongylocentrotus drobachiensis*, several. Amphipods—*Photis reinhardi*, 5. Gastropods—*Beringius stimpsoni*, 2; *Neptunea ventricosa*, 2; *Buccinum plectrum*, 10; *Margarites costalis*, 6. Amphineurans—*Trachydermon albus*, 5.

Station 32 was a complete surprise. It was a canyon 12.1 miles from shore, of undetermined length, about 0.25 mile wide and 741 feet deep, with fairly abrupt walls. The floor of the ocean was at a depth of 438 feet on the shoreward side of the canyon and 522 feet on the oceanward side. The substratum of the canyon was mud, but it was soft, and not stiff, sticky, or clayey like that of the mud zone near shore. As far as could be determined, the entire floor of the canyon was covered with worm tubes of the terebellid *Pista maculata*. Dredge hauls brought up bushels of them. Dr. Pettibone identified 27 other species of polychaetes that occurred in lesser numbers among the tubes of *Pista*. Of these 27 species 11 were tube dwellers also: *Flabelligera affinis*, 1; *Nicomache lumbricalis*, 1; *Pectinaria granulata*, 5; *P. hyperborea*, 10; *Nicolea venustula*, 1; *Terebellides stroemi*, 1; *Thelepus cincinnatus*, 1; *Euchone analis*, 1; *Potamilla neglecta*, 9; *Sabella crassicornis*, 3; and *Spirorbis granulatus*, 1. There were 5 species of polynoids: *Arcteobia anticostiensis*, 1; *Enipo gracilis*, 1; *Gattyana cirrosa*, 11; *Harmothoë extenuata*, 43; and *H. imbricata*, 1. *Arcteobia anticostiensis* is known to be commensal with *Pista flexuosa* (Labrador) and *Enipo gracilis* with *Nichomache lumbricalis* (Alaska;

Halifax, Nova Scotia; and Cape Cod, Mass.). The remaining 11 species were: *Phyllodoce groenlandica,* 1; *Autolytus alexandri,* 2; *Eusyllis blomstrandi,* 1; *Exogone naidina,* 1; *Syllis cornuta,* 4; *S. fasciata,* 16; *Nephtys discors,* 1; *N. paradoxa,* 2; *Lumbrineris fragilis,* 1; *Chaetozone setosa,* 1; and *Brada inhabilis,* 5.

It was impossible to pick over minutely the entire mass of worm tubes of *Pista* brought up; they were hard to untangle, and it was very difficult to remove a worm intact from its tube. A few (about 115)—both tubes with worms and worms that had been removed—were sent to Dr. Pettibone.

Other animals from this station were: Sponges—*Craniella* sp. nov., 2; *Echinoclathria beringensis,* 3. Nematodes—unidentified species (C). Nemerteans—*Amphiporus angulatus,* 10+; *A. groenlandicus,* 2+; *A. lactifloreus,* 3; *Cerebratulus marginatus,* 1. Sipunculids—*Golfingia margaritacea,* 8. Priapulids—*Priapulus caudatus,* 1. Brachiopods—*Diestothyris spitzbergensis,* 5. Bryozoans—*Eucratea loricata* (C-A); *Terminoflustra membranacco-truncata,* 1 large (with the exception of one small colony, this species was taken only at this station and Station 36); *Alcyonidium enteromorpha* (a new species) (A). Ophiurans—*Amphiura sundevalli,* 20; *Ophiura sarsi,* 49; *O. robusta,* 19. Asteroids—*Leptasterias groenlandica* forma *cribraria,* 5; *Henricia sanguinolenta,* 1. Ostracods—*Philomedes globosus,* 13; *Asterope mariae,* 1; *Cytheridea punctillata,* 5; *Cyprideis sorbyana,* 2. Copepods—*Herpyllobius arcticus,* 3. Cumaceans—*Diastylis dalli,* few. Amphipods—*Pontoporeia femorata,* 18 (these and two from Station 36 were the only ones obtained that were not washed ashore). Pelecypods—*Musculus discors* var. *laevigatus,* 19; *M. corrugatus,* 13; *Mysella planata,* 4. Gastropods—*Neptunea* sp., 3; *Tachyrhynchus reticulatus,* 4; *Polinices pallidus,* 2; *P. monteronus,* 2; *Margarites frigidus,* 14. Tunicates—*Didemnum albidum,* 23.

Station 33 was in a good area of the rubble zone, for it yielded a large number of species and of individuals. Many of the rocks were perforated with burrows and holes. Those areas in which *Psolus* and sea urchins were abundant were always rich in other animal life: Sponges—*Leuconia* sp. nov., 6+; *Echinoclathria beringensis,* several; *Myxilla incrustans,* few. Hydroids—*Tubularia* sp., 8; *Thuiaria elegans,* 11; unidentified calyptoblast, many large. Anthozoans (octocoral)—*Eunephthya rubiformis* (C). Turbellarians—*Notoplana atomata,* 4. Nemerteans—*Amphiporus angulatus,* 3; *Tetrastemma candidum,* 3. Bryozoans—*Eucratea loricata* (C); *Bidenkapia spitzbergensis* (A); *Tricellaria erecta* (C); *Dendrobeania murrayana* (A); *Porella compressa* (C); *Myriozoella plana* (C); *Myriozoum* *subgracile* (C); *Lichenopora verrucaria* (A). Polychaetes—*Syllis fasciata,* 15; *Chone infundibuliformis,* 5; *Spirorbis spirillum,* 13. Asteroids—*Leptasterias arctica,* 1. Echinoids—*Strongylocentrotus drobachiensis,* several. Cirripedes—*Balanus crenatus* (young) (AA). Isopods—*Janiralata* sp., 4; *Munna* sp., 3. Amphipods—*Metopa clypeata,* 5; *Proboloides nordmanni,* 3; *Ericthonius tolli,* 15; *Eurystheus melanops,* 6; *Ischyrocerus latipes* (C); *I. commensalis,* 3. Pelecypods—*Musculus corrugatus,* 4; *Hiatella arctica* (A). Gastropods—*Plicifusus verkruzeni,* 3; *Neptunea* sp., 2; *Natica clausa,* 3; *Margarites vahli,* 7. Tunicates—*Didemnum albidum,* 14; *Boltenia echinata,* 5; *B. ovifera,* 23; *Halocynthia aurantium,* 2; *Molgula griffithsi,* 4; *Molgula* sp. No. 2 (A).

Station 34 was in the shoreward part of the mud zone and yielded little besides holothurians—*Myriotrochus rinki* (AA).

Station 35 was in the rubble zone but, compared with other areas with similar bottom, its animal life was relatively sparse as far as individuals were concerned although there were a large number of species. Many of the stones and rocks were porous and brittle, and some were riddled with holes and tunnels that provided refuge for polychaetes. Only a very few live snails were found at this station, and Foraminifera, usually abundant on such bottoms, were very scarce. Amphipods were also scarce, probably because of the scarcity of hydroids and bryozoans. Animals collected were: Anthozoans (octocoral)—*Eunephthya rubiformis,* few. Turbellarians—*Notoplana atomata,* 3. Brachiopods—*Hemithyris psittacea,* 11; *Diestothyris spitzbergensis,* 3. Bryozoans—*Eucratea loricata* (C); *Dendrobeania murrayana* (C); *Microporella arctica,* few; *Smittina bella* (C); *Proboscina incrassata* (C); *Lichenopora verrucaria* (A); *Flustrella corniculata* (A); *Vesicularia fasciculata,* n. sp., few. Entoprocts—*Barentsia gorbunovi,* few. Polychaetes—*Gattyana cirrosa,* 10; *Sabella crassicornis,* 3; *Syllis fasciata,* 18; *Cirratulus cirratus,* 14; *Capitella capitata,* 9. Echinoids—*Strongylocentrotus drobachiensis,* several. Cirripedes—*Balanus rostratus apertus* (C). Isopods—*Janiralata* sp., 4. Amphipods—*Maera danae,* 6. Decapods—*Pagurus trigonocheirus* (C). Gastropods—*Epitonium greenlandicum,* 1; *Crepidula grandis,* several. Amphineurans—*Symmetrogephyrus vestitus,* 1. Tunicates—*Chelyosoma macleayanum,* 4 (exceptionally large); *Boltenia ovifera,* 4.

Station 36 was a muddy area in the rubble zone. In many respects it was like Station 32, having a soft, muddy bottom, with large masses of the tubes of the terebellid *Pista maculata.* Several species of animals, such as the bryozoans *Terminoflustra membranaceo-trun-*

cata and *Alcyonidium enteromorpha* (a new species), were restricted to these two stations. There were a few large rocks that were entirely lacking at Station 32. Animals: Hydroids—*Lafoeina maxima* (AAA). Nematodes—Unidentified species (associated with *Alcyonidium enteromorpha,* hence found only here and at Station 32). Nemerteans—*Lineus ruber,* 1; *Tetrastemma candidum,* 3. Bryozoans—*Eucratea loricata* (A); *Electra crustulenta* (A); *Terminoflustra membranaceo-truncata,* 1 large col.; *Mucronella microstoma* (C); *Costazia nordenskjoldi* (C); *Alcyonidium enteromorpha* (C) (see Station 32); *Flustrella corniculata* (C). Entoprocts—*Barentsia gorbunovi,* 1 very large. Polychaetes—*Pectinaria hyperborea,* 3; *Pista maculata* (AAA). Ophiurans—*Amphiura sundevalli,* 8; *Ophiura robusta,* 9; *O. sarsi,* 18; *Ophiopholis aculeata,* 5. Amphipods—*Pontoporeia femorata,* 2; *Ischyrocerus latipes,* 7; *Unciola leucopis,* 3. Pelecypods—*Nuculana* sp., 6; *Musculus discors* var. *laevigatus,* 54; *M. corrugatus,* 25; *Cardita crassidens,* 3; *Hiatella arctica,* dozens (3-22 mm.). Gastropods—*Tachyrhynchus reticulatus,* 4; *Aquilonaria turneri,* 1; *Margaritopsis pribiloffensis,* 2; *Margarites frigidus,* 21. Tunicates—*Molgula griffithsi,* 4.

Station 37 was in an area of the rubble zone that was above average in the richness of its fauna. The larger perforated rocks afforded space for attachment for such animals as erect bryozoans and tunicates and the holes in the rocks provided refuge for worms and other animals. Animals: Sponges—*Myxilla incrustans,* 4. Hydroids—*Thuiaria elegans,* 10. Anthozoans (octocoral)—*Eunephthya rubiformis,* several large. Nemerteans—*Amphiporus pacificus,* 3+; *Tetrastemma* sp., 2+. Sipunculids—*Golfingia margaritacea,* 11. Brachiopods—*Hemithyris psittacea,* 4. Bryozoans—*Dendrobeania murrayana* (C); *Stomachetosella distincta,* few; *Ragionula rosacea,* 8 col.; *Emballotheca stylifera* (C); *Smittina bella* (A); *Costazia ventricosa* (C); *Myriozoum subgracile* (C); *Plagioecia grimaldii,* few; *Diplosolen obelium* (A); *Lichenopora verrucaria* (A); *Flustrella corniculata* (AA); *F. gigantea* (C). Polychaetes—*Arcteobia anticostiensis,* 4; *Eunoë oerstedi,* 4; *Sphaerosyllis erinaceus,* 13; *Syllis cornuta,* 14; *Chaetozone setosa,* 7; *Cirratulus cirratus,* 21; *Capitella capitata,* 7; *Lanassa venusta,* 7. Ophiurans—*Amphiura sundevalli,* 5; *Ophiopholis aculeata,* 12. Amphipods—*Metopa clypeata,* 5; *Metopelloides stephenseni,* 1; *Ericthonius tolli,* 17; *Maera danae,* 13; *Eurystheus melanops,* 36; *Ischyrocerus latipes,* 6; *Paradulichia typica,* 2. Decapods—*Eualus gaimardi,* 15; *Spirontocaris phippsi,* 2. Pelecypods—*Hiatella arctica* (A). Gastropods—*Crepidula grandis,* 3; *Lepeta caeca,* 10; *Oenopota tenuilirata,* 2. Amphineurans—*Trachydermon* *albus,* 7. Tunicates—*Didemnum albidum,* 10; *Chelyosoma macleayanum,* 4; *Boltenia echinata,* 12; *B. ovifera,* 5.

STATION 38 was in a less productive area than the above station. The bottom of pebbles, gravel, and mud does not provide as much attachment space as does the type of bottom in Station 37. Animals: Hydroids—*Tubularia* sp., 3; *Thuiaria elegans,* 4. Anthozoans—*Cerianthus* sp., 8. Bryozoans—*Eucratea loricata* (C). Entoprocts—*Barentsia gorbunovi* (C). Amphipods—*Anonyx nugax,* 3; *Byblis gaimardii,* 5; *Melita dentata,* 5. Pelecypods—*Liocyma fluctuosa,* 3.

STATION 39 was either a muddy spot in the rubble zone or else a tongue of the muddy zone extending into the rubble zone. Animals: Polychaetes—*Nephtys ciliata,* 6; *Sternaspis scutata,* 3; *Chone duneri,* 3. Pelecypods—*Macoma calcarea,* 14.

STATION 40, in the gravel zone, yielded little of note besides Nemerteans—*Tubulanus capistratus,* 1; and Gastropods—*Aldisa zetlandica* (?), 1.

STATION 41 was in one of the less productive areas of the rubble zone. There were few stones of intermediate size and the contrast between the gravel and small stones and the large rocks was marked. However, the haul was satisfactory and several noteworthy animals were brought up: Turbebellarians—*Acerotisa arctica* (new), 2. Nemerteans—unidentified sp., 6. Brachiopods—*Hemithyris psittacea,* 6. Bryozoans—*Dendrobeania murrayana,* 4; *Ragionula rosacea,* 4; *Emballotheca stylifera* (C); *Porella minuta* (C); *Mucronella microstoma* (C); *Oncousoecia canadensis* (C); *Borgiola pustulosa,* n. sp., 1 very large col.; *Lichenopora verrucaria* (A). Polychaetes—*Trichobranchus glacialis,* 6. Holothurians—*Psolus fabricii* (C). Amphipods—*Maera danae,* 7; *Unciola leucopis,* 5. Decapods—*Pagurus trigonocheirus,* few; *Hyas coarctatus alutaceus,* few. Pelecypods—*Nuculana minuta,* 3; *Astarte borealis,* 3; *A. montagui* (C) (many of them drilled); *Yoldia myalis* (C). Gastropods—*Natica clausa* (C); *Boreotrophon clathratus,* 3; *B. beringi,* 1; *B. pacificus,* 1.

STATION 42, in the rubble zone, with some perforated rocks, was very rich in animal life: Hydroids—*Thuiaria elegans,* 16; unidentified calyptoblast No. 1 (AA); calyptoblast No. 2 (C). Anthozoans—unidentified sea anemone (C). Nemerteans—*Amphiporus angulatus,* 8; *Tetrastemma candidum,* 4; *Tubulanus albocinctus,* 3. Sipunculids—*Golfingia margaritacea,* 10. Bryozoans—*Hincksina gothica,* n. sp. (C); *Eucratea loricata* (A); *Tricellaria erecta* (A); *Ragionula rosacea,* 4; *Porella minuta* (C); *Costazia surcularis* (C); *Myriozoum subgracile* (A); *Oncousoeicia canadensis* (C); *Diplosolen obelium* (C); species encrusting rocks (AA). Entoprocts—

Coriella stolonata, few. Polychaetes—*Eunoë nodosa,* 5; *E. oerstedi,* 4; *Gattyana cirrosa,* 18; *Harmothoë extenuata,* 22; *H. imbricata,* 18; *Cirratulus cirratus,* 22. Asteroids—*Leptasterias arctica,* 1. Echinoids—*Strongylocentrotus drobachiensis,* several large. Holothurians—*Psolus fabricii,* 7. Cirripedes—*Balanus crenatus* (A). Amphipods—*Metopa robusta,* 2; *Syrrhoe crenulata,* 3; *Sympleustes uncigerus,* 30; *Melita dentata,* 4; *Ischyrocerus latipes,* 8; *Unciola leucopis,* 6. Decapods—*Pagurus trigonocheirus,* several; *Hyas coarctatus alutaceus,* several (few large males). Pelecypods—*Pecten islandicus,* 3 (very young); *Musculus corrugatus,* 9; *Astarte borealis,* few; *A. montagui* (A); *Hiatella arctica* (A). Gastropods—*Natica clausa* (C); *Boreotrophon* sp. (C); *Margarites costalis* (C); *Buccinum* (several species), 1 or 2 each. Cephalopods—*Benthoctopus hokkaidensis,* 1 (the only specimen taken).

Station 43 was in a gravel area of the rubble zone with a large amount of mud. There were chunks in which the gravel was cemented together with mud. The station was fairly productive of animal life: Foraminifera (A). Hydroids—*Thuiaria elegans,* 6; *Lafoeina maxima,* few. Anthozoans (octocoral)—*Eunephthya rubiformis,* few. Nemerteans—*Amphiporus pacificus,* 5+. Echiuroids—*Echiurus echiurus alaskanus,* 1 small. Bryozoans—*Eucratea loricata* (A); *Carbasea carbasea,* several col.; *Tricellaria erecta* (A); *Costazia nordenskjoldi* (A); *Flustrella corniculata* (C). Polychaetes—*Harmothoë extenuata* (C); *H. imbricata* (C); *Pectinaria granulata,* 14; *Terebellides stroemi,* 9; *Chone infundibuliformis,* 6. Cirripedes—*Balanus crenatus* (AA). Isopods—*Phryxus abdominalis,* 2 pairs. Amphipods—*Byblis gaimardii,* 9+; *Ischyrocerus latipes,* 33. Decapods—*Eualus gaimardi,* 16. Pelecypods—*Nuculana minuta,* few; *Yoldia myalis,* 12; *Macoma calcarea,* 8; *Hiatella arctica* (A) (nestling among barnacles). Gastropods—*Piliscus commodus,* 6; *Oenopota harpa,* 2; *Natica clausa,* C.

Station 44, in a typical rubble-zone area, was exceedingly rich in marine invertebrates. The abundance of animal life was comparable with that of Station 20. Echinoderms and sea anemones formed a conspicuous part of the fauna from Station 20, and mollusks and polychaetes were predominant forms from Station 44. Animals: Sponges—*Choanites suberea,* 2; *Echinoclathria beringensis,* 2; *Halichondria lambei* (C); *Topsentia disparilis* (C). Hydroids—*Hydractinia* sp. (C); *Lafoeina maxima* (AA); *Thuiaria elegans,* 6; *Thuiaria* sp. (A); unidentified calyptoblast (C). Turbellarians—*Acerotisa arctica,* 2. Brachiopods—*Hemithyris psittacea,* 12. Bryozoans—*Eucratea loricata* (AA); *Electra crustulenta* (A); *Bidenkapia spitzbergensis*

(C); *Dendrobeania murrayana* (A); *Emballotheca stylifera* (C); *Pachyegis princeps* (A); *Escharoides jacksoni,* few; *Porella compressa* (C); *P. minuta* (C); *Smittina bella* (A); *Mucronella microstoma,* (C); *Costazia surcularis* (A); *C. ventricosa* (A); *Borgiola pustulosa,* n. sp. (C); *Lichenopora verrucaria* (A); *Alcyonidum polyoum* (A); *Flustrella corniculata* (A). Polychaetes—*Arcteobia anticostiensis,* 4; *Harmothoë extenuata,* 31; *H. imbricata,* 13; *Eumida minuta,* 28; *Autolytus fallax,* 13; *A. alexandri,* 10; *Exogone naidina,* 49; *Sphaerosyllis erinaceus,* 11; *Syllus cornuta,* 17; *S. fasciata,* 41; *Chaetozone setosa,* 8; *Cirratulus cirratus,* 31; *Nicomache lumbricalis,* 7. Amphiurans—*Gorgonocephalus stimpsoni,* few. Holothurians—*Psolus fabricii,* 34. Cirripedes—*Balanus crenatus* (AAA); *B. rostratus apertus,* few. Copepods—*Schizoproctus inflatus,* 2. Isopods—*Synidotea bicuspida,* 2; *Munna* sp., 24. Amphipods—*Photis reinhardi,* 25; *Eurystheus melanops,* 6; *Ischyrocerus latipes,* 9; *Unciola leucopis,* 4. Decapods—*Sclerocrangon boreas,* 4; *Eualus gaimardi,* 18; *Pagurus trigonocheirus,* 12; *Hyas coarctatus alutaceus,* 15. Pelecypods—*Musculus corrugatus,* 25 small; *Astarte montagui* (AAA); *Cardita crassidens,* 3. Gastropods—*Ptychatractus occidentalis,* 3; *Neptunea ventricosa,* 2; *Buccinum plectrum,* 4; *B. fringillum,* 2 (the only specimens taken); *Boreotrophon* sp. (C); *Piliscus commodus,* 9; *Aquilonaria turneri,* 1; *Natica clausa,* 5; *Onchidiopsis glacialis,* 1; *Molleria costulata,* 3; *Solariella obscura,* 4 juv.; *Margarites costalis,* 26; *M. frigidus,* 4; *Velutina velutina,* 2; *Lepeta caeca,* 2. Amphineurans—*Trachydermon albus,* 2; *Symmetrogephyrus vestitus,* 12. Tunicates—*Amaroucium* sp., 3; *Chelyosoma macleayanum,* 8; *Styela rustica macrenteron,* 8; *Boltenia ovifera,* 31 (host of copepods mentioned above).

Station 45, in the rubble zone, had a fairly rich fauna, and mollusks were conspicuous in the hauls. Animals: Sponges—*Cioxeamistia* sp. (C); *Echinoclathria beringensis,* 3; *Myxilla incrustans,* 1 lot; *Halichondria lambei* (C). Hydroids—Unidentified calyptoblast (C). Anthozoans—Sea anemones, 22; *Eunephthya rubiformis* (octocoral) (C). Bryozoans—*Eucratea loricata* (C); *Emballotheca stylifera* (C); *Porella minuta* (C); *Mucronella microstoma* (C); *Lichenopora verrucaria* (A); other encrusting forms (A); *Flustrella gigantea* (A). Entoprocts—*Barentsia gorbunovi,* 2. Polychaetes—*Autolytus fallax,* 7. Ophiurans—*Ophiura robusta,* 4. Echinoids—*Strongylocentrotus drobachiensis,* several. Holothurians—*Psolus fabricii,* 26. Cirripedes—*Balanus balanus* (C); *B. rostratus apertus* (C). Amphipods—*Metopella nasuta,* 1; *Stenothoe barrowensis,* n. sp., 2; *Metopelloides tattersalli* (2d record of this species), 1; *Parapleustes* *pulchellus,* 1; *Eusirus cuspidatus,* 6; *Melita dentata,* 3; *Guernea nordenskiöldi,* 1; *Ericthonius tolli,* 30. Decapods—*Eualus gaimardi,* 38; *Hyas coarctatus alutaceus,* 3. Pelecypods—*Astarte borealis,* 2; *Cardita crassidens,* 8; *Liocyma becki,* 4. Gastropods—*Admete middendorffiana,* 2; *Ptychatractus occidentalis,* 3; *Neptunea ventricosa,* 2; *Buccinum plectrum,* 6; *B. polare,* 2; *Piliscus commodus,* 6; *Boreotrophon clathratus,* 3; *Natica clausa,* 5; *Polinices pallidus,* 2; *Margarites costalis,* 31. Amphineurans—*Trachydermon albus,* 3; *Symmetrogephyrus vestitus,* 10.

Station 46 was also in the rubble zone. Although common, the encrusting bryozoans were not so abundant at this station as at the following station. Animal life was only fairly abundant: Hydroids—*Lafoeina maxima* (AA). Anthozoans—sea anemones, 8. Nemerteans—*Tetrastemma* sp., several; *Amphiporus pacificus,* 2. Brachiopods—*Diestothyris spitzbergensis,* 7. Bryozoans—*Lichenopora verrucaria* (C); *Alcyonidium polyoum* (C). Polychaetes—*Harmothoë extenuata,* 4; *H. imbricata,* 15. Ophiurans—*Ophiura nodosa,* 1 (the only specimen taken). Echinoids—*Strongylocentrotus drobachiensis,* few (the largest specimens taken). Holothurians—*Psolus fabricii,* 3. Cirripedes—*Balanus crenatus,* few (C). Amphipods—*Onisimus affinis,* 2; *Ampelisca birulai,* 3; *Byblis gaimardii,* A; *Haploops laevis,* 5+; *Ischyrocerus latipes* (C); caprellids (C). Decapods—*Pandalus goniurus,* 2; *Eualus gaimardi* (C); *Pagurus splendescens,* 2; *P. trigonocheirus,* 5; *Hyas coarctatus alutaceus,* 17 (some especially large specimens). Pelecypods—*Astarte borealis,* 2; *A. montagui,* 5. Gastropods—*Neptunea* sp., 4; *N. ventricosa,* 3; *Epitonium greenlandicum,* 2.

Station 47 was in a particularly rich area of the rubble zone. The abundance of its fauna was comparable to that of Stations 20 and 44: Sponges—*Leuconia ananas,* 5+. Hydroids—Unidentified calyptoblast (C); *Lafoeina maxima* (C). Anthozoans—Sea anemones, 15. Turbellarians—*Notoplana atomata,* 9. Nemerteans—*Amphiporus angulatus,* 12; *A. lactifloreus,* 10+; *A. pacificus,* 8+. Sipunculids—*Golfingia margaritacea,* 3. Bryozoans—*Eucratea loricata* (AAA); *Electra crustulenta* (A); *Bidenkapia spitzbergensis* (AA); *Tricellaria erecta* (AA); *Dendrobeania murrayana* (A); *Ragionula rosacea,* several col.; *Pachyegis princeps* (A); *Costazia nordenskjoldi* (A): *Hincksina nigrans* (A); other species encrusting on stones (AA); *Lichenopora verrucaria* (C). Entroprocts—*Barentsia gorbunovi* (A). Polychaetes—*Eunoë nodosa,* 5; *Harmothoë extenuata,* 51; *H. imbricata,* 29; *Pholoë minuta,* 8; *Eteone flava,* 6; *Eumida minuta,* 10; *Autolytus fallax,* 6; *Eusyllis blomstrandi,* 30; *Syllis fas-*

ciata, 20; *Lumbrineris fragilis,* 5; *Lanassa venusta,* 6; *Nicolea venustula,* 7; *Pista maculata,* 6; *Polycirrus medusa,* 12; *Terebellides stroemi,* 7; *Spirorbis spirillum,* 14. Ophiurans—*Amphiodia craterodmeta,* 2. Echinoids—*Strongylocentrotus drobachiensis,* several. Cirripedes—*Balanus crenatus* (adults) (AAAA, young specimens 1-3 mm. long, growing on practically everything). Copepods—*Schizoproctus inflatus,* 7. Amphipods—*Anonyx nugax,* 3; *Byblis gaimardii,* 14+; *Haploops laevis,* 7+; *Gitanopsis arctica,* 4; *Acanthonotozoma serratus,* 15; *Metopa clypeata,* 9; *M. longicornis,* 25; *M. spinicoxa,* n. sp., 30; *Sympleustes uncigerus,* 35; *Eusirus cuspidatus,* 24; *Melita dentata,* 16; *Maera danae,* 8; *Eurystheus melanops,* 9; *Ischyrocerus latipes* (C); *Ericthonius hunteri,* 15. Decapods—*Sclerocrangon boreas,* 4; *Eualus gaimardi,* 165; *Spirontocaris phippsi,* 4; *S. spina,* 2; *Pagurus splendescens,* 14; *P. trigonocheirus,* 13; *Hyas coarctatus alutaceus,* 13. Pelecypods—*Astarte montagui* (A). *Cardita crassidens,* 3; *Hiatella artica* (A). Gastropods—Dorids (white), 3; *Buccinum glaciale,* 6; *B. morchianum,* 2; *Piliscus commodus,* 34; *Natica clausa,* 4; *Margarites costalis,* 8; *M. vahli,* 5; *Oenopota harpa,* 2. Tunicates—*Chelyosoma macleayanum,* 3; *Styela rustica macrenteron,* 4; *Boltenia ovifera* (A); *Molgula griffithsi* (A).

Station 48 was 2.5 miles from shore, at a depth of 129.5 feet in what would supposedly be the rubble zone, but here the rubble was covered by a mud deposit. A bottom sampler used through a hole in the ice brought up very little except mud. Animals: Amphipods—*Haploops laevis,* 1 female with 90 peach-colored eggs containing embryos in which eye spots and appendages were visible. Pelecypods—*Nuculana minuta,* 2 (1 a dead shell); *Astarte montagui,* 1; *Macoma calcarea,* 1.

Station 49 was over the rubble zone where mud had been deposited. At a distance of 3.1 miles from shore, holes were made through 6 inches of ice where a lead had frozen over, and a dredge was lowered to the bottom and pulled by a dog team, but the holes were too close together to get sufficient horizontal pull. The dredge brought up some small stones mixed with the mud. Insofar as is possible, a complete list of the animals taken is given below:

Animal	Number	Remarks
Hydroids:		
Lafoeina maxima		Several colonies
Nemerteans:		
Amphiporus imparispinosus	1	
Sipunculids:		
Golfingia margaritacea	1	Small

Animal	Number	Remarks
Bryozoans:		
Eucratea loricata	C	With brown bodies
Alcyonidium polyoum	C	With oocells—orange eggs
Carbasea carbasea	C	Full of brown bodies
Polychaetes:		
Eunoë nodosa	1	
Gattyana cirrosa	1	
Harmothoë extenuata	1	
H. imbricata	3	
Pholoë minuta	1	
Eteone longa	2	
Castalia aphroditoides	1	Regenerating posterior end
Syllis cornuta	2	Epitokous form with swimming setae
Nephtys ciliata ?	1	Very young
Scoloplos armiger	1	
Chaetozone setosa	1	
Ampharete acutifrons	1	
A. goësi	2	
Cirripedes:		
Balanus crenatus	Few	
Amphipods:		
Byblis gaimardii	2	Juveniles under 5 mm.
Ischyrocerus latipes	6	1 ♂, 5 ♀, 1 with developing marsupium
I. commensalis ?	1	Ovigerous ♀, eggs in early stages
Ericthonius tolli	1	Other very small ones in mud nest
Decapods:		
Eualus gaimardi	2	♂♂
Pagurus trigonocheirus	3	small ♂♂
Pelecypods:		
Nucula tenuis	6	1 with empty gonads, others too immature to determine sex
Nuculana minuta	2	Both immature
Yoldia myalis	3	1 with immature eggs, 2 others too immature
Astarte montagui	10	6 appeared to have mature eggs
Hiatella arctica	2	
Gastropods:		
Oenopota harpa	1	

Station 50, at a distance of 3.2 miles from shore, was also over the rubble zone where mud had been deposited. Holes were made in the lead ice and the dredge was hauled by dog team between holes about 350 feet apart. This was the most successful of the winter dredgings. An attempt has been made to list all the animals collected:

Animal	Number	Remarks
Porifera:		
Unidentified species	1	
Hydroids:		
Syncoryne sp.	1	
Lafoeina maxima	AA	
Anthozoans:		
Burrowing anemones	3	
Nemerteans:		
Micrura alaskensis	1	
Amphiporus imparispinosus	2	
A. lactifloreus	1	
Unidentified sp.	1	
Tetrastemma bicolor	2	
Priapulids:		
Priapulus caudatus	1	
Brachiopods:		
Diestothyris spitzbergensis	13	All living; contained eggs
Hemithyris psittacea	C	Empty shells
Bryozoans:		
Eucratea loricata	C	Full of brown bodies
Carbasea carbasea	4	Some with brown bodies
Tricellaria erecta	3	Eggs and brown bodies in same colony
Dendrobeania murrayana	2	
Costazia nordenskjoldi	4	Apricot-colored eggs
Hincksina nigrans	C	In one colony there were several cells with brown bodies
Other encrusting species	A	Many with brown bodies
Alcyonidium pedunculatum	2	With active sperm
A. polyoum	C	With cells full of sperm
Vesicularia fasciculata, n. sp.	Few	
Polychaetes:		
Arcteobia anticostiensis	2	
Eunoë nodosa	2	
Gattyana cirrosa	2	
Harmothoë extenuata	3	
H. imbricata	4	
Eteone barbata	1	
E. flava	2	
Phyllodoce groenlandica	1	
Autolytus fallax	3	1 ♂ polybostrichus, 2 stem form
A. alexandri	1	
Eusyllis blomstrandi	6	
Exogone naidina	1	
Syllis cornuta	1	Epitokous form with swimming setae
Nephtys ciliata	1	
Glycinde wireni	3	
Lumbrineris fragilis	5	

Animal	Number	Remarks
Scoloplos armiger	4	
Polydora caulleryi	1	
Chaetozone setosa	1	
Brada villosa	1	
Scalibregma inflatum	3	
Praxillella praetermissa	2	
Pectinaria granulata	2	
P. hyperborea	1	
Ampharete goësi	8	
Nicolea venustula	2	
Polycirrus medusa	1	
Terebellides stroemi	13	
Trichobranchus glacialis	5	
Chone infundibuliformis	2	
Spirorbis granulatus	5	
Ophiurans:		
Amphiodia craterodmeta	2	
Holothurians:		
Unidentified sp.	1	
Cirripedes:		
Balanus crenatus	C	
Cumaceans:		
Leucon sp.	1	
Tanaidacids:		
Unidentified sp.	7	
Isopods:		
Phryxus abdominalis	1	
Amphipods:		
Anonyx nugax	2	1 ♀ 38 mm. long
Ampelisca birulai	2	
A. macrocephala	1	
Byblis gaimardii	3	1 young ♀, 2 ovigerous ♀♀ with embryos nearly ready to escape egg cases
Haploops laevis	12	
Maera danae	4	8 mm.
Lembos arcticus	2	
Photis reinhardi	7	1 ovigerous ♀—eggs in early stages
Unciola leucopis	2	1 ♂, 1 ♀
Ischyrocerus latipes	15	7 ♂♂, 8 ♀♀—1 with developing marsupium
Ericthonius hunteri	21	
E. difformis	1	
Dulichia spinosissima	1	♀ 35 mm. long
Caprellid	1	
Decapods:		
Eualus gaimardi	9	
Pagurus trigonocheirus	2	1 small ♂

Animal	Number	Remarks
Pycnogonids:		
Unidentified sp.	2	
Pelecypods:		
Nucula tenuis	8	Gonads immature
Nuculana minuta	2	" "
Yoldia myalis	1	
Astarte montagui	9	1 ♀ filled with mature eggs, 3 immature ♀♀, 1 ♀ with immature eggs, 4 ♂♂ with fairly well-filled testes
Macoma calcarea	1	
Liocyma fluctuosa	1	Shell only
Hiatella arctica	7	Gonads immature; also many small ones 2-3 mm. long on *Lafoeina maxima*
Gastropods:		
Admete middendorffiana	1	
Beringius stimpsoni	1	
Buccinum ciliatum	1	
Piliscus commodus	1	
Natica clausa	3	
Oenopota harpa	1	Apex covered with *Syncoryne* sp.
Tunicates:		
Styela rustica macrenteron	2	Gonads immature
Boltenia echinata	2	" "
B. ovifera	3	" "

STATION 51 was in the rubble zone, 3.1 miles from shore, where a very sticky mud had been deposited. The dredge haul was made by dog team. The following animals were collected: Nemerteans—*Tetrastemma candidum,* 2 (small). Polychaetes—*Gattyana cirrosa,* 1; *Syllis fasciata,* 1; *Scalibregma inflatum,* 1. Amphipods—*Onisimus affinis,* 2; *Byblis gaimardii,* 8; *Haploops laevis,* 1; *Podoceropsis lindhali,* 1 (♂); *Protomedeia fasciata,* 1 (♂); *Ischyrocerus latipes,* 1. Pelecypods—*Macoma calcarea,* 5 (2 ♀♀ with developing eggs, 3 ♂♂ with lively sperm).

STATION 52 was also in the rubble zone where mud had been deposited. It was 4.2 miles from shore. Holes were made through the ice where a lead had frozen over and 6 samples were taken with a bottom sampler. The following animals were collected: Protozoans—Foraminifera (C). Nemerteans—*Amphiporus imparispinosus,* 5. Bryozoans—*Eucratea loricata,* (C) (with brown bodies); *Carbasea carbasea,* few col. (with brown bodies); *Myriozoum subgracile,* small col. Polychaetes—*Scalibregma inflatum,* 1; *Ampharete acutifrons,* 1; *A. goësi,* 1.

STATION 53 was undoubtedly in the rubble zone but the small bottom sampler brought up nothing but mud. Numerous holes were made through the ice in a search for rubble bottom that was not covered with mud.

STATION 53a was also in the mud-covered rubble zone. A bottom sampler was used and only a few animals were brought up: Amphipods—*Socarnes bidenticulatus,* 1 (juvenile, 6.5 mm.); *Melita formosa,* 1 (♂).

STATION 53b was in the mud-covered rubble zone off Browerville (a portion of Barrow Village). It was 2.5 miles from shore. Bottom samples were taken at intervals in a line from Station 53a to 53b about 2.5 miles from shore, in a futile attempt to find an area not covered by mud. The following animals were taken: Polychaetes—*Eteone spetsbergensis,* 1. Amphipods—*Melita formosa,* 1 (♂).

STATION 54 was in the true mud zone. Animals: Anthozoans—*Cerianthus* sp., 7. Polychaetes—*Nephtys ciliata,* 5. Pelecypods—*Nucula tenuis,* 3; *Macoma calcarea,* 41.

STATION 55 was in the mud-covered rubble zone. The animals taken, especially the *Cerianthus,* indicate that they had reestablished themselves after the disturbance the preceding fall: Anthozoans—*Cerianthus* sp., 30. Pelecypods—*Yoldia hyperborea,* 1; *Macoma calcarea,* 34.

STATION 55a was in the mud-covered rubble zone. It yielded few animals, among which were Pelecypods—*Yoldia hyperborea,* 5; *Serripes groenlandicus,* 2.

STATION 56 was also in the mud-covered rubble zone. Some of the animals collected there were obviously reestablishing themselves. Anthozoans—*Cerianthus* sp., 5. Pelecypods—*Nucula tenuis,* 3; *Yoldia scissurata,* 1; *Y. hyperborea,* 2; *Serripes groenlandicus,* 3; *Macoma calcarea,* 20.

STATION 57 was undoubtedly in the mud-covered rubble zone, though at borderline depths of around 118 feet it would have been difficult during the summer of 1950 to determine whether the station was in the mud zone with stones from the rubble zone deposited there or in the rubble zone with a mud deposit. Some of the animals from this station were: Nemerteans—*Amphiporus lactifloreus,* 8. Bryozoans—*Vesicularia fasciculata,* n. sp., few. Polychaetes—*Chone infundibuliformis,* 5. Amphipods—*Haploops laevis,* 18+. Pelecypods—*Nucula tenuis,* 17; *Yoldia myalis,* 2; *Astarte montagui,* 4; *Macoma calcarea,* 14.

STATION 58 was also undoubtedly in the mud-covered rubble zone. Some of the animals, such as *Nucula tenuis,* were obviously transplants. Hydroids—*Tubularia* sp., 3. Pelecypods—*Nucula tenuis*, 14; *Astarte montagui*, 8; *Macoma calcarea*, 15; *M. oneilli*, 2.

STATION 59 was in the mud-covered rubble zone but it yielded a few more animals than some of the above stations. Most of these are listed below: Sponges—*Halichondria lambei* (C). Hydroids—*Lafoeina maxima* (C). Nemerteans—*Cerebratulus fuscus*, 1. Bryozoans—*Electra crustulenta* (C); *Crisia cribraria* (C); *Hincksina nigrans* (C); *Bidenkapia spitzbergensis* var. *alaskensis*, n. var. (C). Polychaetes—*Scalibregma inflatum*, 3; *Terebellides stroemi*, 8; *Chone duneri*, 4. Ophiurans—*Amphiodia craterodmeta*, 5. Copepods—*Choniostoma mirabile*, 3. Amphipods—*Haploops laevis*, 44; *Stegocephalus inflatus*, 1. Decapods—*Eualus gaimardi*, 34.

STATION 61 was in the rubble zone and had been covered with mud. Representative animals from this station were: Nemerteans—*Cerebratulus marginatus*, 1. Amphipods—*Socarnes bidenticulatus*, 3; *Acanthonotozoma serratum*, 2; *Maera danae*, 5. Decapods—*Pagurus trigonocheirus*, 6. Pelecypods—*Yoldia myalis*, 2; *Musculus niger*, 2. Gastropods—*Natica clausa*, 3.

STATION 62 was in the rubble-zone depth and had been covered with mud. Originally it may have been a special area of the rubble zone in which gravel rather than stones predominated, for the dredge brought up only mud and gravel without any stones. A laborious search yielded the following animals: Anthozoans—*Cerianthus* sp., 4. Bryozoans—*Alcyonidium pedunculatum*, 3. Decapods—*Eualus gaimardi*, 8. Pelecypods—*Nucula tenuis*, 7; *Yoldia myalis*, 2; *Musculus corrugatus*, 2; *M. niger*, 2; *Macoma calcarea*, 9. Gastropods—*Aquilonaria turneri*, 1 (a rare species).

The above collecting stations may be located on figure 1. From one to five or six hauls were made at each station. Had it been possible to identify all the specimens, the list for each station would have included other animals.

In addition to the above stations, collections were made at a few other places. For example, on the west side of Elson Lagoon at the entrance to a small tributary lagoon, where the water was about 7 feet deep and was more or less brackish, the following animals were taken on one occasion: Isopods—*Idotaega entomon*, 6. Amphipods—*Gammarus locustus* var. *setosus*, 50; *Gammaracanthus loricatus*, 12; *Pseudalibrotus* sp. (?), hundreds.

TRAPPING THROUGH THE ICE

As soon as the ocean was frozen over a mile or more from shore, several holes 20 inches square were made through the ice with the ice-cutting device (pl. 2, fig. 2). As freezing continued, more holes were made farther from the shore. In order to retard as much as possible the freezing over of the cut surface, as well as to protect the workers, a quonset-shaped icehouse (pl. 4, fig. 2) approximately 8 by 10 feet was built over each hole, or the hole was covered with squares of insulating material held in place by boards. Despite this protection, ice formed to a depth of about 3 inches between visits. Also, the ice walls of the hole, which ranged from 2 to 8 feet thick, would grow inward as the winter progressed and had to be kept chipped away to keep the hole large enough for working. As the weather moderated during the spring months it was much simpler to cut holes occasionally than to keep the old ones clear.

Several types of traps were tried to determine which were the most efficient for various kinds of animals. Window screen was used for small animals such as amphipods and shrimps. These were made in the form of a cylinder with a funnel leading into one end and a hinged door in the side large enough for a hand to be inserted. Another type was made from an oil drum by removing both ends and putting a funnel of $\frac{1}{4}$-inch hardware cloth in one end and covering the other end with the same material. A door was cut with a torch. Traps for catching fish were made of small-mesh chicken-wire netting, and still others were made of hardware cloth with $\frac{1}{4}$-inch mesh.

Both rectangular and cylindrical traps were used, but the former were much more difficult to pull up through the hole in the ice than the latter, as they would catch on the lower edge of the ice as they were drawn up from the ocean floor. The diameter of the hole at the bottom was usually smaller than at the surface, for it was more difficult to keep the encroaching ice chipped away from the sides at a depth of 7 feet.

Crab traps consisting of large metal rings with netting across the circles were also used. These traps were baited with fish or meat fastened in the center of the netting.

A couple of lath traps, somewhat on the order of lobster traps, were tried, but the laths were too far apart to retain the Arctic cod which were running small at the time this type of trap was tried. Since it was known that Arctic cod feed on amphipods, it was considered desirable to allow some traps to float up under the lower surface of the ice in the hope that cod might find their way into the trap if they were feeding on amphipods on the lower surface of the ice. The method or the traps, or both, were unsuccessful.

If available, some fish or meat scraps were placed in the traps for bait. If this was wrapped in screen or wire netting it was more effective than if placed loose in the trap. Thus encased it could be fastened to the trap wherever desired.

Holes were made at the following localities, the depths given being the depth of the water from the upper surface of the ice to the ocean bottom: Near shore, at 7 feet; one-half mile from shore, at 21 feet; three-fourths mile or more, at 37 feet; 1.25 miles, at 64 feet; 1.6 miles, at 80 feet; 1.8 miles, at 80 feet. In all instances the bottom was muddy at the depths investigated.

The traps were attached to ropes and lowered to the bottom. When pulling them up for examination, the ice that had formed over the surface of the hole had to be chopped away and dipped out with a sieve-dipper. Then the rope, which had frozen to the side of the ice near the top of the hole, had to be chipped free before the trap could be pulled to the surface. If possible, to prevent the animals from freezing in the air, the trap was examined without withdrawing it entirely from the water, and the specimens were hastily transferred to a large container, such as a 5-gallon thermos jug, for transportation to the laboratory. During the coldest weather the jug had to be wrapped in insulating material to prevent the contents from freezing.

In the following log, unless otherwise stated, the traps were always placed on the bottom.

TABLE 6.—*Log of trapping through ice*

DEPTH 7 FEET. ICE 3 FEET THICK

Date	Trap	Data
1-27-50	Chicken wire	Set today
1-28-50	" "	Nothing
1-30-50	" "	1 medium Arctic cod (*Boreogadus saida* (Lepechin))
1-31-50	" "	Nothing. Removed from hole
	Oil drum	Set today
2- 1-50	" "	1 medium Arctic cod (chicken entrails for bait)
2- 3-50	" "	Nothing
2- 4-50	" "	3 Arctic cod
	Lath	Set today, just under ice
2- 5-50	"	Nothing
	Oil drum	3 Arctic cod
	" "	2 Arctic cod
2- 6-50	Lath "	Nothing (openings too large for small Arctic cod ?)
2- 7-50	Oil drum	6 Arctic cod. The trap was pulled up for inspection at 4 p.m. and contained 4 fish. It was lowered without removing the fish and was inspected again at 9 p.m., at which time it contained 6 fish.

TABLE 6.—*Log of trapping through ice*—continued

Date	Trap	Data
2- 7-50	Oil drum	A large amphipod, *Onisimus affinis,* was found frozen on the ice wall of the hole, evidently brought up with the trap. Bait: chicken entrails plus decayed Arctic cod. A single-mantle Coleman lantern had been burning in the snow house over this hole from 10 a.m. until 9 p.m. Indirect lighting on the hole. Light left on to burn overnight.
	Chicken wire	1 *Onisimus affinis*
2- 8-50	Oil drum	2 Arctic cod (one only 90 mm. long). The light was out at 8:15 a.m.
2- 9-50	" "	1 Arctic cod at 10:00 a.m. Nothing at 6:30 p.m.
	Chicken wire	Set at 10:00 a.m., resting on oil-drum trap. 1 Arctic cod at 6:30 p.m. A light had been burning in snow house from 10:00 a.m. until 6:30 p.m.
2-10-50	Wire mesh	2 Arctic cod
	Oil drum	Nothing at 4:20 p.m.
2-11-50	Wire mesh	4 Arctic cod at 3:45 p.m.
2-15-50	Oil drum and wire mesh	10 Arctic cod, all stomachs empty. Traps had not been pulled for over three days. Measurements, 7.5 to 12.1 cm.
2-24-50	Oil drum	3 Arctic cod
3- 4-50	" "	2 Arctic cod, about 5.0 cm.
	Chicken wire	1 Arctic cod, about 12.0 cm.
3-10-50	Oil drum	1 amphipod, *Dulichia spinosissima* (ovigerous)
		DEPTH 21 FEET
1-27-50	Lath	Set today, unweighted and allowed to float up under the ice, which was 3 feet thick.
1-28-50	"	Nothing. The trap appeared to be frozen to the undersurface of ice.
1-30-50	"	2 species of amphipods; 1 small Arctic cod
1-31-50	"	Nothing. A light bulb and 2 dry-cell batteries, supported to prevent them from rolling around, were placed in a gallon jar, which was fastened inside the trap. The trap was lowered so that the lower end projected into the water below the surface of the ice. The hole was covered with boards and snow.
2- 1-50	Lath	Nothing. Light was almost burned out. Replaced without the light.
2- 3-50	"	2 Arctic cod (1, 103 mm. long, had 4 amphipods, *Rozinante fragilis,* in its stomach). Temperature of the air, —30° F. The fish froze while getting them out of the trap.

TABLE 6.—*Log of trapping through ice*—continued

DEPTH 37 FEET

Date	Trap	Data
1-25-50	Oil drum	1 annelid, *Autolytus fallax* (female sacconereis with egg sac)
1-27-50	" "	Amphipods (around bait)—12 *Anonyx nugax;* 1 *Orchomenella pinguis;* 1 *Tryphosa triangula;* 1 each of 2 other species
1-28-50	" "	Nothing
1-30-50	" "	1 annelid, *Pectinaria hyperborea.* 1 *Anonyx nugax.* 1 small clam
2-24-50	Screen	Two cylindrical window-screen traps set today. No. 1 set at 10 feet, baited with decaying meat; No. 2 set at 20 feet, with 2 pieces of metal foil suspended in it.
2-25-50	Wire mesh	No. 3 (¼-inch mesh) set today on the bottom. Baited with codfish waste.
2-27-50	Screen	No. 1, nothing; No. 2, 6 Arctic cod
	Wire mesh	No. 3, 8 Arctic cod
2-28-50	Screen	*Anonyx nugax* (hundreds of small ones and a few large); 8 Arctic cod
	Wire mesh	10 Arctic cod (fish-tail bait)
	Oil drum	Nothing (chicken entrails for bait)
2- 4-50	Wire mesh	1 small Arctic cod
3- 6-50	Screen	*Anonyx nugax* (few small)
	Wire mesh	1 annelid, *Eteone flava;* 3 Arctic cod; 1 *Lycodalepis polaris* (fish)
3-10-50	Screen	Amphipods—several *Anonyx nugax* (from 10 mm. to adult); 2 *Pseudalibrotus* sp. (1 female, 9 mm. long, with 16 maroon eggs that turned orange in preservative; egg sizes: 599, 632, 648, 664, 762, 782, and 794 microns; 1 female 8 mm. long); 1 *Pleustes panoplus* with eggs in 2-celled stage; 2 *Tryphosa groenlandica;* 2 caprellids. Snails—2 *Buccinum angulosum normale;* 1 *B. angulosum subcostatum*
3-11-50	"	1 jellyfish, *Chrysaora* sp. 1 annelid, *Antinoë sarsi,* 40 mm. long, shed sperm when water temperature increased to that of room. Amphipods—1 *Hyperia medusarum;* 5 of 2 unidentified species; 2 *Ischyrocerus latipes,* 1 male and a female that had just lost its brood of young. 1 snail, *Buccinum angulosum normale.* 5 small sculpins
4-11-50	"	Annelids—1 *Antinoë sarsi;* 2 *Phloë minuta;* 5 *Nephtys ciliata* (?) young
4-27-50	Wire mesh	2 *Lycodalepis polaris* (29.8 cm. and 31 cm. long). One had swallowed an Arctic cod 14 cm. long and the tail was protruding from its mouth

TABLE 6.—*Log of trapping through ice*—continued

Date	Trap	Data
		when it was brought in. There was also an amphipod, *Anonyx nugax,* in the stomach of the *Lycodalepis.*
5- 2-50	Screen	Several annelids. *Anonyx nugax,* common. 2 snails, *Buccinum angulosum subcostatum* and *B. plectrum.* Several Arctic cod (one had swallowed another small one)
5- 9-50	"	1 *Lycodalepis polaris*
5-17-50	"	Several jellyfish, *Cyanea capillata,* in and on trap. Several amphipods, *Anonyx nugax.* Snails—4 *Buccinum angulosum subcostatum;* 5 *B. angulosum normale;* 4 *B. angulosum transliratum*
5-23-50	Crab	4 snails
	Wire mesh	1 snail, *B. angulosum transliratum.* 1 Arctic cod
5-26-50	Screen	1 snail, *B. angulosum transliratum*
5-30-50	"	2 snails, *B. angulosum normale*
6- 6-50	"	1 annelid, *Phyllodace groenlandica.* 1 shrimp, *Eualus gaimardi.* 4 snails—1 *Buccinum angulosum transliratum;* 2 *B. angulosum subcostatum;* 1 *B. angulosum normale*
6- 9-50	"	1 shrimp
6-11-50	"	Hydromedusae—2 *Sarsia flammea;* 15 *Aglantha digitale.* 1 nemertean. Annelids—*Antinoë sarsi;* 9 small *Pholoë minuta.* 1 copepod. 6 small shrimps; 3 *Eualus gaimardi* (2 males, 1 female). 8 pteropods, *Clione limacina*
6-13-50	"	5 snails (same species as above)
6-23-50	"	Amphipods—3 *Weyprechtia heuglini*
		4 pteropods, *Clione limacina*
6-27-50	All traps	Nothing (no bait)
6-30-50	Screen	1 hydromedusa, *Aglantha digitale* (dead). 1 arrow worm, *Sagitta elegans* (dead). 2 annelids, *Phyllodoce groenlandica* (12 to 14 in. long). Several copepods. 1 pteropod, *Clione limacina.* (The trap was baited but the door was missing.)

DEPTH 64 FEET

Date	Trap	Data
4-18-50	Screen	Set today (baited with salmon trimmings)
4-24-50	"	*Anonyx nugax* (exceedingly abundant). Unidentified amphipod (abundant). 1 snail, *Buccinum polare*
4-27-50	"	1 annelid, *Eteone barbata.* 1 shrimp
5-17-50	"	Several jellyfish, *Cyanea capillata.* 2 annelids, *Phyllodoce groenlandica. Anonyx nugax*

TABLE 6.—*Log of trapping through ice*—continued

Date	Trap	Data
		(few). 2 *Orchomenella pinguis* (females with maroon eggs; one also had a parasitic copepod in its marsupium). 16 snails—3 *Buccinum polare;* 13 *B. angulosum* (including the typical form and three varieties)
5-30-50	"	1 snail, *B. angulosum* variety

DEPTH 80 FEET, 1.6 MILES FROM SHORE

Date	Trap	Data
3- 6-50	Wire	Set today
3- 8-50	Screen	1 hydromedusa, *Halitholus cirratus.* 1 small unidentified amphipod
3- 9-50	Wire	1 *Halitholus cirratus. Anonyx nugax* (abundant). 3 shrimps. 1 crab, *Hyas coarctatus alutaceus*
3-11-50	Screen	*Anonyx nugax* (few). 1 hermit crab, *Pagurus trigonocheirus* (female). 1 Arctic cod
	Wire	7 Arctic cod (trap suspended 7 feet down in water)
3-13-50	Screen	*Anonyx nugax* (few). 1 *Dulichia spinosissima* (amphipod). 1 small shrimp
3-14-50	"	*Anonyx nugax* (abundant). 9 shrimps, *Eualus gaimardi* (8 with developing eggs showing through as green masses)
3-17-50	"	1 amphipod, *Macra danae* (female, 18 mm.). 2 shrimps, *Eualus gaimardi* (with green eggs showing through integument)
3-19-50	"	1 small sculpin (37 mm. long)
3-20-50	"	1 ctenophore, *Beroë cucumis.* 1 nemertean, *Amphiporus lactifloreus.* 7 amphipods, *Hyperia medusarum* (1 ovigerous female, 3 immature females, 3 adult females). 3 snails—1 *Buccinum polare;* 2 *B. angulosum transliratum*
3-29-50	"	Amphipods—1 *Monoculodes borealis;* 1 *Accrodes latipes*
4- 7-50	"	Nothing. Strong northeast winds for several days had altered ice conditions at this station. Ice house caved in.
4-15-50	"	1 shrimp, *Eualus gaimardi* (with green eggs showing through integument)
5-23-50	"	Nothing in trap. Several jellyfish, *Cyanea capillata,* on surface of water at this hole.

DEPTH 80 FEET, 1.8 MILES FROM SHORE

Date	Trap	Data
3-17-50	Wire	2 amphipods, *Socarnes bidenticulatus* (young)
3-20-50	"	1 snail, *Buccinum polare* (large). Amphipods—6 *Hyperia galba.*

TABLE 6.—*Log of trapping through ice*—continued

Date	Trap	Data
4-11-50	Screen	Set today, baited with snail viscera and old fish. Great amount of debris in water for the first time since summer.
4-12-50	"	1 jellyfish, *Cyanea capillata* (large). 1 annelid, *Phyllodoce groenlandica*. *Anonyx nugax* (abundant). 1 snail, *Buccinum glaciale*
	Wire	7 Arctic cod about 50 mm. long (trap suspended at a depth of 10 feet)
4-15-50	Screen	1 *Cyanea capillata*. Amphipods—1 *Anonyx nugax*; 2 *Orchomenella minuta*; 3 *O. pinguis*; 2 *Monoculodes packardi*; 1 *Ischyrocerus latipes*. 2 shrimps, *Eualus gaimardi* (with green eggs showing through carapace). 1 small clam
4-18-50	"	2 *Cyanea capillata*. Amphipods—*Anonyx nugax* (common); 3 *Orchomenella* ? sp.; 1 *Ericthonius* sp.; 1 *Ischyrocerus* ? sp. 1 snail, *Buccinum tenue*
4-24-50	"	26 unidentified amphipods (9 ovigerous)
5- 2-50	Crab	4 *Cyanea capillata*
5-17-50	Wire	30 Arctic cod (trap suspended at a depth of 10 feet)
5-23-50	"	12 Arctic cod (2 very young) (trap suspended as above)
5-26-50	"	21 Arctic cod (trap suspended as above)
5-30-50	Screen and wire	25 Arctic cod. Traps suspended at a depth of 10 feet in a crack that developed in the ice near the 80-foot hole.

RECORDS OF SURF CONDITIONS AND SHORE COLLECTING

During the summer of 1948 the pack ice did not go more than 10 miles offshore, and except when fog prevented was nearly always in sight. With the exception of one day, drift ice was always in sight. On some days it was scattered, and on others it formed large compact cakes, which often grounded along the shore. Sometimes the floes consisted of masses of small ice cakes and sometimes there were islands of ice several acres in extent (pl. 6, fig. 2). Because of so much floating ice, there was comparatively little surf during the summer of 1948, and as a result very few animals were washed ashore. The writer has never seen a beach so barren of animal life over a 3-month period as was that at Point Barrow during the open water of that year. One specimen of the annelid *Arenicola glacialis* found at the edge of the water, an empty snail shell found near the Point, and a few fragments of dead bryozoan colonies constituted the total flotsam and jetsam for the summer.

In contrast, during the summers of 1949 and 1950 the ice went so far out to sea that it was not seen during the entire season. As a result, during heavy offshore winds strong upwelling took place alongshore, bringing up animals from deeper water, as well as throwing ashore animals that were washed out of the mud at shallow depths by the heavy surf.

In the following, the first three paragraphs are samples of 1948 records.

9-24-48 A wind blowing slightly north of east blew all night last night and all day today. Despite the wind, the ice is coming in toward shore. Moisture freezing in the air this morning.

9-27-48 A strong offshore wind, causing the surface water to move seaward and the lower water to upwell. This brought deeper-dwelling animals near the surface and near shore. By walking out on a grounded ice cake it was possible to dip up several animals from a depth of about 3 feet: Two octopuses of a species of *Cirriteuthis,* 4 *Boreomysis nobilis,* 2 species of chaetognaths, a few annelid worms, and jellyfishes of the genera *Cyanea* and *Aurelia. Cyanea* was very abundant. From one ice cake it was possible to count 39 *Cyanea,* from another 42, and from another 56. A plankton net thrown from the ice cake and simply drawn in yielded a rich haul. There was no surf and no animals were thrown ashore.

9-28-48 The wind has blown steadily for two days from the northeast and the water has become steadily rougher, but with ice cakes grounded alongshore and more in the water offshore no animals washed ashore even though the water was agitated sufficiently to make it impossible to see any animals except jellyfishes in the water.

7-20-49 The pressure ridge went out some time during the night of 7-18-49. The first animals appeared on the beach this morning. They were still alive in pools in the gravel where they had been washed by the surf:

	Sarsia flammea	Few
	Chrysaora sp.	1 (observed offshore)
	Cyanea capillata	10 collected. Small. Large numbers in water alongshore
	Hyperia medusarum	2
	Pseudalibrotus litoralis	6
	Idotaega entomon	1 (with young ready to be released)
	Pycnogonid	1
7-22-49	*Sarsia princeps*	1
	Beroë cucumis	1

7-23-49 Morning: Five or six *Beroë cucumis* for every 10 feet of shore. Arrow worms in water.
Evening: Many *Hyperia medusarum* and 3 pycnogonids.

7-24-49 Evening: *Sarsia princeps* and *Sarsia flammea* so abundant in the water alongshore and in pools in the gravel that the water was like soup.

Cyanea capillata	Many
Beroë cucumis	1
Hyperia medusarum	Common
Pagurus splendescens	1

7-26-49 Water lapping shore. Bottoms of puddles in the gravel near shore covered over with two species of medusae.

Sarsia flammea	Immense numbers in water alongshore
Sarsia princeps	Abundant
Cyanea capillata	Abundant
Unidentified medusa	Abundant
Beroë cucumis	Few
Pseudalibrotus litoralis	2
Accrodes latipes	1

None of the above animals so plentiful as on 7-24-49.

7-27-49 Morning:

Sarsia species and other medusae	Much reduced in numbers
Cyanea capillata	2
Beroë cucumis	2 (plentiful in evening)
Arrow worms	Small numbers

7-28-49 Water very calm and clear. Above medusae much less abundant than on 7-26-49.

7-29-49 Heavy surf. Ice cakes being grounded ashore. Water muddy from the surf and grounding ice cakes. No planktonic animals visible from shore because of the muddy and agitated condition of the water.

Evening: Ice broken from floe in tiny to large pieces so that it was difficult to get a water sample. Surf still heavier at 11 p.m.

7-30-49 Surf still heavy.

7-31-49 Surf still heavy. Water very murky. Impossible to see animals in the water because of agitation and murkiness. Few fragments of algae washed ashore, with a bryozoan and a species of *Spirorbis* on it.

8- 1-49 Surf still heavy and water very muddy. No animals visible. Algal fragments on beach and also several dead isopods, *Idotaega entomon.*

8- 2-49 Morning: Surf very much moderated. Water clear. No animals noted.

Evening: Swells, light surf. Water clear. Small school of capelin (*Mallotus catervarius*) alongshore. Ten to twenty came up with small wave and went back with the surge. A few maintained positions in the water when the surf surged back. Later in the evening many eggs were noted high on the beach above the present water level as well as below the surge line. Some of the egg masses were buried in the gravel to a depth of several inches. The eggs were attached to the gravel.

8- 3-49 Morning: Surf heavier again. Water murky. No animals seen alongshore.

Evening: Heavy swells. Water churning. One amphipod collected.

8- 4-49 Morning: Light surf. Water clear. No animals seen.

Evening: Medium light surf. Water clear. No animals seen.

8- 5-49 Evening: Medium light surf (9 p.m.). Water clear. Capelin observed flipping out of the water about 20 feet from shore. By 9:45 they were close enough to the shore to catch them with a hand net. By 10 p.m. large numbers of gulls were seen on and about the water from near the village to the base.

8- 6-49 Morning: Water clear. No animals seen.

Evening: Medium heavy surf. Water clear. A few amphipods observed on the beach above the breaking surf.

8-11-49 to 8-15-49 Heavy surf. No animals visible from the shore. A few jellyfishes, *Cyanea capillata,* were washed ashore.

8-17-49 Water fairly calm. Hundreds of small *Cyanea capillata* in water offshore, *Halistaura cellularia* common but less abundant than above species, and small medusae were visible.

8-19-49 Water fairly calm. Small *Cyanea* seen near the Point.

8-21-49 Very heavy surf. A 25-mile northeast wind. A few animals, such as *Arenicola glacialis* and *Antinoë sarsi,* and several amphipods, *Monoculodes borealis, M. schneideri, Gammarus locustus* var. *setosus, Weyprechtia heuglini, Melita formosa, Protomedeia fasciata,* and *P. stephenseni,* n. sp., were on the beach.

8-22-49 Very high surf alongshore. It cut the beach back 40 feet and the boat had to be moved farther back on shore.

8-23-49 Since 8-21-49 a series of spits have been moving along the beach toward the southwest, forming eight projecting lobes in a distance of about 1.5 miles. The lobe near the boat moved down the beach, that is, southwest, a distance of 190 feet and the extension into the sea is 75 feet from the normal shoreline. The movement of these lobes or scallops is easily accounted for—the breakers have been curling against the beach at an angle of about 60 degrees from the perpendicular to the beach line.

8-24-49 Still very stormy. High wind and fairly heavy surf. Colder air. Wind in the same direction for four days. The storm washed various animals ashore, chief among which were amphipods. These formed a continuous line along the beach where they were left by the surf:

Lafoeina maxima	2 colonies
Burrowing anemone	1
Arenicola glacialis	Common
Antinoë sarsi	Few
Melaenis loveni	Few
Cumacean	1
Hyperia medusarum	1
Themisto libellula	2 young females
Onisimus affinis	1 female with embryos
Acanthostepheia behringiensis	4 females, 5 males, 2 immature females

Weyprechtia heuglini	1 male
Melita formosa	Abundant, forming the major portion of the line along the beach
Ischyrocerus latipes	8 females, 1 male
Dulichia spinosissima	3 males
Idotaega entomon	Few
I. sabini	Few
Pagurus splendescens	1 medium male
P. trigonocheirus	2 small males, 1 small female
Unidentified tectibranch	1
Egg collar of *Natica*	1
Mya japonica	1
M. truncata	3
Hiatella arctica	Few
Alcyonidium disciforme	Common, with snail eggs attached
Fishes	Two or three kinds of young

8-25-49 Surf moderating. Long swells from around the Point. Wind decreasing. One large cumacean on shore.

8-27-49 Heavy surf. Still windy and overcast.

8-28-49 Afternoon: Water fairly calm. Along approximately 2 miles of beach only 6 *Arenicola glacialis,* a few fragments of egg collars of *Polinices,* and several *Hiatella arctica* and a few shells of *Macoma calcarea* were picked up.

8-29-49 High surf. Wind again after the calm of yesterday. The following animals were washed ashore:

Cerianthus sp.	1 about 6 inches long
Sand anemone	1
Hamingia arctica	1
Echiurus echiurus alaskanus	Hundreds
Antinoë sarsi	1
Myriotrochus rincki	6
Melita formosa	Few
Pagurus trigonocheirus	1 small
Egg collars of *Polinices*	Several
Serripes groenlandicus	Few
Hiatella arctica	Few

Note that although there was heavy surf preceding and on 8-24-49 and again on 8-29-49, over twice as many species were washed ashore on 8-24-49 as on 8-29-49, but the total number of animals washed ashore on 8-29-49 was much greater than on 8-24-49. Practically all those washed ashore on 8-24-49 were surface dwellers, whereas over half of the species and the majority, numerically, of those washed ashore on 8-29-49 were mud dwellers, indicating that the bottom not only was disturbed more on 8-29-49 than on 8-24-49 but that it was disturbed at a greater distance from shore.

9- 6-49 Medium light surf. Small waves coming onto the shore. A gentle north wind. The phronimid *Themisto libellula* was common along the beach above high-water mark. Most of these amphipods were covered with a thin layer of frost but they began swimming when placed in water. A few *Arenicola glacialis* and a few pycnogonids were on the beach in the evening.

9- 9-49 Morning: Surf very light; small waves coming in irregularly. A gentle east wind. *Themisto libellula* much more abundant than on 9-6-49, forming a streak about a foot in width along the beach. Pycnogonids and the amphipod *Melita formosa* were common.

9-12-49 Above the high water mark there were three rows of *Themisto libellula* extending along the beach, the first about 4 feet above the water line, the second about 6 feet, and the third about 15 feet. The amphipods were abundant in the first two rows, but the highest row was so thick with amphipods that they could be scooped up in great masses with the hands. All the depressions in the gravel were filled with the animals. At random spots in the top row a segment 10 cm. long was marked off and the amphipods contained therein were counted.

Size of segment of row	*Number of amphipods*
10 x 37 cm.	111
10 x 38 cm.	56
10 x 56 cm.	103
10 x 29 cm.	136
10 x 32 cm.	89
10 x 26 cm.	135
10 x 27 cm.	142
10 x 33 cm.	140
10 x 29 cm.	275
10 x 54 cm.	716
10 x 50 cm.	679

In and around the masses of phronimids along approximately three-fourths of a mile of beach, the following animals were found:

Lafoeina maxima	Common
Sand anemone	2 fragments
Cerianthus sp.	1
Sea anemone	3
Echiurus echiurus alaskanus	3
Arenicola glacialis	Few
Harmothoë imbricata	3
Phyllodoce groenlandica	3
Melita formosa	Common
Gammaracanthus loricatus	1 male, 1 female
Dulichia spinosissima	1
D. arctica	1
Caprellids	2 species
Idotaega entomon	Several
I. sabini	Several
Sclerocrangon boreas	1 ovigerous female
Pagurus trigonocheirus	Few
Pycnogonids	14 (3 species)
Tectibranch	1
Dendronotus frondosus	1
Buccinum sp.	Several
Boreotrophon pacificus ?	9 shells

Natica clausa	2
Egg collars of *Polinices*	Several
Velutina plicatilis	2
V. lanigera	1
Macoma calcarea	Few
Mya japonica	1 small

9-13-49 The major portion of the *Themisto libellula* are still alive.

9-14-49 All the *Themisto* are dead. Three badly battered *Echiurus* were on the beach at noon, also 11 male and one female capelin, dead.

9-15-49 Morning: A thin line of *Themisto libellula* along the beach about 2 feet above the water line, and with them a few *Melita formosa.* A few *Cyanea* of the whitish type were in the water.

9-18-49 Afternoon: Waves scouring the beach. A good deal of sediment in the water.

9-19-49 Morning: Sediment in the water. A few *Melita formosa* on the beach, alive.

Evening: A heavy surf scouring the beach. Water cloudy with sediment. Many animals were being washed ashore:

Antinoë sarsi	Few to common
Arenicola glacialis	4
Themisto libellula	Common
Anonyx nugax	Common
Melita formosa	Few to common
Unidentified amphipod	4
Idotaega entomon	Rare
I. sabini	Rare to few
Pagurus splendescens	2 large
P. trigonocheirus	Few, small
Natica clausa	1
Arctic cod	Few (2 very young)
Fish, unidentified	1

Twenty-five different animals were washed ashore on 9-12-49 and 13 species on 9-19-49. Of these 13 species only six duplicated the ones found on 9-12-49.

9-20-49 Morning: Surf medium heavy. Still scouring the beach and washing well up on the beach. With the exception of *Themisto libellula,* which form a thin line along the beach, fewer animals were washed ashore than on the night of 9-19-49. The phronimids are still alive and each large wave washes more ashore.

Medusae	Few, small
Antinoë sarsi	Few
Phyllodoce groenlandica	1
Arenicola glacialis	1
Themisto libellula	Abundant
Acerodes latipes	1
Gammarus locustus var. *setosus*	1
Anonyx nugax	Few

Caprellids	2 (2 species)
Idotaega entomon	2 (one with very early eggs)
I. sabini	Rare
Unidentified tectibranch	1
Dendronotus frondosus	1
Arctic cod	12 (one very young)

9-22-49 Morning and afternoon: Surf medium light, with small swells. Great amount of sediment in water. Gravel thrown up on beach. Animals alongshore less numerous and less conspicuous.

Myriotrochus rinki	1
Antinoë sarsi	Most abundant animal alongshore
Brada villosa	22
Arenicola glacialis	2
Mysis oculata	1 immature female
Themisto libellula	Rare
Anonyx nugax	Few
Monoculodes borealis	7
Protomedeia stephenseni	1
Melita dentata	1
M. formosa	Few (3 ovigerous females)
Cumaceans	4
Arctic cod	4 young
Capelin	3 (1 alive)
Lycodalepis polaris	1 (alive)

9-23-49 Morning: surf medium light, but heavier than yesterday. Waves of a short period. Much sediment. A bank of gravel built up on the beach.

Arenicola glacialis	Abundant. Some being washed in with each wave. Some completely buried by the washed-in gravel.
Themisto libellula	Rare
Anonyx nugax	5
Melita formosa	Few
Unidentified amphipods	2 (2 species)
Cumacean	1

Evening: Surf becoming much rougher.

Antinoë sarsi	1
Arenicola glacialis	Common, but not so plentiful as this morning
Hyperoche medusarum	1
Themisto libellula	Rare
Anonyx nugax	Common
Acanthostepheia behringiensis	2
Melita formosa	Common
Caprellid	1 large
Snail	1 small
Clams	Few small

9-24-49 Morning: Surf heavier than last night. Waves sweeping shore with great speed. Water very turbid. Gravel bank still present but much reduced in height.

Lafoeina maxima	2 colonies
Echiurus echiurus alaskanus	1 (minus its proboscis)
Eucratea loricata	1 large colony (with caprellids)
Antinoë sarsi	Several
Arenicola glacialis	Few
Themisto libellula	Rare
Anonyx nugax	1
Gammaracanthus loricatus	1
Melita formosa	Few
Caprellids	Abundant (3 species)
Idotaega entomon	Rare (dead)
I. sabini	1
Egg collars of *Polinices*	Few
Mass of snail eggs	1, unidentified

9-26-49 Morning: Surf still relatively heavy, but somewhat moderated. Water turbid. Big swells and whitecaps not so prevalent. Three lines extending along the beach, formed largely by the amphipod *Melita formosa.*

Halitholus cirratus	1
Lafoeina maxima	Few
Corymorpha sp.	4
Sand anemone	3
Sand anemone (sp. 2)	Common
Notoplana atomata	3
Nemerteans	2
Echiurus echiurus alaskanus	2
Eucratea loricata	Few (with caprellids)
Alcyonidium polyoum	1
Antinoë sarsi	Common
Melaenis loveni	Few
Phyllodoce groenlandica	Rare
Arenicola glacialis	Rare
Pectinaria granulata	Few
Brada villosa	Few
Myriotrochus rinki	Abundant
Thysanoëssa longipes	Few
Themisto libellula	Rare
Anonyx nugax	1
Pontoporeia femorata	1 male, 2 females
Acanthostepheia behringiensis	4
Paramphithoë polyacantha	1
Atylus carinatus	1
Melita formosa	Extremely abundant
Caprellids	2 species
Idotaega entomon	Rare (some young specimens)
I. sabini	Rare

Pycnogonids	Few
Egg collars of *Polinices*	Few (some with other egg masses attached)
Alcyonidium disciforme	Common
Tunicate (sp. 1)	Few to common
Tunicate (sp. 2)	Rare

9-27-49 Morning: Surf medium, choppy. Water turbid.
Evening: Surf heavier. Long swells. Surface water current moving southward.

9-28-49 Morning: Surf medium heavy. Short-period waves. Coarse gravel building up on beach. Steep bank forming. Surface water current moving southward.

Eunephthya rubiformis	1
Sea anemone	1 small
Echiurus echiurus alaskanus	Common
Halicryptus spinulosus	1
Alcyonidium disciforme	Common
Myriotrochus rinki	Few
Antinoë sarsi	1
Melaenis lovéni	1
Arenicola glacialis	Few
Flabelligera affinis	3
Hyperoche medusarum	1
Acanthostepheia behringiensis	1
Atylus carinatus	2
Gammaracanthus loricatus	1
Melita formosa	Common
Caprellids	Common (2 species)
Idotaego sabini	2 large, few small
Pycnogonids	Few
Coryphella salmonacea	1
Dendronotus frondosus	2
Dendronotus sp.	1 (translucent white)
Egg collars of *Polinices*	Fragments
Gastropod eggs on *Alcyonidium*	Few
Tunicate (sp. 1)	Common
Tunicate (sp. 2)	Few
Arctic cod	3 (one young)
Fish	1 small

9-29-49 Morning: Surf medium light. Water turbid but relatively smooth. Steep bank next to surf line. Evening: Small medusae washed on shore.

9-30-49 Morning: Surf light. Water smooth, clear. Very small swells parallel to shoreline. Very slight wind. The following animals were in the water near shore:

Small medusae	Abundant
Cyanea capillata	1
Beroë cucumis	3
Mertensia ovum	Abundant

10- 4-49 Medium heavy surf. Swells coming in from the southwest. Beach now flat. Water turbid.

Cyanea capillata	Few
Burrowing anemone	1
Sea anemone	1
Echiurus echiurus alaskanus	Large numbers, with many detached proboscides lying on the beach
Melaenis lovéni	1
Anonyx nugax	1
Acanthostepheia behringiensis	1
Gammaracanthus loricatus	2
Melita formosa	Few
Idotaega entomon	Few
I. sabini	1
Pagurus splendescens	2 males
Dendronotus frondosus	2
Egg collars of *Polinices*	1 fragment

10-10-49 Morning: Long swells coming in with a 4- to 5-second period between waves. Waves high but were not destructive when they broke. Mist rising from water. Impossible to see more than 150 feet from shore. Air temperature, 9° F.; water temperature, —0.8° C. Where the surf had come up on shore during the night the water had frozen, forming a strip of ice about 10 feet wide along the beach.

10-12-49 A few *Themisto libellula* washed ashore during the night.

10-17-49 Light surf with small, short-period swells. Water calm and smooth. No wind. At 9:15 a.m. a thin coating of ice was on the ocean out to about 150 feet. Ice alongshore from freezing water from surf. A small ice ledge has started to form alongshore. The following animals had washed ashore:

Corymorpha sp.	7
Echiurus echiurus alaskanus	Abundant
Hamingia arctica	2
Alcyonidium disciforme	Common
Antinoë sarsi	Common
Melaenis lovéni	Abundant
Travisia carnea	6
Arenicola glacialis	Common
Crossaster papposus	1 male, 3 others
Leptasterias polaris forma *acervata*	1
Myriotrochus rinki	Abundant
Themisto libellula	Few
Sclerocrangon boreas	1 large
Aldisa zetlandica (?)	1
Snail egg capsules	4 different species

10-17-49 On beach of small bay near the Point (see *F*, fig. 1).

Cyanea capillata	Common
Echiurus echiurus alaskanus	Abundant

Antinoë sarsi	Common, large
Eunoë clarki	2
Crossaster papposus	5
Leptasterias polaris forma *acervata*	8 large
L. arctica	1
Henricia sanguinolenta	1
Solaster endeca	5
Anonyx nugax	1
Clione limacina	Very abundant, in puddles on the shore and in water offshore
Snail egg capsules	Common
Tunicate	1

10-28-49 The following animals were washed ashore on the beach at the base (*Lafoeina, Eucratea,* and *Psolus* are from the rubble zone):

Lafoeina maxima	Common
Eucratea loricata	1 colony, with eggs of an eolid attached
Alcyonidium disciforme	Few
Psolus chitinoides	1
Dulichia spinosissima	1
Caprellid	1 large
Egg collar of *Polinices*	1 with mass of snail eggs attached
Mya truncata	1 shell

11- 4-49 The following animals, all frozen, were on the shore this morning:

Lafoeina maxima	Few
Eunephthya rubiformis	1
Stomphia coccinea	3
Cyanea capillata	Common
Echiurus echiurus alaskanus	Common
Alcyonidium disciforme	Few
Themisto libellula	2
Melita formosa	1
Idotaega entomon	3
I. sabini	2
Pagurus splendescens	3
Aldisa zetlandica (?)	1
Egg capsule masses, of snails	Few
Tunicate (sp. 1)	1
Tunicate (sp. 2)	2

11-17-49 Afternoon (2 p.m.): Ice cakes grounding and building up. Some had been thrown ashore and piled up during the night. Some freshly frozen blue-green ice on the shore. Water between the ice cakes frozen from 3 to 5 inches thick. Leads still present. Open water a mile from shore.

11-19-49 A lead has developed along the shore and extends southward. Ice floes in some areas are being pushed out to sea again. A 43-mile-an-hour northeast wind is blowing. In the lead two or three different kinds of medusae were floating southward. A fragment of

Beroë cucumis was seen, and a specimen of *Chrysaora* was taken. It contained well-developed eggs and many planulae. Two male *Hyperoche medusarum* were attached to the jellyfish. A duck was surface diving in the lead.

11-20-49 Some of the ice is moving slightly in the direction of the village and the lead of yesterday is narrowing. Most of the lead water now has approximately 1 inch of ice on it and elsewhere the ice is about 11 inches thick. Two or three species of amphipods were collected when the ice was broken through. Thirty or forty ducks were swimming in water that had a thin crust of ice on it.

12- 2-49 The last eider ducks were seen today. The ocean was late in freezing over.

8-10-50 The following animals were found on the beach:

Travisia carnea	4
Crossaster papposus	1
Myriotrochus rinki	Common

8-16-50 *Cyanea capillata* (up to 12 inches in diameter) abundant. No commensal amphipods noted.

8-23-50 The following animals were found on the beach:

Alcyonidium disciforme	Abundant
Melita formosa	Abundant
Idotaega entomon	Few
Serripes groenlandicus	Few
Hiatella arctica	Few
Egg collars of *Polinices*	Common
Rhizomolgula globularis	Abundant (up to 20 mm. in diameter)
Tunicate (sp. 1)	Few

8-24-50 A few *Echiurus echiurus alaskanus* and a few *Arenicola glacialis*.

8-28-50 The isopod *Idotaega sabini* abundant. Examined 26—all females, none ovigerous.

8-29-50 One ctenophore, *Beroë cucumis*.

9- 1-50 A few jellyfishes, *Chrysaora* sp.

ANALYSIS OF PLANKTON SAMPLING

To obtain a complete picture of the plankton situation would require more time than has already been given to the entire investigation of the invertebrate fauna. Also, such a project should be carried on both summer and winter for not less than three years. The staff connected with this investigation was not large enough to give plankton the attention it deserved. However, many pages of notes were accumulated covering the plankton sampling. Although they are too extensive to be included in full here, certain conclusions can be drawn from them, and much information from them will be found under the discussion of the different phyla.

For instance, there is evidence pointing to a cyclical abundance of diatoms overlapped by a cyclical abundance of larval forms and copepods. This does not show up very pronouncedly in the notes, for the investigation of plankton was always secondary to that of the larger animals and the invertebrate fauna of the bottom. The 1950 winter plankton station was 1.6 miles from shore where the water was 80 feet deep. During January, February, and March the diatoms obtained must of necessity have been ones that were living under the ice or had been carried in by currents from the open leads at least 4 miles farther offshore. There were very few during these three months, but in April they began to increase in numbers. Whether this was due to an increase in light under the ice as the sun rose higher in the sky is not known. When the ice went out in July the cyclical phenomenon began. Great abundance followed by decreasing numbers appeared to take place at about 30- to 40-day intervals during the open season and lengthened to 40 or 50 days in the fall. But several years of sampling would be necessary to establish the certainty of the cycle and the interval. Within one to two weeks following the very abundant flowering of the diatoms, the zooplankton became much more abundant.

There has always been some difference of opinion among oceanographers as to the reason for the diatom cycles in all regions where oceanographic plankton investigations have been carried on. Some maintain that these cycles are caused by a fluctuation in the supply of nutrients—particularly silicates, phosphates, and nitrates—needed by the diatoms; when these nutrients are exhausted the diatoms decrease in number and when the ocean renews them, the diatoms flower again. Others believe that the cycles are due to the increase of zooplankton, made possible by the presence of diatoms, and that the feeding of these hordes depletes the diatom pastures, and the lack of sufficient food in turn depletes the zooplankton. The writer is inclined to think that both factors have their effects; certainly the feeding cycle is a known phenomenon, and there is convincing evidence that it occurs in the Arctic as well as in other oceans.

In the lists below particular attention is given to the young stages of such animals as jellyfishes and ctenophores, to copepods, to the larval forms of other groups, and especially to the winter plankton tows.

Copepods, nauplii, and chaetognaths were the most abundant of the smaller planktonic animals. Any one of these or any combination of these might be so abundant in the material from a plankton tow that it was difficult to sort out the other material. In using the terms "abundant," "very abundant," and "common," the comparison is made more within the group than with other groups. For instance, it is stated that veligers were very abundant on September 9, 1949, and that copepods were also very abundant on that day, but the number of copepods taken were many times more numerous than the veligers. However, in comparison with the number of veligers taken on other days, on September 9, 1949, they were very abundant.

The tows made in November 1949 were from ice cakes alongshore. Conditions during the latter part of November and during December prevented taking plankton samples. The tows from January 21 to February 28, 1950, inclusive, were vertical ones made through the ice at a distance of three-fourths mile from shore where the water was 37 feet deep. Subsequent tows were made through the ice at the regular plankton station 1.6 miles from shore where the water was 80 feet deep. (See "Plankton Sampling, Winter.")

In the following lists certain abbreviations are used: *Cyanea* refers to *C. capillata: Aglantha* to *A. digitale; Mertensia* to *M. ovum; Beroë* to *B. cucumis; Clione* to *C. limacina;* and *Spiratella* to *S. helicina.* A = abundant; AA = very abundant; AAA = exceedingly abundant; C = common; R = rare; lg. = large; sev. = several; sm. = small; and yg. = young.

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*

DIATOMS

8- 2-48	Few of several kinds
8-30-48	Many kinds abundant; circular (*Coscinodiscus*) type, A
9- 4-48	A
9- 9-49	Several kinds, C
9-10-49	AAA
9-13-49	AAA
9-30-49	R
10-24-49	AAA
10-31-49	Few, mostly circular type
11- 1-49	Spiny type, A; spicule type, C; circular type, R-C
11-10-49	Rare
1-21-50	1 fragment of spiny type
1-25-50	Few of circular iridescent type
1-27-50	" " " " "
2-10-50	" " " " "
2-25-50	None
2-28-50	1 circular type
3- 8-50	1 of circular iridescent type
3-14-50	None
3-23-50	2 of circular iridescent type; 1 spiny type

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

3-29-50	Circular iridescent type, few
4- 8-50	Circular iridescent type, R; chain type (sev. kinds), A
4-24-50	1 circular; 1 circular iridescent; 1 chain type (sm., elongate)
5- 2-50	Chain type, A; circular iridescent, C; spiny type, 8
5- 9-50	Circular iridescent type, 7; chain type, 3; 2d chain type, 1
5-17-50	Circular iridescent type, 2; spiny type, 2; chain type, 1; 2d chain type, C
5-23-50	Circular iridescent, 4; spiny type, 2; chain type, 6; 2d chain type, C.
6- 6-50	Chain type, AA
6-20-50	Chain type (sev. kinds), A
6-23-50	Chain type, C
6-27-50	Chain type, C-R
6-30-50	Chain type, few
7-13-50	Circular iridescent, C

COELENTERATES

8- 6-48	5 *Rathkea octopunctata*, budding; medusae of *Obelia*, C
8- 9-48	*Aglantha* in all sizes; 1 medusa of *Obelia;* 1 *Rathkea*, budding
8-12-48	1 sm. *Cyanea;* 1 sm. *Aurelia*
8-16-48	Ephyra of *Cyanea*
9- 4-48	Medusae of *Obelia*, C
9- 9-49	Yg. *Aglantha*, few
1-21-50	None
1-25-50	*Aglantha*, C
1-27-50	" "
2-10-50	None
2-25-50	"
2-28-50	"
3- 8-50	1 sm. *Aglantha*
3-14-50	None
3-23-50	"
3-29-50	*Aglantha*, C (1 with developing gonads)
4- 8-50	10 *Aglantha* (with developing gonads)
4-15-50	1 sm. medusa
4-24-50	2 *Aglantha;* 1 hydromedusa
5- 2-50	7 *Aglantha*
5- 9-50	*Aglantha*, C
5-17-50	3 *Aglantha* (gonads developing)
5-23-50	None
5-30-50	1 *Aglantha;* 1 hydromedusa
6- 6-50	None
6- 9-50	"
6-16-50	"
6-20-50	Sev. *Aglantha*
6-23-50	*Aglantha*, C
6-30-50	1 *Aglantha*
7-13-50	13 *Aglantha;* 1 ephyra; 1 *Rathkea octopunctata* (with buds)

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

CTENOPHORES

8- 2-48	Yg.; adult *Mertensia*
8- 5-48	Larval forms; various sizes of *Mertensia*
8- 9-48	Egg; cydippid yg. in various sizes
8-12-48	Larval cydippids
8-30-48	" "
9- 4-48	Sm. *Mertensia;* lg. cydippid larvae
9- 9-49	Larvae of cydippids, R
9-10-49	None
9-13-49	"
9-30-49	Cydippid larvae, C; 2 *Beroë*
10-24-49	None
10-31-49	"
11- 1-49	"
11-10-49	Fragments
1-21-50	None
1-25-50	6 sm.; few fragments
1-27-50	None
2-10-50	"
2-25-50	Larvae, R
2-28-50	" "
3- 8-50	5 larvae
3-14-50	6 "
3-23-50	3 eggs; few cydippid larvae
3-29-50	Larval forms, C
4- 8-50	Larvae of *Beroë,* few
4-15-50	1 larva of *Beroë*
4-24-50	1 cydippid larva
5- 2-50	Fragments
5- 9-50	None
5-17-50	4 larval *Beroë,* 2 adults; 2 cydippid larvae
5-23-50	6 " "
5-30-50	14 " "
6-16-50	Yg. *Mertensia,* 5 cm., C

ANNELIDS—POLYCHAETES

8- 2-48	Larval forms; trochophore larvae; larva of *Polydora* (probably *caulleryi*)
8- 9-48	Yg. larval worms, A; trochophore larvae, A
8-30-48	Larval forms
9- 4-48	Larval forms (a few trochophores metamorphosed in finger bowls between 9-4-48 and 9-12-48 so that larval polynoids were recognizable)
9- 9-49	Larval forms, few
9-10-49	Larval forms, C; trochophores, C
9-13-49	Larval forms, C
9-30-49	Larva of spionid (2.5 mm.)
10-24-49	Larval forms, C

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

10-31-49	None
11- 1-49	Larval forms, few
11-10-49	None
1-21-50	1 sm.
1-25-50	1 larva; 1 *Autolytus fallax* with egg sac
1-27-50	4 sm. forms
2-10-50	None
2-25-50	"
2-28-50	2 sm.
3- 8-50	1 sm.
3-14-50	None
3-23-50	"
3-29-50	*Autolytus fallax* with egg sacs, AA; *Syllis fasciata* (with eggs inside), 3; 10 *S. cornuta* with swimming setae
4- 8-50	4 larval forms; 2 trochophores; sev. adult worms, with eggs, going to pieces
4-15-50	10 larval forms; 5 metamorphosing from trochophore stage; *Autolytus fallax* with egg sacs, A; 2 *Syllis cornuta* with swimming setae
5- 2-50	Larval forms, C; trochophores, C
5- 9-50	14 trochophores (sev. kinds); 6 yg. worms
5-17-50	8 larval forms; trochophores, C; 1 ovig. syllid
5-23-50	Larvae, C (with 4 eye spots)
5-30-50	Larvae, A (with 4 eye spots) in various stages
6- 6-50	Larvae, C (feeding on green diatoms)
6- 9-50	Larvae, C
6-16-50	Larvae, C (perhaps spionid)
6-20-50	Larvae, C; 1 polynoid larva
6-23-50	Larvae, C
6-27-50	Larvae, C (at least 2 kinds)
6-30-50	Larvae, few
7-13-50	Larvae, 3 or 4 kinds; sev. kinds of trochophores; 4 larval polynoids

ARTHROPODS—CRUSTACEANS

	COPEPODS	NAUPLII	OTHER
7-24-48	A	C	Many crab larvae
7-25-48	A	C	" " "
8- 2-48	A	A	None
8- 6-48	AA	AA	Crab larvae
8-30-48	A	Few-C	Few other larvae
9- 4-48	A	None	None
9- 9-49	AA	None	Few larvae
9-10-49	AA	"	" "
9-13-49	A	"	" "
9-30-49	AAA	"	Larvae, R
10-29-49	AAA	C	Larvae, C
10-31-49	A	Few	Ostracods, mysids, euphausiids, 2

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

	COPEPODS	NAUPLII	OTHER
11- 1-49	A	R-few	Ostracods, few; 1 yg. isopod
11-10-49	A	C	None
1-21-50	Few-C	7	"
1-25-50	A (1 ovigerous)	4	Ostracods, few
1-27-50	A (1 ovigerous)	None	4 ostracods
2-10-50	C	"	None
2-25-50	A	"	Few larvae
2-28-50	A (5 ovigerous)	"	Larvae, few; 1 sm. amphipod
3- 8-50	A	3 (2 with much oil)	Larvae, few
3-14-50	None	None	Larvae; 2 sm. isopods
3-23-50	A	"	1 sm. isopod *
3-29-50	AA	C	None
4- 8-50	AA**	C	1 sm. isopod *
4-15-50	AAA	None	Larvae
4-24-50	A (some with oil)	C	3 sm. isopods; * 1 yg. cladocere ?
5- 2-50	A (3 ovigerous)	C-A	None
5- 9-50	AA	C	4 sm. isopods; * 2 protozoans
5-17-50	A (2 ovigerous)	AA	None
5-23-50	A (2 ovigerous)	AA	2 zoea
5-30-50	A (ovigerous-C)	AAA (sev. types)	2 protozoea; 10 zoea
6- 6-50	Few	A	None
6- 9-50	C (pair mating)	A	"
6-16-50	A†	A (1 with oil globules ?)	"
6-20-50	A	A	"
6-23-50	A (sev. kinds)	C (sev. sizes)	Few zoea
6-27-50	A (sev. kinds, 1 ovigerous)	AA (3 or 4 sizes) §	1 protozoea (black eyes) Few zoea (huge black eyes)
6-30-50	A (2 kinds, some mating)	C	None
7-13-50	A	AA (all have dark masses in digestive tract)	2 protozoea; 8 zoea; 1 euphausiid; 1 cumacean; 1 shrimp

* Looks like the male of a parasitic form.
** No oil in some, good-sized droplets in others.
† Both juvenile and adult of some species.
§ The majority contained yellow-green food masses, others green food masses.

MOLLUSKS

8- 5-48	1 veliger larva; larval clams
9- 4-48	Tiny snails; trochophores and adults of *Clione*
9- 9-49	Veligers and yg. snails, AA (more than on any other date)
9-10-49	Veligers, R
9-13-49	Veligers very rare; trochophores of *Clione* (now larger)
9-30-49	Trochophores of *Clione* (0.7 mm.)

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

10-29-49	Pteropods, A; veligers, R
10-31-49	Veligers, R
11- 1-49	Veligers, few; 1 yg. clam
11-10-49	None
1-21-50	1 veliger
1-25-50	1 veliger
1-27-50	3 veligers; trochophore of *Clione*
2-10-50	None
2-25-50	Veligers, few; trochophores * of *Clione*
2-28-50	Veligers, C; trochophores of *Clione*
3- 8-50	Veligers, few; trochophores of *Clione;* 1 lg. *Clione*
3-14-50	Veligers, 10; trochophores of *Clione*
3-23-50	Veligers, few; trochophores of *Clione*
3-29-50	Veligers, few; trochophores of *Clione,* C; 2 yg. clams
4- 8-50	Veligers, C; trochophores of *Clione;* (veligers with opercula)
4-15-50	Veligers, C; trochophores of *Clione,* 17; (veligers with opercula)
4-24-50	Veligers, 8; trochophores of *Clione,* C
5- 2-50	Veligers, 5; trochophores of *Clione,* C; 1 yg. *Spiratella*
5- 9-50	Veligers, C; trochophores of *Clione,* C
5-17-50	Veligers, none; trochophores of *Clione,* C; (1 with wings developing)
5-23-50	Veligers, 8; trochophores of *Clione,* C
5-30-50	Veligers, 7; trochophores of *Clione,* C-A
6- 6-50	Veligers, sev. (early stages)
6- 9-50	Trochophores (very early)
6-16-50	1 veliger of *Spiratella*
6-20-50	1 *Clione*
6-23-50	1 *Clione*
6-27-50	Veligers, 2 (2 species); 1 trochophore of *Clione*
6-30-50	1 sm. *Clione,* 1 very sm. *Clione;* trochophores of *Clione;* veligers, few
7-13-50	4 trochophores of *Clione;* 3 veligers of *Spiratella;* other veligers (sev. kinds)

* These trochophores have a large circle of oil droplets around the anterior end.

MISCELLANEOUS

8-30-48	Echiuroid larvae
9- 9-49	Pluteus larva No. 1, few; pluteus larva No. 2, C
9-10-49	Pluteus larvae, few
9-13-49	Pluteus larvae, none
9-30-49	Pluteus larvae, none
10-24-49	Pluteus larvae, rare
10-24-49	Ciliates, AA; appendicularians or tunicate larvae, R
10-31-49	Vorticellids attached to mysid; appendicularians or tunicate larvae, R
10-31-49	Pluteus larva, none
11- 1-49	Pluteus larvae, rare
1-21-50	From 28 hauls made from this date until 7-13-50 no pluteus larvae were observed
1-27-50	1 tintinnid; ciliates, C
3- 8-50	3 appendicularians; few unidentified larvae

TABLE 7.—*Gross analysis of plankton, Point Barrow, Alaska, August-September 1948, September 1949-July 1950*—continued

3-14-50	1 tunicate larva
3-29-50	Foraminifers; few
4- 8-50	Tintinnids, few; nematodes, few; tunicate larva, 1; eggs, unidentified, C
4-15-50	Tintinnids, R; tunicate larvae, 3; fish eggs, few (somites visible)
4-24-50	Tintinnids, few; tunicate larvae, 2
5- 2-50	Tintinnids, few; tunicate larvae, none; dinoflagellates, 3; eggs, C
5- 9-50	2 eggs; tunicate larvae, none
5-17-50	Eggs, few; tunicate larvae, 1
5-23-50	1 yg. Arctic cod (?) ; tunicate larvae, none
5-30-50	1 nematode (microscopic branching algae have been present for 4 weeks)
6- 6-50	1 huge trochophore (possibly of the echiuroid *Hamingia arctica*)
6- 9-50	1 huge trochophore
6-16-50	2 huge trochophores
6-20-50	1 huge trochophore
6-20-50	Eggs of 2 sizes; fish eggs
6-23-50	Eggs of 2 sizes, C
6-23-50	Few huge trochophores
6-27-50	Few huge trochophores
6-27-50	Eggs, lg., C; eggs, sm., A; eggs, very sm., few
6-30-50	Eggs, lg., few; eggs, sm., A
7-13-50	1 yg. Arctic cod; sm. chaetognaths, C

Examination of the above lists of plankton sampling reveals several items of interest. The spiny types of diatoms were absent from November 1, 1949, to March 23, 1950, but several circular forms were present throughout the winter. The chain type of diatoms became abundant in the spring before the spiny type.

The fact that the winter tows were made vertically and hence covered a very small area as compared with tows made in the usual manner, reduces to little significance the absence of any one form from the plankton for one or two hauls. But the continued absence of a form must have significance even though the hauls were not extensive.

That not a single echinoderm larva appeared in any of the hauls from November 1, 1949, until July 13, 1950, when it was no longer possible to take hauls, is surely an indication that no echinoderms were spawning during the winter.

The trachyline medusa *Aglantha digitale* was present throughout the winter, and the gonads began development on March 29, 1950. Although not shown on the above lists, adults of the jellyfishes *Cyanea* and *Chrysaora* were present throughout the winter (see "Trapping Through the Ice"), and eggs and swimming larvae were observed in *Chrysaora* on November 19, 1949. This fact, plus the presence of an ephyra on July 13, 1950, indicates that much goes on under the ice in winter. The presence of the medusa *Rathkea octopunctata* on July

13, 1950, with well-developed buds is an indication of earlier reproduction of the hydroid.

Larval ctenophores were present up to September 30, 1949, and appeared again on February 25, 1950, and became increasingly abundant from then on. Fragments of ctenophores were found on November 10, 1949, and small ctenophores and fragments on January 25, 1950, showing that these forms were not entirely absent.

The giant trochophores that were present throughout the month of June suggested that they might be those of the echiuroid *Hamingia arctica,* for the latter produces giant eggs (see phylum Echiuroidea, under "Discussion of Animals by Phyla").

Larval polychaetes and small worms were present all during the winter. The main sexual activity and egg-bearing stages of several of the polychaetes occur in winter.

Copepods were present throughout the winter, ranging from common to abundant to exceedingly abundant. Nauplii were much less common during the winter, not becoming abundant until about May 17, 1950. Although never abundant, other crustacean larvae of various kinds were present throughout the winter.

It is an interesting fact that although veliger larvae were never abundant as compared with other forms, they were present throughout the winter. Certain gastropods must lay eggs at various times during the winter or else the larvae spend a long pelagic life. Most of the egg capsules that were dredged or washed ashore during the open season contained young snails at some time, but there were several kinds that contained only eggs and too few were found to determine whether the eggs hatched as swimming larvae or as young snails. It is possible that in some species the eggs hatched as swimming larvae that escaped from the capsules without further development and that these were the veligers found in the winter plankton.

That invertebrate eggs and fish eggs begin to be common to abundant in June is another proof that certain animals either carry on as usual during the winter or produce eggs from oil stored during the open season.

PARASITES AND COMMENSALS

It is unfortunate that more could not be learned of the parasitic and commensal relationships of the animals collected, for these relationships form such an interesting and important part of the knowledge of a fauna. When animals must be obtained by dredging (rather than by digging them from mudflats or sand or by finding them among or under rocks), the determination of commensal relationships is difficult and sometimes impossible.

Among the polychaetes there must be commensal relationships that could not be determined with certainty. For instance, the polynoid worm *Antinoë sarsi* is undoubtedly commensal with the echiuroid worm *Echiurus echiurus alaskanus.* The polynoid *Enipo gracilis* is known to be commensal (Alaska) with the maldanid *Nicomache lumbricalis,* and although both of these worms were collected at Point Barrow they were not found within the same tube. The polynoid *Arcteobia anticostiensis* is also known to be commensal with the terebellid *Pista flexuosa* in Labrador. This polynoid occurs at Point Barrow, and even though *P. flexuosa* was not found there, other suitable terebellid hosts were abundant. One or two of the other polynoids showed characteristics of commensalism, but appearances could not be substantiated by evidence.

The bryozoan *Alcyonidium polyoum* was often found growing on snail shells, and several species of hydroids were found on clam shells and snail shells, especially *Boreotrophon* sp., *Neptunea ventricosa,* and *N.* sp.

The following table summarizes most of the parasitic relationships that were found:

TABLE 8.—*The parasites of Point Barrow, Alaska, and their hosts*

HOST	PARASITE
DECAPOD	RHIZOCEPHALANS
Pagurus trigonocheirus (Stimpson), on abdomen	*Clistosaccus paguri*
	Peltogaster depressus
POLYCHAETES	COPEPODS
Antinoë sarsi	*Herpyllobius arcticus*
Gattyana cirrosa	" "
Harmothoë extenuata	" "
H. imbricata, on head	" "
Terebellides stroemi	*Saccopsis terebellidis*
AMPHIPODS	
Onisimus affinis, in marsupium	Unidentified
Haploops laevis, in marsupium	"
Macra danae, in marsupium	"
DECAPOD	
Eualus gaimardi, under branchiostegite	*Choniostoma mirabile*
TUNICATES	
Boltenia echinata, in branchial basket	*Doropygus* sp.
B. ovifera, in branchial basket	*Schizoproctus inflatus*

TABLE 8.—*The parasites of Point Barrow, Alaska, and their hosts*—continued

HOST	PARASITE
FISH	
Boreogadus saida, on gills	*Hemobaphes cyclopterina*
DECAPODS	LEECH
Sclerocrangon boreas, on exoskeleton	*Crangonobdella murmanica*
	ISOPOD
Eualus gaimardi, on abdomen	*Phryxus abdominalis*

DISCUSSION OF ANIMALS BY PHYLA[3]

Phylum PROTOZOA

Because of the time-consuming techniques involved, no attempt was made to collect protozoans other than the Foraminifera. These are extremely abundant at Point Barrow and are attached to practically everything—hydroids, bryozoans, stones, barnacles, shells, worm tubes, chitons, and tunicates. The furrows in the shells of *Pecten islandicus* are favorite nestling niches, and the tunic of tunicates and the girdle of chitons (*Symmetrogephyrus vestitus*) are places of attachment sufficiently plastic to permit the Foraminifera to form depressions to fit their tests. Other epizoic forms of Protozoa were observed on such animals as crustaceans, mollusks, hydroids, and bryozoans.

Whenever possible, Foraminifera were picked from other animals and preserved and labeled. Sediments washed from the collections were also saved and labeled. All this material was turned over to Dr. Alfred R. Loeblich, Jr., and from it he identified 66 species, including 4 new genera and 11 new species. In the summer of 1950, when Dr. Loeblich spent a few weeks at Point Barrow, he accompanied the writer on dredging trips and during this time he added 9 more species, including 2 new ones, to the collection, making a total of 75 species. The results of the study of these Foraminifera have already been published (Loeblich and Tappan, 1953).

Phylum PORIFERA

Sponges often formed a conspicuous part of the fauna of the dredge hauls. Except in the waters from Eluitkak Pass to Elson Lagoon (depth 40 feet, bottom of stones, gravel, and mud), almost no sponges

[3] Detailed information concerning individual species could not be included in this discussion. Any reader interested in more specific data on any animal or group of animals should contact the writer.

were taken at depths of less than 110 feet. The stalked, flared-goblet-shaped *Echinoclathria beringensis* (Hentschel) was common at Eluitkak Pass, as was also *Halichondria lambei* Brønsted. Specimens of the former species from Eluitkak Pass were larger (up to 9 inches across) than from any other station, although this species occurred in practically every haul from depths greater than 110 feet, up to 741 feet. Since there is a strong current at Eluitkak Pass and the water is often very muddy and sometimes somewhat diluted, the ability of this sponge to thrive is remarkable. Often quantities of mud could be squeezed from a specimen. It is muddy white or grayish in color and has a disagreeable odor. A copepod, probably of a new species, is often found in large numbers on the inner face of the "goblet."

From a depth of 522 feet a portion of a *Polymastia andrica* de Laubenfels was dredged. This sponge, which was in the form of a small-bore cylinder, was a beautiful rose red in color.

From a depth of 741 feet two specimens of a new sponge, *Craniella craniana* de Laubenfels, were dredged, and a third at 438 feet. The first two specimens were from a worm-tube and mud bottom, the other from a stony bottom. All were greenish gray in life. The largest specimen was approximately 2 inches in diameter and 4 inches high. The long spicules of this sponge are massed in cone-shaped projections arranged in a manner that caused the staff to refer to the animal as the "pineapple sponge." At least two species of somewhat amorphous sponges, identified as *Myxilla incrustans* (Johnston) Lundbeck and *Topsentia disparilis* (Lambe) Burton, were often found completely surrounding a group of barnacles (*Balanus rostratus apertus* Pilsbry) except for the apertures of the barnacles.

The color of sponges does not last many months in preservative. Some of the yellow sponges at Point Barrow even faded in the laboratory before they were placed in preservative. One unusually bright one faded to a pale yellow while preparations were being made to photograph it. Other sponges that were referred to as a "dirty yellow" faded to a dirty white before they could be preserved.

The collection of sponges was turned over to Dr. M. W. de Laubenfels who identified (de Laubenfels, 1953) and described 10 species, 3 of which were new and included 1 new genus. Unfortunately, not all the material was identified.

Phylum COELENTERATA

At least in number of individuals, if not in number of species, the coelenterates at Point Barrow are extremely abundant. Six or seven species of gymnoblasts and about 15 species of calyptoblasts were collected. There are about six species of anthomedusae, perhaps two of leptomedusae, about three of trachymedusae, and three or four of jellyfishes. Since no special effort was made to collect jellyfishes and other medusae, the number of species of coelenterates may be much higher than here indicated.

As yet no one has been found to identify the jellyfishes and medusae. Dr. Cadet Hand is working on the sea anemones, and after completing this work he expects to identify the hydroids. Dr. Frederick M. Bayer identified the one octocoral found.

Order HYDROIDA

Suborder Gymnoblastea

Colonies of *Hydractinia,* which partially or completely covered snail shells of the genera *Polinices, Neptunea,* and *Buccinum,* occupied either by hermit crabs or by the original owners, were taken at Eluitkak Pass (gonophores present on August 10, 1948) by hand dredging from 50 feet on July 26, 1948, and by dredging from depths of 110 to 453 feet from August until the middle of October.

The most striking hydroid was a deep flesh-colored species of *Corymorpha* dredged from a sandy-muddy bottom at a depth of 10 feet on July 21, 1948 (gonophores present). Other specimens were washed ashore, the largest measuring 100 mm. in length. A specimen 55 mm. long collected on October 16, 1949, was double-headed: at about two-thirds the height of the stem it branched and gave rise to another polyp about one-half the size of the main polyp.

A species of *Garveia* was dredged occasionally (large flesh-colored gonophores present on October 6, 1949). A species of *Tubularia* with long straw-colored or tan unbranched stems up to 150 mm. in length and with polyps at least 20 mm. across was taken frequently but sparingly from depths of 80 to 477 feet. (See *Tubularia* under "Abundance of Animals.")

Suborder Anthomedusae

Sarsia flammea Hartlaub was undoubtedly the most abundant hydromedusa at Point Barrow. Although common at various times, during July 1949, and especially between July 20 and July 27, there were countless numbers in the water along the shore, and many were carried ashore into pools in the gravel. On July 11, 1950, two specimens were taken through the ice in a screen trap at a depth of 37 feet.

Less abundant than the above species, *S. princeps* (Haeckel) was nevertheless common during the week of July 20 to July 27, 1949, and was present at other times. One specimen taken on July 26, 1949, had five radial canals ard five tentacles.

A single specimen of *S. tubulosa* (M. Sars) taken in a plankton tow on July 16, 1948, forms the first record of this species from the western Arctic.

About six specimens of what is undoubtedly the medusa of *Bougainvillea superciliaris* L. Agassiz were taken near shore in August 1948 and July 1949. One taken on July 23, 1950, appeared to be sexually mature.

Six specimens of *Rathkea octopunctata* (M. Sars) were taken near shore in August 1948, and another one in a vertical plankton haul through the ice at the 80-foot hole 1.6 miles from shore on July 13, 1950. This transparent medusa is about 3 mm. high and 2 mm. in diameter, with brown manubrium, dark-brown lithocysts, and brown medusa buds. All the medusae were bearing budding medusae, and some of the buds were in turn producing buds before becoming de-detached from the parent. Young buds are transparent, appearing somewhat like blisters, but become tan and then brown as they grow older.

The circumpolar *Halitholus cirratus* Hartlaub was a seasonal visitor at Point Barrow. Occurring less frequently than *Halistaura,* for instance, it nevertheless was common on August 3, 1948, September 3, 1949, and July 20, 1950.

Suborder Calyptoblastea

Hydroids of this group were often growing on other hydroids or other animals: *Campanularia* on *Obelia, Sertularia,* and *Thuiaria; Clytia* (?) on the clams *Nuculana* sp. and *Macoma calcarea,* and on the legs of a pycnogonid; *Obelia* on the legs of the king crab *Paralithodes camtschatica;* and *Ophiodissa* (?) on the stem of *Tubularia.*

The most abundant hydroid, which the writer tentatively refers to as *Lafoeina maxima* Levinsen, was taken in large masses at Eluitkak Pass and from a few to numerous colonies were taken in every dredge haul from 110 to 477 feet, being particularly abundant at 453 and 477 feet. This hydroid, which resembles strands of chenille as much as it does a hydroid, was usually attached to rocks but was also found on barnacles, old shells, and even bryozoans. Two different species may be represented, for both branched and unbranched forms were common. Colonies up to 130 mm. in height were not uncommon.

New colonies were taken through the ice on February 14, 1949, at a depth of 149 feet. This is a truly Arctic species that has been known from eastern Canada, Greenland, Iceland, and the European, Russian, and Siberian Arctic, but has not been reported previously from Point Barrow.

Another common species, probably *Sertularia* sp., was taken in every haul from 110 to 477 feet, and large colonies were taken through the ice on February 18, 1950, at 162 feet. The simple ascidian *Molgula griffithsi* often grew on its stems and Foraminifera were frequently found on it. (See "Reproduction Phenomena.") Colonies of the treelike *Thuiaria elegans* Kirchenpauer, up to 200 mm. in height, were dredged at Eluitkak Pass and at depths of 120 to 741 feet. Since this species has been known only from Flower Bay in Bering Sea, the Point Barrow specimens represent a northward extension of range into the Arctic. Another species of *Thuiaria,* possibly *T. lonchitis* (Ellis and Solander), was common at depths of 80 to 477 feet.

Suborder Leptomedusae

Medusae of a species of *Obelia* were taken in plankton tows in August of 1948 and 1949. They were transparent, with brown gonads and a pale, translucent, tan manubrium. In most specimens there appeared to be a progression of development in the gonads in that one gonad was small, another a little larger, the third fairly well developed, and the fourth still more mature. One medusa had eaten a green ciliated larva too large to be engulfed at one time and part of it was projecting from the mouth while the cilia of the larva continued beating.

Other Leptomedusae were collected from shore by means of a net.

Order TRACHYLINA

Suborder Trachymedusae

The transparent *Halistaura cellularia* (A. Agassiz), with peach-colored canals, was common about the middle of August and was seen occasionally at other times.

The most consistently abundant hydromedusa was *Aglantha digitalis* (O. F. Müller), which was plentiful to extremely abundant at times. Specimens were observed from the latter part of June, when they were taken through holes in the ice, to the first week in September. On August 6, 1948, all sizes were present, ranging from young specimens with gonads that were mere specks to full-grown ones with long mature gonads. The four oral lobes, that perform startlingly like fingers in grasping food, act with amazing rapidity and efficiency.

An unidentified trachymedusan 24 mm. high and 47 mm. in diameter was taken on July 24, 1949. The manubrium, radial canals, and tentacles were translucent white, and the large, lobate gonads were cream-colored. Red-eyed phronimids with red-and-white bodies nestled into the subumbrellar surface of the medusa with their backs to the subumbrella. They had pulled the tissue of the latter around their backs and held it with their feet. These phronimids may be the young of *Hyperoche medusarum*.

Class SCYPHOZOA

Order SEMAEOSTOMEAE

Since no special attempt was made to obtain jellyfishes, it is probable that more species occur at Point Barrow than are included in the present collection. At times the water alongshore in the vicinity of Point Barrow literally teemed with them, especially during the summer of 1948 when ice floes were always present. They may have been just as numerous in 1949 and 1950, but if so they were farther from shore and less obvious.

There has been much discussion about the species or varieties of *Aurelia*. Some authors consider the several forms as mere varieties of *A. aurita* (Linnaeus), while others give them specific rank. Point Barrow should be a good place to study *Aurelia* and *Cyanea,* for both of these jellyfishes occurred in a variety of color forms.

Countless thousands of a uniformly translucent, pale olive-tan *Aurelia* ranging up to 2 inches in diameter were at the edge of the water on August 12, 1948. One specimen about 5 inches in diameter with brown tentacles and gonads was also observed. Again on August 16, 1948, the small, pale olive-tan specimens were exceedingly numerous, and a few white specimens about 4 or 5 inches in diameter with brown tentacles and gonads were seen. One specimen was white with white tentacles and brown gonads.

Young specimens of *Aurelia* (and also of *Cyanea*) up to 2.5 inches in diameter withstand a wide range of temperature. Taken into the laboratory from water barely above freezing, they will live for days in pans of water that soon reaches room temperature.

Cyanea capillata (Linnaeus) was also exceedingly abundant, but it occurred more consistently throughout the summers from 1948 to 1950 than did *Aurelia*. Specimens usually ranged in color from pale tan to yellowish brown with dark-brown canals and tan to brown tentacles, but on August 17, 1949, a large orange-brown specimen was seen. Frequently a form with a whitish bell and delicate flesh-colored tentacles was seen. This form, 4 to 12 inches in diameter, was abundant on September 8, 1948, and common on September 15, 1949. Specimens of *Cyanea* species up to 20 inches in diameter were taken through holes in the ice throughout the winter of 1949. Ephyra and postephyra stages less than half an inch in diameter, with transparent bell and lobes and very pale flesh-colored central parts, were taken in August 1948 and from September to November 1949.

A species of *Chrysaora* was seen frequently but never in such abundance as the above two species. On November 19, 1949, several specimens contained yellowish-brown eggs, some of which were rotating and developing into active planulae.

Two species of commensal phronimids, *Hyperia medusarum* and *Hyperoche medusarum,* were found with *Cyanea* and *Chrysaora.* (See "Amphipoda.")

Class ANTHOZOA

Subclass Alcyonaria

One species of the octocoral *Eunephthya rubiformis* (Pallas) was found. It was exceptionally abundant at Eluitkak Pass and was dredged from 125 to 522 feet. Colonies up to 6 inches high were not uncommon. Occasionally instead of colonies of the usual reddish color, a pale-orange or a beautiful apricot-colored colony was taken.

Subclass Zoantharia

Order ACTINIARIA

Sea anemones were exceedingly abundant in some hauls, rare or absent in others. The most plentiful species, *Stomphia coccinea* (O. F. Müller) was characterized by brick-red markings on a cream background, with tentacles about the color of the markings. Small specimens do not show these markings so vividly. Adult specimens that were a delicate peach color throughout were frequently taken, but they may belong to another species. Specimens 65 mm. high and with a basal diameter of 70 mm. were dredged. This species was taken at Eluitkak Pass and at most of the rubble-bottom stations. In one dredge haul from 130 feet (on September 15, 1948) there were 123 specimens, and hauls from several other stations brought up 50 or more.

One specimen of this species taken on October 14, 1949, at 175 feet was filled with eggs measuring 697 microns in diameter that were clearly visible through the body wall.

An amazing phenomenon was observed in this anemone. When it was subjected to unfavorable conditions, such as overcrowding in a pan or jar of sea water, it cast out through the mouth a re-formed translucent white inner lining with translucent stubby tentacles, the latter so short that they were mere tubercles. This offspring was somewhat suggestive of a pickled onion, for the lines of the septa were clearly visible through the body wall. If conditions remained adverse, more offspring were cast off, each one becoming smaller than its predecessor.

That this phenomenon is not limited to laboratory conditions was evidenced by the fact that on August 21, 1948, at a depth of 140 feet, one of these translucent anemones 16 mm. high and 11 mm. in diameter was dredged. At the time this was believed to be a new species of an unusual nature, and it was not until the end of the dredging season in 1949 that its true identity became known, but it was then too late for experimental investigation since no more specimens could be dredged. Specimens left overnight in jars with too little water yielded as many as six offspring each, the smallest one being no larger than a pea. On September 2, 1949, there was washed ashore a translucent anemone 21 mm. in diameter in which the basal disk, the mouth, and the tentacles were colored like those of the adults mentioned above although in a somewhat paler version. The tentacles were short and stubby but longer than those of a newly cast offspring. This individual was obviously a cast offspring that had undergone subsequent development.

Other anemones were common—a purplish-red, an oyster-white, a lavender form, and some with white base, peach-colored column, and translucent peach tentacles with whitish tips. Two broad, uniformly lemon-yellow specimens were dredged on August 17, 1949, at 438 feet. Two specimens of *Halcampa duodecimcirrata* (Sars) with a muddy white column, white peristomium, and olive-gray tentacles were taken, one at 70 feet, the other at Eluitkak Pass. Two other species of burrowing anemones were found.

Order CERIANTHARIA

From 1 to 30 specimens of *Cerianthus,* possibly *borealis* Verrill, were taken in hauls from 22 to 132 feet. Since there was considerable variation in the proportion of the diameter to the length, it is possible that two species are represented.

Phylum CTENOPHORA

Like the jellyfishes, the comb jellies were much more abundant alongshore during the drift-ice summer of 1948 than during the open-water summers of 1949 and 1950. Three species, each belonging to a different order, were identified. At times all three would be abundant at the edge of the water and again only one or two species would be in evidence from the shore; at other times none were seen. Sometimes they would be washed ashore in great numbers.

Mertensia ovum (Fabricius) was especially abundant on July 26, 1948, and again on September 30, 1949. On both of these dates the majority of the specimens were about 10 mm. long, but individuals up to 60 mm. in length were observed at various times. Some individuals taken on the morning of August 5, 1948, were gorged with plankton; one 9 mm. long and 7 mm. in diameter had ingested one appendicularian, several copepods and ostracods, strings of diatoms, protozoans, arrow worms, nauplii, and a piece of red tentacle.

In the summer of 1948 *Bolinopsis infundibulum* (O. F. Müller) was first observed on August 2, when a specimen only 55 mm. long and 35 mm. wide was taken alongshore. Later, individuals exceeding 200 mm. in length were common.

Although it never occurred in such enormous numbers as either *Mertensia* or *Bolinopsis,* the rose-colored *Beroë cucumis* Fabricius was more frequently present along the shore than were the other two species. In 1948 it was first observed on July 20, in 1949 on July 22, and in 1950 on July 20. In 1949 it was observed alongshore until September 30, and throughout the winter fragments were seen in leads or were taken through holes in the ice.

Beroë cucumis could be preserved satisfactorily, but despite time and effort spent on the other two species, no success was achieved. Solutions that preserved the animals also contracted them to such an extent that they could not be worked on, and those that left the animals in a relaxed, transparent state completely dissolved them within a period of six months.

Point Barrow would be an excellent place for life-history studies of the ctenophores, for often all stages of development from larvae to adults are present at one time.

Phylum PLATYHELMINTHES

Class TURBELLARIA

Only two species of polyclad flatworms were taken, but one of these, *Notoplana atomata* (Müller), was present in every dredge haul from a bottom that afforded niches and hiding places, namely, Eluitkak

Pass and at depths of about 125 to 741 feet. One dredge haul from Eluitkak Pass yielded 20 specimens of this worm, which nestled between the abundant growths of barnacles and no doubt fed on them. Thick growths of bryozoans and of the octocoral *Eunephthya rubiformis* also provided refuge for it. In life *Notoplana atomata* is light beneath and rosy tan above, the latter color produced by minute tan spots. Internal opaque white spots show through the dorsal surface. Although this is the commonest polyclad of northern shores of the North Atlantic, both in Europe and America, it has not previously been reported from western Arctic shores.

A new species of polyclad, *Acerotisa arctica* Hyman, was found only rarely: 2 specimens on October 6, 1949, at 295 feet, 1 on September 1, 1949, at 328 feet, and 1 on October 11, 1949, at 453 feet—all on stony bottom. It is pale red, with a deeper red longitudinal band through the middle.

Both of these species, with a description of the new one, are included in a recent publication by Hyman (1953).

Class CESTODA

Since parasitology is a study in itself, no search was made for tapeworms, but any that were found were preserved. Specimens up to 600 mm. in length and from 3 to 4 mm. in width were taken from the intestine of a bearded seal, *Erignathus barbatus* (Fabricius). Another much smaller species was found by the hundreds at the edge of the water and on the bottom of a fresh-water pond near the Point. They had obviously come from bird droppings, and since dozens of loons were on the water and flying around, no doubt this bird is the secondary host of the tapeworm.

Phylum NEMATODA

Free-living nematode worms were abundant and many of them were unusually large. They could be found among bryozoans and hydroids, in the interstices between individuals in a colony of barnacles, in the mud and debris in holes in rocks, in the growth on rocks, and in more specialized habitats. Specimens of the jell-like cylindrical bryozoan *Alcyonidium enteromorpha* Soule were somewhat wrinkled longitudinally and within these wrinkles several nematodes were ensconced. Others were found at the bases of the simple tunicates *Chelyosoma macleaynum* and *Molgula griffithsi*. Still others were found between colonies of the compound ascidian *Didemnum albidum* and the worm tubes (*Pista maculata*) on which they were growing.

Two striking nematodes, 290 mm. and 325 mm. in length, were washed ashore on August 18, 1948. These were white, with the head end tipped with black, and a gray, or hyaline, longitudinal stripe along the ventral side.

The nematodes were sent to Dr. B. G. Chitwood for identification. He expects to describe a new species of *Thoracostoma* that was found in a rock from a depth of 130 feet on September 15, 1948.

No attempt was made to find parasitic nematodes, but specimens up to 180 mm. in length and 1 mm. in diameter were abundant in the intestine of the bearded seal. Masses of another species so filled the deeper nasal passages of this seal that one wondered how the animal could breathe.

Phylum NEMERTEA

Nemerteans were more abundant off Point Barrow than in any other place within the collecting experience of the writer. They occurred in practically every haul from 30 to 741 feet. The collection was turned over to Dr. Wesley R. Coe for identification, and the results of his study were published in 1952. From the 300 specimens sent him (many duplicate specimens of certain species were not preserved), Dr. Coe identified 24 species, only 3 of which had been taken previously in the Point Barrow area of the Arctic (Cape Smythe, Wainwright, etc.). At least 10 of the species had not been recorded previously from Arctic seas: *Tubulanus capistratus* (Coe), *T. albocinctus* (Coe), *T. frenatus* (Coe), *Micrura alaskensis* Coe, *Paranemertes peregrina* Coe, *Nemertopsis gracilis* Coe, *Amphiporus imparispinosus* Griffin, *A. pacificus* Coe, *Tetrastemma aberrans* Coe, and *T. bicolor* Coe. Four of the species found at Point Barrow are also known from the Southern Hemisphere: *Tubulanus annulatus* (Montagu), *Lineus ruber* (O. F. Müller), and *Cerebratulus fuscus* (McIntosh) from the coast of South Africa, and *Emplectonema gracile* (Johnston) from the coast of Chile. *Tubulanus frenatus* had been recorded previously only from southern California.

The most abundant genus was *Amphiporus* with seven species, and the most abundant species were *A. angulatus* and *A. lactifloreus*. *A. angulatus* was collected by Stimpson in Bering Strait in 1857. In view of its abundance at Point Barrow and its size and conspicuous coloration, it seems remarkable that it had not been taken previously in this area.

Two living specimens of *Micrura impressa* that washed ashore on September 26, 1949, had taken measures of self-preservation. They had literally tied themselves in knots, curled up into balls, and then secreted mucous bags about themselves. This species has been known only from the type specimen from Bering Strait and later from Japan.

These Point Barrow nemerteans have added to the knowledge of circumpolar distribution. Coe (1952) states: "Even at the present time no nemerteans are known from the Polar seas between the Point Barrow area and northwest Greenland on the east and Novaya Zemlya and Franz Josef Land on the west."

Phylum SIPUNCULOIDEA

Two or three species of sipunculids were collected, the most abundant being *Golfingia margaritacea* (Sars), which occurred at Eluitkak Pass and at nearly every station from 120 feet to 741 feet. From 1 to 11 specimens were taken in each haul. They were found among masses of barnacles, in the interstices among pebbles and gravel that covered the tunicate *Molgula,* and among debris gathered around old holdfasts of tunicates and hydroids. The Point Barrow specimens extend the range of this species from the 54th parallel of latitude into the western Arctic to the 71st parallel.

A single individual of a species of *Phascolion* was dredged from 741 feet, and although it may well be new it was too small and contracted for anatomical study.

The sipunculids were identified by the late Dr. W. K. Fisher.

Phylum PRIAPULOIDEA

Two species of this phylum were found; the better known of the two was taken less frequently than the rare one. One specimen of *Priapulus caudatus* Lamarck was dredged from 741 feet and another was taken through the ice on February 18, 1950, from 162 feet. Four other individuals, ranging in length from 70 to 110 mm. were washed ashore. These specimens extended the range of this species into the western Arctic.

A single small specimen of *Halicryptus spinulosus* von Siebold was dredged at Eluitkak Pass on August 1, 1950, and 17 specimens, ranging in length from 70 to 170 mm., that washed ashore were collected. Only small examples of this species had been taken previously, the largest, recorded by Théel from Spitsbergen, being 27 mm. in length. This species has been recorded from West Greenland on the east and from the Kara Sea on the west but had never before been taken from the North American Continent.

The writer is indebted to the late Dr. W. K. Fisher for identifying these species and for furnishing other data.

Phylum ECHIUROIDEA

Two species of echiuroid worms were collected. One of the most abundant of the mud-dwelling animals at Point Barrow is *Echiurus echiurus alaskanus* Fisher, but it lives so far beneath the surface in such stiff mud that only small specimens were brought up by the dredge, and then only rarely. However, during the summers of 1949 and 1950 hundreds of these worms were washed out of their burrows and thrown ashore during storms. About half of these storm-tossed creatures were minus the proboscis. Specimens with short proboscides in the process of regeneration were common. A scale worm, *Antinoë sarsi* Kinberg, undoubtedly commensal with *Echiurus,* was also washed ashore in numbers.

Spawning time was not determined for this animal. Males collected on October 16, 1949, had sperm in the storage sacs and females had eggs within the body cavity. These eggs, which were white, granular, and spherical, were 175 microns in diameter.

Whether prompted by hunger or by the urge to add variety to their diet, or perhaps by both, the Eskimos seldom overlook an opportunity to obtain food. Chester Lampe, one of the Eskimo employes at the Arctic Research Laboratory, told the writer that the older Eskimos used to eat any *Echiurus* that washed ashore. He said they would "cut off the head" and eat the remainder of the animal. What they actually did was to cut off the anal end, which is encircled by a double row of setae; they mistook the proboscis for a tail.

Hamingia arctica Koren and Danielssen, a bright deep-green echiuroid with a bifurcated proboscis, was found only on the beach following storms and less than 10 specimens were collected. One specimen with a body 75 mm. long had a proboscis 44 mm. long; the largest, with a body 96 mm. long and 12.2 mm. in diameter, had lost its proboscis.

The body wall of a female collected on August 10, 1950, had been torn so that an egg sac, also torn, was extruded and the eggs were visible. These eggs, which were bright coral, were 900 microns in diameter—enormous for an echiuroid. They appeared to be fertilized, perhaps by some other specimens that were in the pan.

Although this species appears to have a wide distribution it has been taken only sparingly and there were no specimens of it in the U. S. National Museum. It has been collected in East Greenland, Spitsbergen, the Murman Sea, and east to the Barents Sea, Iceland, and the west coast of Norway. It was taken in the Antarctic by the *Discovery* Expedition and in the South Shetlands at a depth of 404.5

fathoms. The Point Barrow specimens extend the range of this species to the western Arctic.

Phylum CHAETOGNATHA

Three species of arrow worms were taken, the most abundant being *Sagitta elegans* Verrill. Since only surface plankton tows were taken, there is a probability that the other two species are more abundant than the haul would indicate. The writer is indebted to Dr. E. Lowe Pierce for identifying this group.

Sagitta elegans Verrill (probably var. *arctica* Aurivillius, the form commonly found in Arctic waters) is exceedingly abundant at times at Point Barrow. During the middle of July 1948 plankton tows near shore brought in thousands of individuals 13 to 27 mm. in length. These had immature gonads. Some 28-mm. specimens taken on September 27, 1948, had long, slender ovaries and visible testes; others had very small ovaries. Dunbar (1941b) discusses the breeding cycle of this species.

In July, when the ice was melting rapidly, *Sagitta* survived when the salinity of the surface water was only 18.12 to 15.22 parts per thousand, but on July 16, 1948, when the salinity dropped from 15.22 to 5.81 between 9 a.m. and 4:30 p.m., untold millions were killed. Living *Sagitta* are caught and eaten by ctenophores, jellyfishes, and hydromedusae. Those that fall to the bottom are soon devoured by amphipods.

Collection records for this species were made from September 9, 1949, to July 13, 1950, collections from January through June being made by vertical plankton tows through holes in the ice. During February and until late in March (for 6 tows), no *Sagitta* were brought in, but they were taken throughout the remainder of the winter season and became abundant in June. A few specimens taken on June 20, 1950, were 11 mm. long and others were between 22 and 25 mm. long, indicating two age groups.

On September 27, 1948, two specimens of *Sagitta maxima* ? (Conant) 50 mm. in length were taken with a dip net from an ice cake grounded near shore. A strong offshore wind was blowing the surface water seaward and the deeper water was upwelling.

Also on that same date, eight specimens of *Eukrohnia hamata* (Mobius) were taken in the same manner as the above species. These were about 40 mm. long, with well-developed testes and long ovaries containing well-developed eggs. Two of the specimens were carrying young in a marsupium formed by folding the posterior lateral fins together—a phenomenon hitherto unknown in arrow worms. In the laboratory some of the young, which were nearly 3 mm. long, began escaping from the marsupium.

This is said to be a bipolar, cosmopolitan species, restricted in warmer seas to deeper water. In colder waters it may be found close to the surface, but even in the Arctic it occurs mainly in deep water (Kramp, 1938b; Dunbar, 1942b).

Had it not been for the upwelling of deeper water, this species and *Sagitta maxima* probably would not have been taken at Point Barrow, for even the cosmopolitan *S. maxima* usually occurs only in the deeper parts of the ocean, never less than 200 meters below the surface in tropical and temperate regions (Kramp, 1938a).

Phylum BRACHIOPODA

Only two species of brachiopods were found. Dr. G. Arthur Cooper, who identified these, will report on some noteworthy characteristics of the smaller species in a future publication.

Shells of *Hemithyrus psittacea* (Gmelin) were common, and living specimens were occasionally brought up from depths of 120 to 741 feet. The hauls from 328, 295, and 453 feet yielded the greatest numbers, 11, 6, and 12, respectively. Specimens from 20 to 22 mm. in length appeared to be about 5 years old, and large ones were more abundant than small ones. Specimens between 3.6 mm. and 7.6 mm. long were taken in September and October at depths of 328, 217, 477, and 453 feet. Although this is a circumpolar, Arctic-Boreal species, this is apparently the first record from Point Barrow.

The smaller *Diestothyris spitzbergensis* Davidson was taken at depths of 110 to 741 feet, usually alive. In life the shell is tan. The largest shells of this species were slightly over 15 mm. long, 12.9 mm. wide, and 5.2 mm. in depth, and were from 3 to 5 years old. The hauls from 150, 741, and 152 feet yielded 6, 5, and 7, respectively. The greatest number, 13, was taken through the ice on February 18, 1950, at a depth of 162 feet. Nine of these contained eggs, one contained sperm, and in three the sex could not be determined without making sections of the gonads. Nine of the eggs measured from 195 to 227 microns in diameter, with an average of 211 microns. Two small specimens 3.6 mm. and 4.1 mm. long were taken from 477 and 741 feet, respectively.

Phylum BRYOZOA

The bryozoans, or moss animals, comprise an extremely important part of the bottom fauna at Point Barrow and were found in large numbers. There is scarcely a stone without at least one colony of encrusting bryozoans; many bore several colonies, and often the dredge brought up stones with the entire surface covered. Bryozoans are also found on pecten shells, snail shells, tunicates, crabs, large isopods, barnacles, and other bryozoans, and on holdfasts of tunicates, hydroids, and other bryozoans. The upright forms are exceedingly abundant. Attached to stones, they provide refuge and places of attachment for innumerable other animals.

The collection of bryozoans was turned over to Dr. Raymond C. Osburn, who identified 99 species, among them 12 new species and 1 new variety. All these species are mentioned and the new species described by Osburn in his monograph, "Bryozoa of the Pacific Coast of America" (in three parts, 1950, 1952, 1953) and by Soule (1951). The majority of the Arctic forms treated by Osburn were from the MacGinitie Point Barrow collection.

Order GYMNOLAEMATA

Suborder Cheilostomata-Anasca

By far the most abundant of the upright forms was *Eucratea loricata* (Linnaeus), which forms large bushy colonies up to 6 or 7 inches in height. It was taken in all hauls from bottoms affording places of attachment (Eluitkak Pass, and from 110 to 741 feet), and even from the carapaces and legs of crabs. Small colonies were also found in 7 feet of water in Elson Lagoon where the water was brackish. Colonies taken at Eluitkak Pass on August 6, 1948, had coral-colored eggs. This species was common in the dredge hauls made through the ice during the winter.

Carbasea carbasea (Solander), a foliaceous, upright form, was also common in hauls from Eluitkak Pass and from most depths of 110 to 741 feet, and in winter dredge hauls. Brown bodies were noted in February as well as in August. Colonies taken at Eluitkak Pass on August 30, 1948, had two sets of barnacles, one with individuals about 4 mm. across the base, the other 0.75 mm. to 2.0 mm. Colonies taken at the same locality on September 2, 1948, had barnacles up to 6 mm. in diameter. The bases of the minute barnacles fitted into the bases of the bryozoan cells.

A few colonies of *Terminoflustra membranaceo-truncata* (Smitt) were taken at 140, 477, and 741 feet. The large colony from the latter depth had the following bryozoans growing on its dorsal surface: *Tricellaria erecta* (Robertson), *Rhamphostomella bilaminata* (Hincks), and *Cauloramphus cymbaeformis* (Hinks).

Bidenkapia spitzbergensis (Bidenkap) was common and conspicuous in dredge hauls for it often forms large colonies of laminate frills. Several colonies taken on October 14, 1949, at 175 feet bore ovicells, and one large colony practically surrounded a large mass of sponge. A new variety, *alaskensis* Osburn, was collected at 140 feet.

The new species *Tegella magnipora* Osburn also forms large, laminate, orange-colored colonies. It was taken at depths ranging from 150 to 420 feet.

Next to *Eucratea loricata* in abundance among the erect, branching forms of bryozoans was *Tricellaria erecta* (Robertson), which forms cream-colored colonies several inches in height and width. It was taken at depths ranging from 110 to 741 feet, attached to stones, tunicate holdfasts, hydroids, other bryozoans, and the carapaces and legs of crabs. It was especially abundant at 175 feet. It is new to the Arctic.

In the matter of abundance, *Dendrobeania murrayana* (Johnston), in its typical form and several varieties, including *fruticosa,* vies among the bushy forms with *Eucratea loricata* and *Tricellaria erecta.* A muddy tan in color, it forms colonies up to several inches in height that were common to abundant in most hauls and were present in all hauls from 125 to 522 feet attached to stones, holdfasts of tunicates, crabs, and other animals.

Suborder Cheilostomata-Ascophora

Three species of *Hippothoa,* forming a delicate tracery over stones, shells, and other objects, were common. *H. hyalina* (Linnaeus), is new to Point Barrow, *H. divaricata* Lamouroux is new to the Arctic as well as Alaska, and *H. expansa* Dawson is new to the western Arctic and to Alaska.

Ranging in color with age from pale rose to dark purple, *Stomachetosella sinuosa* (Busk), which forms round encrusting colonies on shells, is common at Point Barrow. Two bright-red colonies, 15 mm. and 18 mm. in diameter, were taken on October 6, 1949, at 295 feet. It is new to the western Arctic.

The related *S. cruenta* (Norman) forms white or yellowish encrusting colonies that may be deep red when old. The new species *S. distincta* Osburn forms shining, encrusting colonies on shells and stones. The type was taken from 217 feet on September 6, 1949.

Ragionula rosacea (Busk) forms beautiful, lobed, pale-peach colonies attached by a "stem" and spreading base to stones. The colonies at Point Barrow are exceptionally large—one colony with 10 lobes measured 22 mm. wide and 18 mm. high. This is the first record from the Pacific side of the Arctic.

Without doubt *Pachyegis princeps* (Norman) is the most abundant and conspicuous encrusting species at Point Barrow. It forms coarse, reddish-brown colonies on stones and shells, sometimes completely enveloping a stone. There was scarcely a stone taken from 175 and 453 feet without at least one colony of this species. It occurred from 110 to 741 feet. The yellowish-brown *P. brunnea* (Hincks) is also common. Both species are new to the western Arctic.

Although not abundant, *Porella compressa* (Sowerby) is a common and conspicuous species that forms large foliate colonies up to 100 mm. high and wide. It was taken from 110 to 522 feet. One large colony from 522 feet had three species of bryozoans, young barnacles, an annelid (*Spirorbis*), many Foraminifera, and a compound tunicate *Didemnum albidum* growing on it. It is new to the Pacific side of the Arctic.

Seven species of *Rhamphostomella* were taken, including the new *R. gigantea* Osburn, which forms large colonies of erect, foliate expansions and frills that rise to a height of 80 mm. and vary in color from greenish yellow to bright yellowish orange to deep orange. Colonies were taken from 80 to 420 feet.

Costazia nordenskjoldi (Kluge) occurs abundantly, forming white, almost globular masses about 5 to 8 mm. in diameter that surround stems of hydroids, bryozoans, holdfasts of tunicates, etc. It is new to the Pacific area of the Arctic.

The branching forms *Costazia surcularis* (Packard) and *C. ventricosa* (Lorenz) were in hauls from 110 to 741 feet. The latter species bore ovicells on October 11, 1949, and eggs were present on August 17, 1949. Both species are new to the western Arctic.

The beautiful branching *Myriozoum subgracile* d'Orbigny forms large white colonies sometimes 8 inches high. A very large colony matted with sponge and with hydroids growing from the sponge was taken at 125 feet. It is new to the Arctic.

Suborder Ctenostomata

The soft encrusting *Alcyonidium polyoum* (Hassell) was usually found on shells (*Buccinum* and *Neptunea*), on barnacles, and holdfasts of tunicates. Colonies taken from 453 and 149 feet were bearing ovicells. Colonies from 152 feet contained eggs that averaged 112 microns in diameter. It is new to the western Arctic.

Species of *Alcyonidium* seem to be given to unusual shapes but perhaps the most amazing is that of *Alcyonidium disciforme* Smitt which has the shape of a convex washer. The largest colony measured 50 mm. in diameter, with the rim measuring 12 mm. in width, leaving the hole in the "washer" about 26 mm. in diameter. A colony 39 mm. in diameter had a rim 14 mm. wide. As the colony increases in size, the diameter of the hole in the center also becomes larger. This species was taken from muddy bottom from 10 to 80 feet. A few specimens came from Eluitkak Pass and one from 328 feet. Since the colonies are unattached, they are frequently washed ashore. They often have the firm gelatinous egg masses of some snail attached to them. This species was known previously only from the Kara Sea, and Wakeham Bay, Ungava.

The club-shaped *Alcyonidium pedunculatum* Robertson forms firm jelly-like colonies sometimes more than 100 mm. long and up to 15 mm. in diameter at the widest point. The cuticle is translucent brown and the zooids are a darker brown. Colonies came from Eluitkak Pass and from 110 to 162 feet, the latter through the ice on February 18, 1950, and were washed ashore during storms. This is the first record of this species since it was described from the Pribilof Islands in 1902.

Even more unusual than the above species was the new *Alcyonidium enteromorpha* Soule, which was collected on August 17, 1949, at 741 feet and on September 6, 1949, at 477 feet. It forms long, roughly cylindrical, gelatinous, unbranched, pale amber colonies without peduncles (in contrast to the above species). In both hauls these colonies of *enteromorpha* were so entangled with the tubes of the annelid *Pista maculata,* which made up the bulk of the haul, that it was impossible to remove one intact. Lengths up to 750 mm. were disentangled.

Flustrella corniculata (Smitt), which forms branching, fleshy colonies that are often covered with sand and debris, was common to abundant in hauls from 110 to 477 feet, the greatest number of colonies coming from 217, 328, and 453 feet. It is new to the western Arctic. The related *F. gigantea* Silen, new to the Arctic, was also taken at 217 feet.

Bowerbankia gracilis aggregata O'Donoghue, also new to the Arctic, was taken at Point Barrow.

Phylum ENTOPROCTA

Two species of this group were taken at Point Barrow. Both of these species had been known previously "only from Kluge's record (Drifting Ice Expedition in the central Arctic Ocean in the icebreaking Str. 'G. Sedov,' 1937-40)" (Osburn, 1953).

Beautiful and luxuriant colonies of *Barentsia gorbunovi* Kluge were dredged from depths of 120 to 477 feet. Colonies from 175 feet on October 14, 1949, had colonies of *Callopora spitzbergensis, C. craticula,* and *Tricellaria erecta* growing on them. An especially large colony came from 477 feet. The colonies resemble miniature bushes with white berries.

Coriella stolonata Kluge was collected at depths of 120 and 295 feet. The colony is smaller and less complex than the above species.

Phylum ANNELIDA

Class CHAETOPODA

Order POLYCHAETA

The polychaetes comprise an important group of the Point Barrow fauna. They were found in every zone from the gravel through the mud to the rubble, both as inhabitants of the substratum and as epifauna, and occasionally as planktonic forms. At two dredging stations, 477 and 741 feet, the hauls were made up largely of the terebellid *Pista maculata* in long, sinuous, and entangled tubes. Certain species, such as *Phyllodoce groenlandica* and *Autolytus fallax,* form an important source of food for other animals.

From the collection of 3,324 specimens of polychaetes Dr. Marian H. Pettibone identified 88 species, comprising 26 families. In this study she was able to reduce 49 species to synonymy, thus making a material contribution toward straightening out some of the great confusion into which the taxonomy of this group had fallen. One new species was described (Pettibone, 1951), and the results of the study of this group have recently been published (Pettibone, 1954). Eighteen of the 88 species are mainly Arctic, 30 are Arctic-Boreal, 18 are Arctic-Boreal-Lusitanian, 21 are cosmopolitan or nearly so, and 1 is bipolar.

Many specimens of the polynoid *Antinoë sarsi* Kinberg were collected but only four were dredged (from the mud zone). Another was taken through the ice in a trap on April 11, 1950, at a depth of 37 feet. Specimens up to 68 mm. in length were taken.

Like many polynoids, this species threw off its scales or elytra when it was disturbed and consequently successful preservation of the animal presented a problem. Various methods and many different anesthetics and preservatives were tried. A mixture of 5 parts of absolute alcohol to 95 parts of sea water, which is an effective and satisfactory anesthetic for most polychaetes, was only an irritant to *Antinoë sarsi.*

A method that proved successful with a polynoid from southern California that always broke itself in two when handled was then tried: the worm was laid on a paper towel until it became partly dry and inactive, when it could be placed in preservative without a casualty. *A. sarsi* could not be managed in this manner. Varying strengths of both hot and cold formalin and alcohol were tried separately and in combination, as well as in combination with other chemicals, without success. A quick flooding with boiling formalin was the most satisfactory method but this shrank the specimens considerably. Other methods, such as anesthetizing before placing the worm in preservative (provided the anesthetization was successful in the first place), sometimes gave promise of being successful. The elytra would stay in place for several hours—but then all of them would drop off.

As a last resort it was decided to try anesthetizing these worms with something to which they were already accustomed—cold. They were placed in a tray with barely enough water to cover them and put in the freezing compartment of a refrigerator. When ice formed, it was thawed slightly and the worms quickly placed in preservative. If only the water froze, the worm would be as lively as ever when the ice thawed, but if the worm became slightly frozen it could be placed in preservative without danger of the elytra's shedding. An attempt was made not to freeze the worm to the extent of damaging the tissues. This method of anesthetizing polynoids proved the most satisfactory one, even with those species that were less sensitive.

Without much doubt, *Antinoë sarsi* is commensal with the echiuroid worm *Echiurus echiurus alaskanus*. Both were washed ashore in large numbers during storms. The polynoid looks like a commensal form and it closely resembles *Hesperonoë adventor* (Skogsberg), which is commensal with the echiuroid worm *Urechis caupo* off the coast of California (MacGinitie, 1935). The writer often wished it were possible to dig the animals out of their burrows as easily as they can be dug from a mud flat. The copepod *Herpyllobius arcticus* was found on a specimen of *Antinoë sarsi* collected on August 21, 1949—a new host for this parasite.

The bright tan-colored polynoid *Arcteobia anticostiensis* (McIntosh) was taken from 148 to 741 feet. It is no doubt commensal with one of the terebellids, possibly *Pista maculata*. It is new to Arctic Alaska.

The large (60 mm. long by 23 mm. wide) *Eunoë nodosa* (Sars), undoubtedly a free-living form, was fairly common from depths of 110 to 522 feet. In life it is pale green and dull red, with reddish-brown tubercles on the scales. Like *Antinoë sarsi*, this species would often submit to the usual anesthetization and preservation without shedding more than a few scales, but an apparently beautifully preserved specimen would subsequently be found without a single adherent scale.

Eunoë oerstedi Malmgren was taken at Eluitkak Pass and at 110, 175, 216, and 453 feet. *Gattyana ciliata* Moore was taken at 522, 453, 118, and 138 feet. The abundant tan to brownish *Gattyana cirrosa* (Pallas) was taken at Eluitkak Pass and at depths of 110 to 741 feet, with from 1 to 18 individuals per haul. Two were taken through the ice on February 18, 1950, at 162 feet. Three specimens were parasitized by *Herpyllobius arcticus. G. cirrosa* is new to Arctic Alaska.

One of the most abundant polychaetes in the dredge hauls was *Harmothoë extenuata* (Grube), which was taken at Eluitkak Pass and at depths of 125 to 741 feet. Specimens up to 70 mm. in length were taken, sometimes more than 50 per haul, but not all the specimens could be saved. They were found among bryozoans and hydroids, on rocks, and among masses of worm tubes, and were frequently hidden among the laminate growths of such bryozoans as *Bidenkapia spitzbergensis.* Each of two specimens from 217 and 125 feet had a female *Herpyllobius arcticus* on its head and one from 130 feet (September 15, 1948) had two. This species is new to Arctic Alaska.

Probably the most abundant polychaete in the dredge hauls was *Harmothoë imbricata* (Linnaeus), which was taken from Eluitkak Pass and in hauls from 70 to 741 feet. It seemed to be everywhere—among barnacles, bryozoans, old holdfasts of hydroids and tunicates, and around the bases of the octocoral *Eunephthya rubiformis.* There is great color variation in this species, the general effect being gray, but tan specimens and almost black ones are not uncommon. The scales were usually mottled with brown, black, or red, but the most distinctive pattern was one in which the black pigment was concentrated toward the inner half of the scales, producing the effect of a black stripe down the center of the back. Five specimens from Eluitkak Pass on August 6, 1948, were parasitized by 3 to 9 specimens of *Herpyllobius arcticus.* The one with the 9 copepods was only 38 mm. in length. This species is new to Arctic Alaska.

Most striking in appearance among the polynoids was *Melaenis lovéni* Malmgren with its small elytra which leave the center one-third of the back bare. About three elytra on one side and two on the other are black, the remainder of the scales and the body of the worm being pale gray. Only two specimens were dredged (from gravel bottom at a depth of about 10 feet) but they were common on the beach after certain storms. One specimen collected on October 4, 1949, was a bright peach color from the tenth parapodium posteriorly. This color, due to eggs showing through, extended well out into the parapodia. The quick-freeze method of preservation was 100 percent effective with this worm. In the literature there is no record of this invertebrate from low water, where it obviously occurs at Point Barrow. Also, there is no mention of its being commensal, but the smooth scales suggest that it may be, and if it is, it may well be commensal with the lugworm *Arenicola glacialis,* which also lives near shore.

Thirty specimens of the sigalionid *Pholoë minuta* (Fabricius), up to 25 mm. in length, were taken from Eluitkak Pass and from 100 to 741 feet, and two from a screen trap at 37 feet on April 11, 1950.

Six species of phyllodocids that were new to Arctic Alaska were taken: 4 specimens of *Eteone barbata* (Malmgren) from Eluitkak Pass, 37 feet, and 162 feet; 23 *E. flava* (O. Fabricius) from depths up to 453 feet, all but one from stony bottom; 38 *E. longa* (Fabricius) from Eluitkak Pass and at depths of 110 to 453 feet and 2 from 10 feet from a small area of sandy-muddy bottom about 300 feet from shore (the latter were killed by the low salinity, 6.4 parts per thousand, of the surface water as they were brought up); 4 *E. spetsbergensis* Malmgren from 10 feet (sandy-muddy bottom—also killed by low salinity), 175 feet (April 11, 1950), 213, and 216 feet; 46 *Eumida minuta* (Ditlevsen) from 100 to 453 feet (28 specimens from the latter depth); and two very small specimens of *Mystides borealis* Théel from sessile animals on a small rock from 217 feet. *Eumida minuta* was known previously only from a few scattered records. Its abundance at Point Barrow indicates that it has probably been overlooked because of its small size, for it occurs among bryozoans and hydroids and growths on rocks.

The most abundant species of phyllodocid was *Phyllodoce groenlandica* Oersted, which was taken at Eluitkak Pass, from the beach after storms, and from 10 to 741 feet. Specimens up to 310 mm. in length were taken. This species also was killed when it was brought up through surface water of low salinity.

Twenty-seven specimens of the hesionid *Castalia aphroditoides* (O. Fabricius) were taken at Eluitkak Pass and from depths of 125 to 453 feet. An additional specimen, in the process of regenerating its posterior end, was taken through the ice on February 14, 1950, at 149 feet. White eggs, apparently ripe, showed through the integument of specimens taken on August 10, 1948. This hesionid was flesh-colored on the anterior end and parapodia but the central portion of the body was green from the internal organs (not from eggs showing through). It is new to Arctic Alaska.

One of the most interesting worms was the syllid *Autolytus fallax* Malmgren, which ranged in length from 3 to 18 mm. The asexual or stem form was taken throughout the season of open water, sometimes on hydroids, bryozoans, or rocks, but often in tubes extending lengthwise along the hydroid *Lafoeina maxima*. In the asexual form the anterior portion of the worm was pale yellowish, with two dorsolateral longitudinal dark bands, and the posterior portion was orange. The female sacconereis stages bearing egg sacs were taken through the ice from January 25 to May 17, 1950. On March 29, 1950, there were hundreds of these worms, with egg sacs, swimming in the water at the 80-foot plankton hole and on April 7, 1950 (1.9 miles from shore) when the slush ice was removed from a 4-foot-wide lead, hundreds were welling up and swimming around. The worms were about 10 mm. long and the egg sacs 2.5 mm. long. Depending on the stage of development of the embryos, the egg sacs varied from a bright tan through flesh to a deep coral. The eggs contained enough yolk for the embryos to develop into small worms while still inside the sac. An occasional worm with two egg sacs was found. The manner in which these eggs become fertilized is not known.

Two other species of *Autolytus*—*A. prismaticus* (O. Fabricius) and *A. alexandri* Malmgren—not reported previously from Arctic Alaska, were taken, the former from Eluitkak Pass and from depths of 125, 175, 184, and 420 feet; the latter from depths of 100 to 741 feet. They are often found among hydroids and bryozoans.

The unusually large numbers of the species of *Autolytus* collected provided forms and sufficient material to enable Dr. Pettibone to clear up much of the confusion connected with the taxonomy of this group. (See "Reproduction Phenomena.")

Another abundant syllid, *Eusyllis blomstrandi* Malmgren, was taken at Eluitkak Pass and at depths of 80 to 741 feet, with the larger yields at Eluitkak Pass, 125, 140, and 175 feet. This luminescent species was common on hydroids, bryozoans, and masses of barnacles. The bluish-white light that it emitted when first brought to the laboratory aided materially in finding this small syllid, from 12 to 18 mm. long, among the growth on stones. This species is flesh-colored in life, with brownish-red eyes, and in an occasional individual there was a white stripe down the middle of the back. It is new to Arctic Alaska.

Other syllids new to Arctic Alaska were collected: *Eusyllis magnifica* (Moore) at 110 feet (September 16, 1948), both atokous and epitokous forms; *Exogone dispar* (Webster), 217 and 420 feet; *E.*

naidina Oersted from hydroids and bryozoans and on rocks from 100 to 741 feet (abundant at 453 feet) ; *Pionosyllis compacta* Malmgren from 216 and 477 feet (rare) ; asexual forms of *Sphaerosyllis erinaceus* Claparède from hydroids, bryozoans, and stones from 100 to 453 feet, and through the ice on February 14 and 18, 1950, and sexual forms at the 80-foot plankton station on March 29 and April 15, 1950. *S. erinaceus,* which is somewhat colorless to dusky, bears large rose-colored eggs on its dorsal surface between setigers 8 to 24, one to four per segment (125 feet on September 9, 1948). Another female (216 feet on October 6, 1949) was carrying large developing larvae attached to its dorsal surface.

Syllis cornuta Rathke, new to the western Arctic, was common in hauls from 125 to 741 feet, being most abundant in hauls from 217, 420, and 453 feet. The epitokous form with swimming setae was taken through the ice on February 14, 1950, at 149 feet, and on February 18, 1950, at 162 feet. Others were found swimming at the 80-foot plankton station on March 29 and April 15, 1950. The eggs are rose-colored.

Over 200 specimens of *Syllis fasciata* Malmgren, new to Arctic Alaska, were dredged from 110 to 741 feet, the largest numbers coming from 453, 175, 328, 217, and 741 feet. Two male stolons with swimming setae, not reported previously but since described by Pettibone (1954), were taken on March 29, 1950, at the 80-foot plankton station.

Two nereids were collected: *Nereis pelagica* Linnaeus, uniformly purplish or reddish-brown and iridescent in life, was taken from 110 to 522 feet, and *N. zonata* Malmgren, new to Arctic Alaska, was taken at Eluitkak Pass and at depths of 80 to 477 feet. Two specimens of the latter species taken on August 21, 1948, were purplish brown anteriorly and creamy tan posteriorly, the light color undoubtedly being due to eggs or sperm.

Four nephtyids were collected: The detritus-feeding *Nephtys ciliata* (O. F. Müller), 37 specimens from 28 to 453 feet; *N. discors* Ehlers, 4 specimens from 148, 213, 217, and 741 feet; *N. longosetosa* Oersted, 16 specimens from Eluitkak Pass, 10, 60, and 150 feet, and from the beach after a storm; and *N. paradoxa* Malm, 2 specimens from 141 and 741 feet.

A single specimen of *Glycera capitata* Oersted new to Arctic Alaska was taken on September 6, 1949, at 477 feet.

One goniadid, *Glycinde wireni* Arwidsson, represented by 5 specimens from 175, 138, and 162 feet, was collected. It is new to Arctic Alaska. One lumbrinerid, *Lumbrineris fragilis* (Müller) (29 specimens—deep flesh-pink in life and sometimes banded with brown), and one orbiniid, *Scoloplos armiger* (Müller) (19 specimens), both new to Arctic Alaska, were taken.

Four species of spionids, all new to Arctic Alaska, were taken rather sparingly.

The cirratulid, *Chaetozone setosa* Malmgren, which is yellowish in life, was taken from 120 to 741 feet. It is new to Arctic Alaska. The more abundant *Cirratulus cirratus* (Müller) was dredged at Eluitkak Pass and from 80 to 453 feet. The integument of this worm varies from cream to yellowish but, with the red of the blood and the green of internal organs showing through, the general effect is a mixture of green, red, and cream; the cirri of the head are cream except where flushed with blood and the body cirri are also cream with two red lines caused by the flowing of two streams of blood. It is new to Arctic Alaska.

Nine specimens of the greenish-colored *Brada inhabilis* (Rathke) were dredged from 120 feet (September 15, 1948), 125, 453, 522, and 741 feet. Twenty-four specimens of the drab *Brada villosa* (Rathke), always somewhat covered with adhering sand, were washed ashore and two specimens were dredged from 175 and 162 feet. Nine specimens of *Flabelligera affinis* Sars were taken at depths ranging from 110 to 741 feet, and five washed ashore. In life this species is green, with a body so soft that it appears almost gelatinous. All these flabelligerids are new to Arctic Alaska.

A total of 17 specimens of the beautiful flesh-pink *Scalibregma inflatum* Rathke, new to Arctic Alaska, were collected. The largest ones, up to 100 mm. in length, were washed ashore on October 16, 1949. Four small ones were dredged during the summer of 1949, at 420, 175, and 477 feet. Fauvel (1927) states that this species is found in sand or mud at a depth of 12 to 24 inches. At this depth, only small specimens or larger specimens that were near the surface could be dredged from the sticky mud at Point Barrow. During the winter of 1950, eight specimens were dredged or taken with bottom samplers at depths of 138 to 185 feet, indicating that these worms had been washed from the muddy bottom nearer shore and then deposited with the mud at a greater distance from shore.

Two specimens of the whitish opheliid *Ammotrypane breviata* Ehlers, 6 to 7 mm. in length, were dredged, one at 217 feet, and the other at 175 feet. This worm had been taken from the South Orkney and Falkland Islands and from Kaiser-Wilhelm II Land, but there was only one other record (East Greenland) from the Northern Hemisphere. Another opheliid, *Travisia carnea* Verrill, new to Arctic

Alaska, washed ashore on October 17, 1949 (9 specimens), and August 10, 1950 (3 specimens).

Arenicola glacialis Murdoch is obviously very abundant for it washed ashore in great numbers after certain storms, especially in the open season of 1949. Two were dredged from the gravel near shore at a depth of 10 feet. This species is reddish, sometimes with a greenish prostomium and greenish caudal end. When preserved it often turns the preserving fluid a dark green and the worm itself becomes almost black.

Five species of maldanids, all new to Arctic Alaska or the western Arctic, and one new to Arctic America, were dredged. *Praxillella praetermissa* (Malmgren) was taken from seven stations in the mud-covered rubble zone in the fall and winter of 1949-50. Since it had not been taken in hauls from similar depths in 1948, it had obviously been transported to the rubble zone from the mud zone by the storms in the late open season of 1949.

Six specimens of the beautiful sabellariid *Idanthyrsus armatus* Kinberg, which is new to Arctic Alaska, were dredged from 28, 150, and 420 feet. The predominating colors are red and white, with golden setae on the head structures.

The cosmopolitan detritus-feeding *Sternaspis acutata* (Ranzani) appeared in the dredge hauls from 10, 132, and 148 feet.

Two species of pectinariids, both new to the western Arctic, were taken: *Pectinaria granulata* (Linnaeus) (53 specimens) from 22 to 741 feet; and *P. hyperborea* (Malmgren) (19 specimens) from 118 to 741 feet. Both were largely from stations characterized by mud bottoms.

Four species of ampharetids, three new to Arctic America and one new to Arctic Alaska, were dredged. The most interesting of these was *Asabellides sibirica* (Wiren) from 22 feet on July 26, 1948, (3 specimens). It lives in a mud tube with a tough lining. The tubes were from 100 to 140 mm. in length. One worm was 45 mm. long.

In number of species the terebellids equaled the syllids and polynoids, for each family was represented by 11 species. All the species of terebellids are new to Arctic Alaska and several are new to Arctic America.

A single specimen of *Amphitrite groenlandica* Malmgren was dredged from 295 feet and one specimen of *Leaena abranchiata* Malmgren was taken from 150 feet. *Amphitrite cirrata* Müller was represented by 14 specimens from 110 to 420 feet, 5 coming from 125 feet.

Lanassa venusta (Malmgren) was represented by 44 specimens from 110 to 453 feet, the 125-foot station yielding 10. This worm lives in a soft tube of mud cemented together with mucus, with a thin membranous lining, and with a small amount of sand and small pebbles adhering to the outside. The worm is pale peach below, somewhat darker above, with apricot tentacles tipped with red.

Seventy-nine specimens of *Nicolea venustula* (Montagu) were dredged from 80 to 213 feet, with 12 specimens coming from 125 feet. This worm lives in a tube of coarse sand attached to rocks. Fauvel (1927) states that it lives in a "thin tube of sand agglutinated to branches of algae or hydroids." In the absence of algae at Point Barrow, it apparently chooses the next best object for attachment.

By far the most abundant terebellid, and perhaps one of the most abundant polychaetes, was *Pista maculata* (Dalyell), which lives in long, cylindrical, membranous tubes with adherent foraminifers, small pebbles, and various kinds of debris. The bulk of the dredge haul from 477 and 741 feet was a mass of tubes of this species. The tubes were so long and so intertwined that it was difficult to disentangle them and it was still more difficult to remove a worm (up to 150 mm. when preserved) intact from its tube. Although 27 specimens of this worm were taken at 11 other stations from 125 to 522 feet (the most from any one station being 3), this species obviously prefers a soft, muddy bottom such as was encountered at 477 and 741 feet, for none was taken in the clayey mud zone.

Thirty-five specimens of *Polycirrus medusa* Grube were dredged from 80 to 477 feet. Six specimens from 125 feet were obtained by breaking apart the bryozoans *Bidenkapia spitzbergenis* and *Myriozoum subgracile.* Egg-filled females were reddish, but when the skin burst and released the eggs the worm became dark green.

Six specimens of *Proclea graffi* (Langerhans) were collected from 125, 217, and 216 feet.

Seven specimens of *Thelepus cincinnatus* (Fabricius) were dredged from 120, 125, 438, 477, 453, and 741 feet. The twisted, cylindrical tubes were associated with those of *Pista maculata* at 477 and 741 feet, and with the stems of the hydroid *Tubularia* at 120 feet. The hydroid in turn was associated with the mud-tube nests of the amphipod *Ericthonius tolli.* Sperm-filled specimens were apricot above and along the sides and white beneath, with bright-red branchiae and olive-apricot tentacles.

Eighty-seven specimens of *Terebellides stroemi* M. Sars, one of which was parasitized by the copepod *Saccopsis terebellidis,* were taken. A few were washed ashore, 1 came from Elson Lagoon (7 feet of water), 13 were taken through the ice at 162 feet, and the remainder came from hauls from 110 to 741 feet.

Fifteen specimens of *Trichobranchus glacialis* Malmgren were taken at depths of 162 to 295 feet.

Seven species of sabellids, two new to the western Arctic and the other five new to Arctic Alaska, were taken: *Chone duneri* Malmgren (21 specimens) from 80 to 295 feet; the variable-colored *C. infundibuliformis* Kröyer (32 specimens) from 118 to 295 feet; *Euchone analis* (Kröyer) (3 specimens) from 216, 217, and 741 feet; *Myxicola infundibulum* (Montagu) (2 specimens) from 151 and 213 feet; *Potamilla neglecta* (Sars) (24 specimens) from 130 to 741 feet; *P. reniformis* (Leuckart) (15 specimens) from 130 and 328 feet; *Sabella crassicornis* Sars (15 specimens) from 217 to 741 feet.

The tubes of this group are unusually variable: *Myxicola infundibulum* lives in a tube of transparent, viscous mucus, so thick that it appears more like a mass of mucus than a tube. *Potamilla reniformis* lives in a horny tube with adherent sand, and the free end curls like a scroll when the worm draws inside. The Point Barrow specimens were in holes in rocks. *P. neglecta* lives in transparent horny tubes that are somewhat sand-encrusted. *Sabella crassicornis* lives in a cylindrical tube, the free end of which is grayish and flexible, and the embedded end transparent, rigid, horny, and covered with sand grains.

Potamilla neglecta retains its eggs within the tube until the larvae hatch. They are laid in a single layer on the wall of the tube about one-third of the way down; they are held in place by a thin, transparent membrane between the eggs and the worm.

Two species of serpulids, both new to Arctic Alaska and the western Arctic, were found. The sinistrally coiled tubes of *Spirorbis granulatus* (Linnaeus) were found on bryozoans, hydroids, and stones. Eggs were being incubated in the operculums on August 17, 1949 (741 feet) and on February 18, 1950 (162 feet). The dextrally coiled tubes of *Spirorbis spirillum* (Linnaeus) were found on the bryozoans *Porella compressa* (125 feet) and *Dendrobeania murrayana* (175 feet), and *Bidenkapia spitzbergensis* and *Dendrobeania murrayana* (184 feet), on bryozoans growing on the crab *Hyas coarctatus alutaceus* (175 feet), and on the spines of the tunicate *Boltenia echinata* (217 feet). Eggs were being incubated within the tube on September 29, 1948 (125 feet) and on August 30, 1949 (184 feet).

Class HIRUDINEA

Only one species of marine leech, *Crangonobdella murmanica* Selensky, was collected. Its host was the large shrimp *Sclerocrangon boreas* (Phipps). The writer is indebted to Dr. Marvin Clinton Meyer for identifying this leech. Although several species of fish, such as the Arctic cod and sculpins, that might be expected to harbor leeches, were taken, none was found on them. It is believed that marine leeches tend to drop from their hosts when the latter are drawn out of the water, which would account for their apparent scarcity.

Only three adult specimens of this leech were found: one unattached individual in a haul from 110 to 120 feet on September 15, 1943, that included a *Sclerocrangon boreas;* one from an ovigerous *S. boreas* that washed ashore on September 30, 1949; and another from the gravel nearby. *S. boreas* had numerous empty egg capsules of the leech attached to its pleopods. Another female shrimp from 110 feet (September 8, 1948) had a few empty capsules on its pleopods, and one that washed ashore on September 12, 1949, had over 50 egg capsules attached to its exoskeleton. A few of these were empty but the majority contained developing worms (one per capsule). Two female *S. boreas* taken on October 11, 1949, had on their pleopods a few capsules containing young leeches. These brownish, circular, convex, chitinous capsules, which are 1 mm. across, are attached to the host by an adhesive rim. They are blisterlike in appearance. The type specimens of *Crangonobdella murmanica,* described by Selensky in 1923, were taken from *S. boreas* off the Murman coast of Russia, northeast of the Kola Peninsula—on the opposite side of the Pole from Point Barrow—and no further record of the species has since appeared.

Phylum ECHINODERMATA

About 20 species of echinoderms were collected at Point Barrow: 6 asteroids, 8 ophiurans, 1 echinoid, and 5 (possibly more) holothurians. No crinoids were found in the area investigated. Most of the species were abundant, some of them exceedingly so, but, as is true of many species of echinoderms, some of them are gregarious or occur in patches, so that if they are taken at all they are taken in large numbers, unless the dredge happens to pass at the edge of the group. The writer is indebted to the late Austin H. Clark for identifying the echinoderms.

Class ASTEROIDEA

Fourteen species of starfishes have been reported from the eastern Arctic (from Greenland to the New Siberian Islands). Three of these, *Crossaster papposus, Solaster endeca,* and *Henricia sanguinolenta,* were found at Point Barrow. In addition, three species, *Leptasterias polaris* forma *acervata, L. groenlandica* forma *cribraria,* and *L. arctica* forma *arctica,* that are not known from the eastern Arctic were collected. These last three species are new to Point Barrow.

Thirteen specimens of *Crossaster papposus* (Linnaeus) were collected. About half of these were washed ashore at a small bight near the Point, and the others were taken at 125 feet, 120 and 130 feet (September 15, 1948), and 152, and 741 feet.

Five specimens of *Solaster endeca* (Linnaeus) (197 to 246 mm. in diameter) were washed ashore near the Point, and a small individual (85 mm.) was dredged at 420 feet. This is the first record from the western Arctic.

Two individuals (35 mm.) of *Henricia sanguinolenta* (O. F. Müller) were dredged at 125 and 741 feet, and one (50 mm.) washed ashore near the Point.

Nine specimens of the 6-rayed *Leptasterias polaris* (Stimpson) forma *acervata* Stimpson were collected: 8 from the shore near the Point, and 1 on the shore by the base. They ranged between 107 and 223 mm. in diameter.

Five individuals (from 12 to 32 mm. in diameter) of *L. groenlandica* (Lütken) forma *cribraria* (Stimpson) were dredged at 741 feet. Three specimens of *L. arctica* (Murdoch) forma *arctica* Murdoch were collected: one at 184 feet, one at 216 feet, and one from the beach.

Class OPHIUROIDEA

Of 10 species of ophiurans known from the eastern Arctic, 6 were collected at Point Barrow, two of them new to that area. Two species not known to the eastern Arctic were also collected.

Well over a dozen specimens of the basket star *Gorgonocephalus stimpsoni* (Verrill), the largest with a disk 75 mm. in diameter, were collected at 125 feet, 130 feet (September 15, 1948, and August 9, 1949), and 522 feet. One young one in the ophiocrenoid stage, arms forking only once, with a disk only 2 mm. in diameter, was taken at 125 feet. Two collected on August 9, 1949, with disks 17 and 21 mm., respectively, spawned freely in the laboratory. Swimming larvae developed.

Three small specimens of *Ophiacantha bidentata* (Retzius) were dredged at 175, 741, and 477 feet. The one from the latter depth was filled with eggs. This species is new to the western Arctic.

Collections comprising a few to large numbers of *Ophiopholis aculeata* (Retzius) were made from 110 to 741 feet, 20 to 30 specimens being obtained from 125, 130, and 217 feet. This species begins reproducing when it is less than half grown. From the well-filled condition of the gonads throughout August and the first week of September, it would appear that either spawning occurs after the first part of September or the eggs are retained until spring.

About 20 specimens of *Amphiodia craterodmeta* H. L. Clark were taken in 12 hauls from depths of 110 to 741 feet. Only one specimen was found well filled with eggs (on October 6, 1949). This is the first record from Arctic Alaska.

Over 100 specimens of *Amphiura sundevalli* (Müller and Troschel) were dredged from depths of 110 to 741 feet. They were found in interstices among other animals, often among the branches of the bryozoan *Myriozoum subgracile*. The condition of the gonads indicates that this species spawns during the latter part of August and in September. It is new to Arctic Alaska.

Ophiura sarsi Lütken was probably the most abundant of the ophiurans, but, since its habitat is a soft substratum beyond shallow water, it was limited to 477 and 741 feet in the area investigated. Evidence indicated that this species had spawned by the middle of August.

A single specimen of the circumboreal *O. nodosa* Lütken was dredged at 152 feet.

At least 70 specimens of *O. robusta* (Ayres), with disks from 2.9 to 10.8 mm. in diameter, were dredged at 16 stations at depths of 110 to 741 feet. Individuals with disks less than 5.5 mm. in diameter were juveniles.

Class ECHINOIDEA

Only one echinoid, *Strongylocentrotus dröbachiensis* (O. F. Müller), was found at Point Barrow, where it occurred at eight stations from 125 to 522 feet, being most abundant at 125 feet (approximately 175 specimens) and at 130 feet (September 15, 1948, 73 specimens).

Class HOLOTHUROIDEA

Two species of sea cucumbers that have been identified were exceedingly abundant; the three to five unidentified forms were seldom taken.

The mud-dwelling *Myriotrochus rinki* Steenstrup was taken at depths of 20 to 70 feet, and on several occasions hundreds were washed ashore during storms. This species ingests large quantities of mud for its contained detritus. Eggs appeared mature on August 10, 1950. In Greenland this species harbors a commensal snail *Entocolax ludwigi* within its cloaca. Although many specimens were examined, no snails were found in the Point Barrow *Myriotrochus*.

Psolus fabricii (Düben and Koren) was dredged from depths of 120 to 453 feet. As with the sea urchin, either very few or else large numbers of this animal were dredged. For example, 118 were taken at 125 feet, and 86 at 130 feet, 86 at 120 feet, and 170 at 110 feet on September 15, 1948. This is a detritus feeder. Spawning was not observed, nor were the gonads examined. The measurements of juveniles collected over a period of 2.5 months suggest that the species must spawn over a considerable period of time.

Phylum ARTHROPODA

Class CRUSTACEA

The crustaceans form a very important part of the fauna at Point Barrow for they are extremely abundant both as to species and individuals. They include pelagic and bottom-dwelling forms, both of which supply food for other animals.

Order OSTRACODA

The writer is indebted to Dr. Willis L. Tressler for supplying distribution data and identifying the members of this group, which consisted of 61 individuals and 5 species, each from a different genus. With the exception of those found on an amphipod, the greatest number—21 individuals, representing four of the genera and species—came from the station at 741 feet. This suggests that still deeper dredging might yield a greater population of ostracods than were found in the present investigation. Even at shallower depths, if special methods of collecting were employed, the yield in individuals at least, and probably in species, would be greater. Only 4 species of ostracods have been taken on the east coast of Greenland, as compared with about 50 from the west coast. This discrepancy in number of species may be due largely to differences in methods and intensity of collecting and perhaps to differences in sorting methods. Such small animals are easily overlooked.

A total of 19 specimens of the commonest and largest species at

Point Barrow, *Philomedes globosus* (Lilljeborg) were taken at seven stations from 125 to 741 feet, 13 from the latter depth. It is new to the western Arctic. One female of the almost cosmopolitan species *Asterope mariae* (Baird) was taken at 741 feet. Also new to the western Arctic, *Cytheridea punctillata* Brady, which is usually taken in depths of 35 to 125 feet, was taken at Point Barrow as follows: 175 feet, 1 female; 420 feet, 1 female; 741 feet, 5 specimens. *Cyprideis sorbyana* (Jones), new to the Pacific side of the Arctic, was taken as follows: 30 feet (mud), 1; 175 feet, 1 female; 741 feet, 2 specimens. Thirty specimens of the cosmopolitan genus *Paradoxstoma,* too immature to identify as to species, were found clinging to the medial side of the bases of the thoracic appendages and the ventral side of the thorax of an amphipod, *Gammaracanthus loricatus,* that washed ashore on October 4, 1949.

Order COPEPODA

The copepods are an important group in the economy of the sea. The pelagic species sometimes exist in such enormous swarms that they form a large part of the food of certain fishes and whales. They are also eaten by ctenophores and jellyfishes, and their larvae provide food for small organisms in the plankton. Although much less numerous than the pelagic species, the bottom-dwelling forms are fed on by other animals and their larvae furnish food for certain ophiurans and other strainers. The parasitic forms also affect other animals, albeit adversely. However, the larvae of even these forms must play their role in the feeding of certain animals. Of the 12 or 13 species of parasites collected at Point Barrow 8 or 9 were copepods.

The writer is indebted to Dr. Paul Illg for identifying many of the members of this group and supplying some of the distribution data.

Certain of the following species of Calanoida usually are not taken at the surface. Some of them were collected near shore following a storm and subsequent upwelling that brought deeper-water animals to the surface. Only surface plankton tows were taken at Point Barrow; no hauls were made at night.

The cosmopolitan *Calanus finmarchicus* (Gunnerus) and the circumpolar *C. hyperboreus* Kröyer were common in the plankton at Point Barrow. Both these species occur in deeper water in warmer seas (Jespersen, 1939). *C. tonsus* Brady, originally described from the Antarctic, *C. cristatus* Kröyer, *Xanthocalanus greeni* Farran, *Scaphocalanus magnus* (Scott), *Chiridius obtusifrons* Sars, *Metridia longa* (Lubbock), and *Heterorhabdus norvegicus* (Boeck), all apparently new to Arctic Alaska, were also present. *Metridia longa* goes through a daily vertical migration, except during the season of long daylight, when it remains below the upper layers of water. In Scoresby Sund Fjord in east Greenland, *Heterorhabdus norvegicus* is believed to spawn in summer, for spermatophore-bearing females were collected in July and August (Jespersen, 1939).

Several unidentified bottom-dwelling species of copepods were so common that they deserve mention here. The one occurring in the greatest number of dredge hauls was a shield-shaped siphonostome, with spherical egg sacs containing a total of about 18 large apricot-colored eggs. Ovigerous females were found in August and October at 420 and 175 feet, respectively.

Another species, perhaps new, was common on the inner surface, especially of larger specimens, of the sponge *Echinoclathria beringensis* from Eluitkak Pass. About 50 percent of those collected on August 6, 1948, were ovigerous females. Among 35 specimens examined on August 1, 1950, there were 8 males, 14 females carrying eggs, and 3 females carrying young.

Copepoda Parasita

Herpyllobius arcticus Steenstrup and Lütken was found parasitic on four species of polynoids: 3 out of 375 specimens of *Harmothoë extenuata*, 13 out of 215 *H. imbricata*, 1 out of 63 *Antinoë sarsi*, and 3 out of 126 *Gattyana cirrosa*. *Antinoë sarsi* is a new host for this copepod and *Gattyana cirrosa* may also be a new one. This species of copepod occurs in east Greenland (Stephensen, 1912, 1943b), Iceland (Stephensen, 1940b), and west Greenland (Jespersen, 1939).

Saccopsis terebellidis Levinsen was found on 1 out of 87 specimens of the terebellid *Terebellides stroemi* Sars that were examined. It also occurs in west Greenland (Levinsen, 1878), east Greenland (Hansen, 1923; Jespersen, 1939; Stephensen, 1943b), west Iceland (Stephensen, 1940b), and in the Pacific (Wilson, 1935) with the same host but the specimen from Point Barrow forms the first record from Arctic America.

Several specimens of *Choniostoma mirabile* Hansen were found under the branchiostegites of the shrimp *Eualus gaimardi*. None of the copepods exceeded 3 mm. in length and one female was only 2.1 mm. long. They are cream-colored and bear cream-colored eggs (September 8, 1948; August 1, 1950). This copepod was described by Hansen in 1886 and reported by him from east Greenland in 1923. Stephensen lists it from the Kara Sea (1940b) and Davis Strait

(1943b) and reports it from Iceland on the shrimp *Spirontocaris lilljeborgi* and from east Greenland (1943b) on the shrimp *Eualus gaimardi.* The specimens from Point Barrow form the first record from America.

At least 10 specimens of *Schizoproctus inflatus* Aurivillius were taken from branchial baskets of the tunicate *Boltenia ovifera.* Of 90 *B. ovifera* examined from 175 feet on October 14, 1949, seven contained copepods measuring from 4.5 to 5.0 mm. in length and the bodies of the hosts (greatest dimension) were from 12 to 29 mm. Both larger and smaller tunicates were free of parasites. A 13-mm. *B. ovifera* from 341 feet contained a copepod, and two 35-mm. specimens from 453 feet each contained one. These two *B. ovifera* were from a cluster of 26 specimens in which the holdfasts and stalks were entwined. Although this copepod has been reported from Spitsbergen, northern Norway, west and east Greenland (Stephensen, 1943b) and Arctic Canada (Wilson, 1920), it is new to Arctic Alaska. In east Greenland it usually lives in a species of *Phallusia* (Stephensen, 1943b).

Specimens of a new species of *Dorypygus* were found in the branchial baskets of *Boltenia echinata:* two females (3.5 mm. long) with a large number of yellowish eggs (preserved) from 217 feet; one (4.5 mm. long) from 175 feet (October 14, 1949); and others. *B. echinata* is a new host and this genus of copepod is new to Alaska and Arctic America.

A large unidentified female copepod belonging to the family Enterocolidae was found by Dr. Donald P. Abbott among the unopened tunicates sent to him.

A single specimen of *Haemobaphes cyclopterina* (Fabricius) with a bright-red body 6.5 mm. long was taken from the gills of an Arctic cod, *Boreogadus saida,* that was brought in on June 21, 1950. The two cylindrical egg sacs, 6 mm. long, were white. Although this copepod is a well-known Arctic, subarctic, and north temperate species, it has not been reported previously from Arctic Alaska or from the Arctic cod as a host.

Order CIRRIPEDIA

Suborder Thoracica

Although only three species of this group were taken, they made up in number of individuals what they lacked in number of species. Dr. Dora Priaulx Henry identified these barnacles.

Balanus balanus (Linnaeus) was the least abundant. Specimens were taken at Eluitkak Pass and at 328 and 438 feet.

Next in abundance was *B. rostratus apertus* Pilsbry, which grows embedded in masses of sponge (see "Porifera"), with only the aperture open to the outside. A group of a dozen or more individuals growing one upon another may be surrounded by sponge. This barnacle was taken with *Topsentia disparilis* at 438 and 341 feet, and with *Myxilla incrustans* at 125, 328, and 217 feet.

Balanus crenatus Bruguière is one of the most abundant sessile animals in the waters off Point Barrow. It occurred in profusion at Eluitkak Pass and in all hauls from stony bottom from 110 to 522 feet. It was even found on mud bottom attached to snail shells and old clam shells. On August 3, 1948, a specimen attached to a snail shell had numerous tiny barnacles growing on it, and on August 30 a haul from Eluitkak Pass revealed new sets of young barnacles on everything to which they could attach—stones, shells, and even the isopods *Idotaega entomon* and *I. sabini*. Young from 1 to 1.5 mm. in diameter were abundant at 184 feet, and a young set was found attached to adult *B. crenatus* at 216 feet.

Order RHIZOCEPHALA

Two species of rhizocephalan parasites, identified by Dr. Edward G. Reinhard, were found. In both species the host is the pagurid *Pagurus trigonocheirus*.

One mature *Clistosaccus paguri* Lilljeborg was taken on a male pagurid at 438 feet; one very young specimen from a female pagurid at 217 feet, and another at 72 feet. The pagurid represents a new host and the copepods from Point Barrow extend the range northward from the 58th to the 71st parallel of latitude.

A single *Peltogaster depressus* Reinhard was taken from a male pagurid at 438 feet. Only two other specimens of this cirriped, both from *Pagurus capillatus* (Benedict), have been reported: one from off Kodiak Island, and one in the Bering Sea, taken by the *Albatross* in 1893 and 1897 (see Reinhard, 1944). *Pagurus trigonocheirus* therefore represents a new host, and the extension of range of the cirriped is the same as that of the above species.

Order MYSIDACEA

Only three species of mysids were collected. The writer is indebted to Dr. Albert H. Banner for identifying them.

Two ovigerous females of *Mysis oculata* (Fabricius) were taken in a plankton tow on October 31, 1949, together with immature males and females about 15 mm. long (Banner, 1954). The eggs were 0.6 to 0.7 mm. in diameter. Very immature stages were taken on July 23, 1948, and immature males and females on September 1, 1949. Immature specimens of the *"relicta"* or brackish-water form of this species were taken on September 13, 1949, at Elson Lagoon where they occurred in great numbers along the shore, and again on July 28, 1950, near the Point, where they had washed ashore in such numbers that they formed rows along the beach. On September 30, 1949, there were swarms of this form near shore at the base, but all the 500 specimens, about 13 mm. long, that were collected were immature.

Four specimens of the bathyarctic *Boreomysis nobilis* (Sars) were taken near shore on September 27, 1948, when upwelling water brought them from deep water (see "Cephalopoda"). These extend the range of this species into the western Arctic. This mysid has beautiful, reddish, globular, luminescent organs that emit a blue light.

A single specimen of *Neomysis rayi* (Murdoch) was taken near shore on July 13, 1950.

Order CUMACEA

The strange creatures comprising this group look like the clowns of the crustaceans, but they are very retiring by nature and, instead of forcing themselves upon one's attention, the majority of them must be searched for. Although they appear to reach their maximum development in the Arctic, the largest known species, *Diastylis goodsiri* (Bell), does not greatly exceed an inch in length. Some of the larger ones at Point Barrow were white or cream beautifully marked with red bands, but the majority of the species were small and were an inconspicuous tan. A few specimens were found on the growth on rocks, but most of them were obtained by microscopic examination of the debris that collects in the bottom of jars containing unsorted masses of materials. Cumaceans live and feed on the mud and detritus of ocean bottoms, often at great depths. The peculiar shape of the forward part of the body may well be an adaptation fitting the animal for locomotion through the mud and detritus, functioning somewhat like a plowshare.

Nine species representing four families of cumaceans were collected. They ranged in length from 3.4 to 25 mm. For the identifications thus far received, the writer is indebted to Dr. Howard M. Feder, who expects to publish on this group.

Specimens of *Diastylis dalli* Calman were collected in 1948 at 110 feet and in 1949 at 120, 175, 184, 438, and 741 feet. The range was extended northward about 2 degrees. *D. bidentata* Calman was taken in 1949 at 120, 152, 216, and 295 feet and in 1950 at 204 feet.

Two species of *Diastylis,* both apparently new, were washed ashore during high surf in 1949. The single specimen of one of them was 25 mm. long.

Several specimens of species of the genus *Brachydiastylis* were collected in 1949 at 216, 477, and 741 feet. Only two species of this genus have been described. These above species show closest affinity to *resima* (Kröyer), which has not been reported from Arctic Alaska. A single specimen, only 7 mm. long, of a species of *Leptostylis,* probably new, was taken at 741 feet.

Specimens of *Cumella,* possibly *pygmaea* Sars, were collected at 184, 216, 217, 295, 438, 453, and 741 feet.

Two very small specimens of *Leucon,* possibly *nasicoides* Lilljeborg, were taken at 216 and 162 feet.

A single specimen, only 3.4 mm. in length, of a species of *Petalosarsia* was dredged on October 14, 1949, at a depth of 175 feet.

Order TANAIDACEA

Several specimens apparently all of one species, of the family Tanaidae, were collected at 80 feet, and several were dredged through the ice at 162 feet. These measured about 3 mm. long and were a glistening milk-white. They live on mud bottom and the best way to locate them in this sticky substance at Point Barrow is to place some of it in a pan and pour sea water over it. In time the tiny animals will find their way out of the mud and come to the surface of the water.

Order ISOPODA

For the identifications thus far made on this group the writer is indebted to Dr. Robert Menzies. About 11 species, representing 8 genera, 5 families, and 3 suborders were collected. The four or five species of Munnidae taken were not among those reported by Gurjanova (1933) from the Kamchatka Peninsula. The Point Barrow specimens must, therefore, either be new or else are the same as European Arctic species not well known in this country.

By far the most abundant species was *Idotaega entomon* (Linnaeus) (=*Mesidotea entomon* of authors). Over 250 specimens were counted and many others were collected for use by physiologists. The majority were taken at Eluitkak Pass, others along the ocean shore at a depth of 10 to 15 feet. This suggests that *I. entomon* prefers shallow water and possibly water of low salinity; or it may be that it comes to water of low salinity to breed. Of those collected, the females outnumbered the males seven to one. For example, of 45 specimens collected on September 2, 1948, 14 were males and 31 females (4 ovigerous), and of 88 specimens collected on August 1, 1950, 1 was a male and the other 87 were females (4 ovigerous). The males averaged larger than the females: the largest male was 86 mm. long, the largest female 74 mm.

Ovigerous females were found as soon as the ice went out and until the water froze over in late fall. Females taken on July 13, 1950, had young isopods (from 482 to 776) in the brood pouches, and others taken on October 28, 1949, were carrying eggs only recently deposited. Eggs in the early stages are yellowish green and measure about 1.085 by 1.020 mm. The data collected suggest that in this species egg laying and development is continuous throughout the year. It may be of significance that this circumpolar species has not been taken in Greenland or Iceland. If brackish water is necessary for its existence, the proper conditions may be lacking in these two localities.

Idotaega sabini (Kröyer), less abundant than the above, also was taken only at shallow depths, largely at Eluitkak Pass and along shore. Of those collected, the males were about twice as numerous as the females. As in the above species, ovigerous females with eggs and brood were found early and late in the season. The males were larger than the females: the largest male was 85 mm., the largest female 68 mm.

Both of these species are unusually tolerant of fresh water and the former could not be killed by immersion in it. If not overcrowded, both species could be kept indefinitely in a cool place in finger bowls with only occasional changes of salt water.

One male and one ovigerous female of *Synidotea bicuspida* (Owen) were taken at 453 feet and a juvenile form at 741 feet. The female was carrying well-developed young. In life this species is tan with black eyes.

An ovigerous female of *Idarcturus* (?) *murdochi* (Benedict) ? was taken at 125 feet and a juvenile at 453 feet. This species, also, is tan with black eyes.

Thirty-eight specimens of a new species of *Janiralata,* including males, females, and juveniles, were taken from 120 feet September 15, 1948, to 741 feet. The animals are tan with a sprinkling of black pigment spots over the entire body.

At least two species of *Munna* were taken from 120 to 477 feet. One female was carrying young on August 30, 1949, and another contained eggs in early stages of development.

Two species of *Pleurogonium,* represented by a single specimen each, were taken at 120 and 216 feet.

The parasitic *Phryxus abdominalis* (Kröyer) was found on the shrimp *Eualus gaimardi* (20 females and 1 male) and on *Spirontocaris phippsi* (1 male). About 5 percent of the *Eualus* taken from 215 feet were parasitized by this isopod. Immature specimens of the isopod were taken in August, October, and February, and females with eggs (yellow to dark yellow) on October 10 and 14, 1949.

Seven species of shrimps that are common hosts of *Phryxus abdominalis* were collected at Point Barrow, but only two of these were found parasitized, perhaps in some instances because too few specimens were collected. Stephensen (1943c) reports that the commonest host in east Greenland was *Lebbius polaris* and that only a few were found on *Eualus gaimardi,* but that the latter species was the common host in Iceland (1937a). This isopod is a circumpolar species but has not been recorded previously from Point Barrow.

Order AMPHIPODA

It would be impossible to overestimate the importance of amphipods in the Point Barrow fauna. They occur everywhere—in the plankton, and in the gravel, mud, and rubble zones. They are numerous, both as to species and individuals. That veritable swarms occur in the plankton is evidenced by the great numbers that were frequently washed ashore during storms (see below under *Themisto libellula* and *Melita formosa*). They form an important source of food for various fishes, for the bearded seals, and for many of the invertebrate forms such as ctenophores, jellyfishes, chaetognaths, and even other amphipods. Great numbers of the smaller *Apherusa glacialis* occur on the undersides of ice floes and cakes, from which the bearded seal can sweep them with its whiskers. On August 29, 1948, great swarms of this amphipod would dart away from the undersides of ice cakes when the latter were kicked.

With at least three species of amphipods occurring in such vast numbers that seals can grow and thrive on them, it would seem that they should form a source of food for military personnel forced to abandon ship or make a forced landing. *Apherusa glacialis* could be gathered with nets from the swarms that dart away when an ice cake is disturbed. Further research on the natural history of this group throughout the year could undoubtedly furnish information on ways and means of obtaining amphipods in sufficient numbers to supply food for survival.

Since many of the amphipods cannot be identified in the field or even in the laboratory without painstaking dissection of minute mouth parts, it was impossible to keep as detailed collection data or natural-history notes as the writer wished. However, complete records were kept on the many species that are quite distinctive and easy to identify. As a rule taxonomists studying amphipods see only the preserved dead material, from which the color has completely faded or, at least, has changed. In working with the amphipods at Point Barrow it was noted that many of them have distinctive eye colors that fade out so completely in preservative that it is sometimes difficult to locate the eyes at all. The writer believes that by correlating adequate color notes on the living animal with subsequent determinations of other characteristics it would be possible in many instances to identify many of the amphipods by eye color without dissecting them.

The writer is indebted to Clarence R. Shoemaker of the U. S. National Museum for identifying the amphipods, which comprised about 100 species, including about 8 new ones (see Shoemaker, 1955).

The commensal phronimid *Hyperoche medusarum* (Kröyer) was not found associated with certainty with any particular species of jellyfish but was taken in plankton tows and from the beach. The closely related *Hyperia medusarum* (Müller) was much more abundant, and large numbers could be found on the beach when storms carried jellyfishes ashore. It appeared to be commensal with both *Chrysaora* and *Cyanea*. Evidence indicates that there are two or more generations of this species per year. The eggs, which are about 0.4 mm. in diameter, are white. Juveniles were taken on July 21, 1950. Dunbar (1942a) found this species, which is not often taken in the Arctic and is rarely found at the surface, less abundant in the Canadian eastern Arctic than *Hyperoche*.

The free-living, widely distributed Arctic phronimid *Themisto libellula* (Mandt) was extremely abundant, but during the summer of 1948 only a few were taken in plankton tows or picked up on the beach. By contrast, during almost the entire month of September 1949 *Themisto* was washed ashore, sometimes in such enormous numbers as to form rows along the beach for miles. On September 12, 1949, there were three rows of *Themisto* at distances of about 4, 6, and 15 feet above the waterline (see "Records of Surf Conditions and Shore Collecting"). At no time were ovigerous females found, but many newly molted specimens in which reddish-brown egg masses were visible through the integument were collected on the above date.

A female with a developing marsupium was taken on September 30, 1949.

Anonyx nugax (Phipps) was not observed at all during the summer of 1948 but was taken throughout the summer of 1949 and the winter of 1949-50. Never especially abundant except during the third week in September 1949, when thousands were thrown ashore, it was dredged from early August until October 14, 1949, at depths of 120 to 522 feet. In the winter and spring it was taken (by means of screen traps through the ice) regularly but sparingly except on February 28, 1950, when hundreds of small ones were taken, and on March 10, 1950, when both young and adults were numerous. One ovigerous female, with eggs 1.3 mm. in diameter, was taken on August 8, 1949, at 120 feet. Freshly molted females washed ashore on September 22, 1949, had well-developed ovaries that showed through as peach or orange masses, and several females between 32 and 37 mm. long had developing marsupiums. This species is new to Arctic Alaska.

An ovigerous female *Paronesimus barentsi* Stebbing washed ashore on October 5, 1949, and another taken on August 21, 1949, had, in addition to three young amphipods, a male and female copepod in its marsupium. This species has been known only from west of Nova Zemlya.

Several species of *Pseudalibrotus,* difficult to distinguish because of their similarity and small size, were taken. *P. birulai* Gurjanova, which has reddish-brown eyes, came from plankton tows and the fine gravel near shore. *P. littoralis* (Kröyer), a pale-gray species with cerise eyes and coral-colored eggs, may be found in the gravel near shore, where it goes in and out of the interstices, feeding voraciously on any disabled animals that it can find, such as arrow worms, shrimps, amphipods, and even fish. It is a hardy species that can survive low salinity and abrupt changes of temperature.

The only specimen of *Onisimus normani* Sars collected was an ovigerous female from 60 feet. This amphipod was pinkish white, and the large, oval eggs were orchid color, turning yellow in preservative.

Onisimus affinis Hansen was dredged from 120 to 438 feet, taken through the ice on March 9, 1950, at 135 feet, and in a fish trap on February 7, 1950, at 7 feet. In the latter specimen the ostegites and thoracic appendages were translucent white, the caudal appendages and the thorax and abdomen pinkish buff, and across the posterior margin of each segment was a transverse band of bright orange red. The antennules were tinged with the same color and the eyes were a shining orange red. A specimen that washed ashore on September 19, 1949, was duller in appearance and was without the transverse bands. Two females had parasitic copepods in their marsupiums.

Three species of *Orchomenella,* difficult to distinguish after preservation, could undoubtedly be identified in life by eye color. *O. groenlandica,* a small white amphipod with large, oval, black eyes, was taken sparingly. *O. pinguis* (Boeck), a small, white amphipod with red eyes, was abundant. An ovigerous female with pale orchid eggs was taken through the ice on January 27, 1950, at 37 feet. *O. minuta* (Kröyer) was taken at Eluitkak Pass and at depths of 80, 120, 135, 152, and 741 feet. All are new to the western Arctic.

Socarnes bidenticulatus (Bate) was dredged from 175 to 453 feet. A female from 453 feet was carrying eggs in a medium-early stage of development and one from 175 feet was carrying young embryos. Ovigerous females were taken in east Greenland (Stephensen, 1944) from July 30 to August 18, 1933, down to about 95 feet. In life this species is a beautiful mixture of maroon and white, with black eyes.

A single ovigerous female *Tryphosa triangula* Stephensen was taken from a fish trap at a depth of 33 feet on January 27, 1950. It was pale flesh color, with translucent white appendages. The eggs were a bright maroon.

A specimen of *Stegocephalus inflatus* Kröyer was taken at 138 feet and an ovigerous female at 130 feet (August 9, 1949). The latter was tan on a whitish background with an olive-green cast.

A female *Stegocephalopsis ampulla* (Phipps) 39 mm. long and with a marsupium was taken at 125 feet. This large amphipod is cream-colored, with a dark dot at the lower edge of each thoracic segment. Although rather widely distributed in the Arctic, apparently it is not abundant, for it was found only once at west Greenland and three times in Baffin Bay (Stephensen, 1944).

Two specimens of *Ampelisca eschrictii* Kröyer, including a female 37 mm. long with ovaries full of well-developed eggs, were found (August 21, 1948). This species is white, with orange-red and dull-orange markings, four maroon eyes, and a reddish mouth region.

Ampelisca birulai Brüggen was collected from 80 to 216 feet. A female from 216 feet was carrying 14 or 15 eggs about 0.8 mm. in diameter that were in early stages of development.

Byblis gaimardii (Kröyer), a common and conspicuous amphipod, was taken from depths of 80 to 420 feet. Pinkish or pale-salmon color, with both black and chalk-white pigment "stars" on the head region of the carapace and white pigment stars on the terminal half of the first ostegites, and with four red eye spots (that turn black in preservative), it is easily distinguished in the field. The eggs, which are about 0.8 mm. long, are bright maroon. This species builds mud tubes in colonies, the tubes of adults being about 50 mm. long and 12 mm. wide with no constriction at the opening. Any one haul may bring up both large and small individuals, from 5 to 19 mm., for example. The Point Barrow specimens form the first record from the western Arctic.

Haploops laevis Hoek was present, and occasionally abundant, in hauls from 118 to 741 feet. The body is whitish and the small eyes are a bright cerise, which fades out completely in preservative. Below each eye and slightly anterior to it is a cerise spot that at first glance resembles another eye. There are no black pigment spots around the eyes as in *Byblis gaimardii.* The eggs are clear with a small orange-red spot at the pointed end and a larger orange-red spot toward one side and the larger end. *Haploops laevis* also builds mud tubes in colonies. The tubes of adult animals are about 50 mm. long and 12 mm. in diameter and are sometimes constricted at the top. In one dredge haul made through the ice on February 18, 1950, 14 specimens from 3 to 19 mm. in length were collected. This species is new to Arctic America.

Pontoporeia femorata Kröyer was taken at 477 and 741 feet where the bottom is characterized by a mud softer than that of the mud zone. Forty-eight specimens were picked up from the beach from September 22 to 26, 1949. This species is oyster white with whitish, opaque eyes, more suggestive of tumors than eyes, that sometimes have pink spots scattered over the surface. The eggs are salmon-colored. This is abundant in Iceland (Stephensen, 1940a). It is new to Alaska and the western Arctic.

A few specimens of *Gitanopsis arctica* Sars, a small species with a creamy-white body and round brown eyes, not previously reported from Alaska and the western Arctic, were taken at 125, 175, and 216 feet.

Thirty specimens of *Acanthonotozoma inflatum* (Kröyer), a small white species with tan showing through, and with round brown eyes, were taken from 150 to 420 feet.

Eight species of *Metopa,* one of which was new and the other seven of which were new to Alaska, were collected: *M. clypeata* (Kröyer), 50 specimens from Eluitkak Pass and depths of 120 to 477 feet; *M. glacialis* (Kröyer), 4 specimens from 477 feet; *M. bruzeli* (Goës), 16 specimens from 80 to 453 feet; *M. longicornis* Boeck, 34 specimens from 60 to 295 feet; *M. spinicoxa* Shoemaker, n. sp., 52 specimens from 60 to 184 feet; *M. tenuimana* Sars, 11 specimens from 80 to

184 feet; *M. propinqua* Sars, 1 specimen from 110 to 125 feet; *M. robusta* Sars, 3 specimens from 175 to 216 feet.

Also forming first records for Alaska were *Metopella nasuta* (Boeck), with 1 specimen from 341 feet and 1 from 741 feet, and *M. longimana* (Boeck), with 1 specimen from Eluitkak Pass and 40 from depths of 100 to 341 feet.

Ten specimens of *Mesometopa neglecta* (Hansen), also new to Alaska, were collected from 80 to 216 feet, and 19 specimens of *M. gibbosa* Shoemaker, n. sp., were taken from 80 to 420 feet.

Two specimens of *Stenothoë barrowensis* Shoemaker, n. sp., were collected at 341 feet, and 19 specimens of *Stenothoides angusta* Shoemaker, n. sp., were dredged from 100 to 216 feet. *S. barrowensis* is a translucent white species with a translucent grayish-tan dorsum and almost transparent appendages and shining orange-red eyes.

Ten specimens of *Proboloides nordmanni* (Stephensen) were collected from 80 to 217 feet. This species formerly was known only from a single female taken from the southwest coast of Greenland.

Two species of *Metopelloides,* both new to Alaska and the Arctic, and each forming the second record of its occurrence, were collected: 1 specimen of *M. tattersalli* Gurjanova came from 341 feet; 5 specimens of *M. stephenseni* Gurjanova from 5 to 5.5 mm. in length came from 120 to 217 feet. Even though it is small, the latter is a beautiful and conspicuous species. The main portion of the body and the appendages are either transparent or else translucent white. Just posterior to the head there is a broad transverse band of bright reddish orange that extends to the tips of the ostegites, and another broad band of the same color extends across the posterior portion of the thorax. The small round eyes are of the same bright color, but have a more shining and metallic appearance. This species is new to America and the western Arctic.

About 25 specimens of *Acanthonotozoma serratum* (Fabricius) were dredged from 125 to 216 feet. This species is beautifully colored with almost round, white eyes. The body in some specimens is irregularly striped transversely with orange red and white or with pinkish red and white; in others it is almost a solid pink or peach color with the tail portion white. No two color patterns are exactly alike. The color fades out completely in preservative. This species is new to Alaska and the western Arctic.

A few specimens of *Acanthostepheia malmgreni* (Goës), new to Arctic Alaska, were washed ashore. *Acanthostepheia behringiensis* (Lockington) was obtained chiefly from specimens washed ashore, but it was dredged also at Eluitkak Pass and alongshore in water from

10 to 15 feet deep. This species is gray above, with sometimes a suggestion of tan, and light beneath, and the eyes are black. It is new to Alaska and Arctic America.

Seven specimens of *Monoculodes borealis* Boeck were washed ashore on September 22, 1949. This species is whitish, and the large, single, shining eye, situated toward the tip of the long rostrum, is a pale-peach color. Three specimens of *M. latimanus* (Goës) were dredged from 110, 120, and 741 feet. This species varied from cream to pinkish white. A few specimens of *M. schneideri* Sars were also found. An ovigerous female *M. packardi* taken at 80 feet on March 29, 1950, was transparent pale orchid and the eggs were a transparent greenish. The eye, similar to that of *M. borealis* but nearer the tip of the rostrum, was much larger in proportion to the size of its body than that of *M. borealis.* All four species are new to Alaska.

Two specimens of *Aceroides latipes* (Sars) were taken at 80 feet on March 29, 1950. They were translucent white except for the distal ends of the appendages, which were lavender.

Three specimens of *Syrrhoë crenulata* (Goës) were taken at 216 feet. The body was transparent with a few splotches of orange red and with large reddish-peach eyes shining like a headlight at the very top of the head. This species is new to the western Arctic.

Apherusa glacialis (Hansen) was one of the abundant species at Point Barrow, where it was found chiefly under ice cakes (see introductory remarks on the "Amphipoda"). This pelagic arctic species is circumpolar in distribution. Stephensen (1944) reports it from east Greenland from the stomach of a seal, a young *Phoca foetida,* and Dunbar (1942a) has reported it in plankton from east and southeast Baffin Island, and from the stomach of *Phoca hispida.* The amphipod is grayish white and the round, rather large eyes are dark.

A female *Pleustes panoplus* (Kröyer) was dredged at 80 feet and an ovigerous female was taken in a screen trap on March 10, 1950, at 37 feet. The eggs, which were in the two-celled stage, were a translucent yellow orange averaging 788 microns in diameter, including the membrane. The dorsal portion of the body of the amphipod is a splotched, mottled, and speckled effect of pale brown, reddish brown, brown, red, and chalk white. The ostegites and rostrum are mainly olive and gray with chalk-white spots and a little red. This is the first record from Alaska. A few specimens of *Pleustes medius* (Goës), also new to Alaska and the western Arctic, were taken at 217 to 420 feet.

Sympleustes pulchellus (Sars), new to the western Arctic, was taken sparingly at 125, 438, and 453 feet, and *S. kariana* Stappers, known only from the Kara Sea, was dredged at 110 and 175 feet. The more abundant *S. uncigerus* Gurjanova was taken from 60 to 477 feet. The highest yields (a total of 107 specimens) came from 125, 175, 184, and 216 feet (September 15, 1948) by breaking apart such bryozoans as *Bidenkapia spitzbergensis* and *Myriozoum subgracile.* The body of this amphipod is white and the large oval eyes are dusty rose. The eye color is retained in preservative for a few months but it may change to reddish brown or pink. This species has been reported previously only from the tidal zone in the Sea of Japan.

About 12 specimens of *Paramphithoë polyacantha* (Murdoch) were taken from Eluitkak Pass, from the beach, and from depths of 130 to 420 feet. This is a large, bright red-and-white species, with dorsal and lateral spines. The males averaged smaller than the females: the largest male was 22 mm. long, the largest female, 35 mm.

Atylus carinatus (Fabricius) was collected sparingly at Eluitkak Pass and at about 10 feet along shore. This species, new to Alaska and the western Arctic, occurs in Greenland mainly with *Laminaria* and other algae (Stephensen, 1944). Except at certain areas of Elson Lagoon, such algal growths are lacking at Point Barrow. Careful collecting at Elson Lagoon might yield more of this species.

Eusirus cuspidatus Kröyer, new to Alaska, was a colorful and common species in all hauls from 125 to 741 feet. It is reddish brown to dull orange on a cream background, with dull orange-brown bands on the antennae, and with crimson, bean-shaped eyes. Males from 25 to 38 mm. and females from 23.5 to 47 mm. were collected. Juveniles from 2 to 8 mm. were taken at 125, 246, and 175 feet.

Rhachotropis aculeata (Lepechin), new to Alaska and the western Arctic, was taken at 80 to 328 feet. It is a colorful red-and-white species with no two color patterns alike. Males were from 22 to 24 mm. and females from 23 to 39 mm. in length.

Four specimens of *Rozinante fragilis* (Goës), new to Alaska and the western Arctic, were taken from the stomach of an Arctic cod (*Boreogadus saida*) that was caught in a fish trap on February 3, 1950, at 21 feet.

A few *Weyprechtia pinguis* (Kröyer) were dredged at Eluitkak Pass and at 80 feet. Several *W. heuglini* (Buchholz) were dredged from the mud zone at 80 feet on July 21 and September 9, 1948. Several were washed ashore, and 3 females were taken through the ice on June 23, 1950, at 37 feet. Two of these females, measuring 43 mm. in length, were developing marsupiums and were filled with oil. Both these species are new to Alaska and the western Arctic, and the latter to Arctic America.

Although only two specimens of *Melita formosa* Murdoch came in with dredge hauls, countless numbers washed ashore (see "Records of Surf Conditions and Shore Collecting"). This species is dull orchid in color. In seven ovigerous females the number of eggs ranged between 44 and 81, but the majority were carrying 54, averaging 0.7 mm. in diameter.

In contrast to the above species, only one specimen of *Melita dentata* (Kröyer) was picked up on shore, but from 1 to 16 or more individuals appeared in all dredge hauls from 80 to 453 feet. This species, which is new to Alaska and the western Arctic, is also dull orchid, with blackish-brown eyes. No ovigerous females were found.

Never especially abundant, *Maera danae* (Stimpson) was present in dredge hauls from 80 to 477 feet. It has dark eyes and a pale yellowish-red or pale-orchid body and appendages. The eggs, which measure about 0.8 mm. in diameter, are clear with yellow spots. The entire egg turns yellow in preservative.

Two specimens, a male 33 mm. long and a female 32 mm. long, of *Gammarus locustus* (Linnaeus) var. *setosus* Dementieva appeared in a dredge haul from 120 feet (September 15, 1948), but all the other specimens came from Eluitkak Pass or from shallow water along shore. It is no doubt abundant in favorable localities in Elson Lagoon. Males up to 51 mm. and females up to 32 mm. were taken. This species is somewhat variable in color but is predominantly grayish. Young or freshly molted specimens may be almost translucent white. The tips of the thoracic appendages, the antennular flagellae, and the third joint of the antennal peduncle are reddish brown. The small, bean-shaped eyes are black. This species, which is new to the western Arctic, is a hardy form that can tolerate adverse conditions and considerable dilution with fresh water.

Gammaracanthus loricatus (Sabine) was taken at Eluitkak Pass, in 5 feet of water at Elson Lagoon, and alongshore in from 10 to 20 feet of water. The largest male measured 45 mm. in length, the largest female 53 mm. Two small bivalves and an ostracod were attached to one 40-mm. female from Eluitkak Pass (August 1, 1950). This amphipod is gray and white or tan and white above, with the color so arranged that it forms longitudinal lines down the back. The appendages are white with tinges of gray or tan, and the basal half of the distal segment of the three long legs is a deep maroon. The antennules are banded with tan or maroon. The eyes are a shining, pinkish salmon. This is also a hardy species that is tolerant of adverse conditions and great changes in salinity.

About 40 specimens of *Photis reinhardi* Kröyer were taken at depths of 110 to 741 feet, with the highest yield (25) from 453 feet. Males up to 5.2 mm. long and females up to 5.5 mm. were taken. Juveniles from 1.5 to 2.0 mm. long were taken at 453 and at 162 feet. This species has a shiny, brownish-gray body, with small, oval, dark eyes. From 5 to 14 white eggs, measuring 0.5 mm. in diameter, were counted from ovigerous females from 4.5 to 5 mm. long. This species is new to the western Arctic.

Eurystheus melanops Sars, also new to the western Arctic, was taken in most hauls from 110 to 741 feet. Males up to 9 mm. were taken, and juveniles were collected on August 30 and October 11, 1949. The upper portion of the body is pale gray, the remainder transparent, and the large, round eyes are black. From 3 to 18 eggs, 0.4 to 0.5 mm. in diameter, were taken from females from 3.5 to 14 mm. in length. The eggs were white or cream or yellow. This variation in the color may be due to the stage of development, but the variation in length of the females suggests either that they begin reproducing at an early age or that two species are represented.

One male and two ovigerous females of *Protomedeia fasciata* Kröyer were dredged at 80 feet and numerous specimens from 7 to 8 mm. in length were taken at 110 feet (September 8, 1948). The body of this species is marked with grayish brown or gray on a whitish background, and the eyes are black, with the facets outlined in white. The eggs are purplish blue. A few specimens of *Protomedeia grandimana* Brüggen were also collected. Both species are new to Alaska and the western Arctic. Eleven specimens of a new species, *Protomedeia stephenseni* Shoemaker (1955), washed ashore in August and September 1950.

No haul from 80 to 741 feet was without *Ischyrocerus latipes* Kröyer, sometimes so numerous that only a few representative specimens could be picked out and preserved. The largest were about 17 mm. long. Juveniles were taken throughout the open season. This species is usually marked with silvery gray on a lighter background, but some individuals have purplish-brown markings and others are tinged all over with dull rose orchid. The small, nearly round eyes are black in the center with reddish brown around the periphery. Juveniles are grayish white. Embryos are white, with a speck or two of red. A female 12 mm. long from 453 feet had parasitic copepods and their egg sacs in the posterior half of her marsupium, and another female had parasitic copepods and egg sacs filling the entire marsupium. This amphipod is apparently new to Arctic America.

The less conspicuous *Ischyrocerus commensalis* Chevreux (up to 5 mm. in length) was in hauls from 110 to 453 feet. This amphipod is whitish with gray-brown markings that turn reddish brown in preservative. The large round eyes are reddish brown. One female from 184 feet was carrying 15 eggs about 0.5 mm. in diameter. This species is new to the western Arctic.

Ericthonius hunteri (Bate) was one of the very abundant species in hauls from 125 to 216 feet. It builds masses of mud-tube nests several inches in height. The animals are gray with two bands of color around the antennae and antennules: in the young these bands are red and in larger specimens they are purplish brown. This is the first record from Arctic America.

Ericthonius tolli Brüggen, a colorful species that came from 125 to 477 feet, also lives in colonies of mud tubes. The body is dull orange red and white and the flagellae of the antennae and antennules are golden tan. Freshly deposited eggs are purplish pink.

About seven specimens of the bizarre *Dulichia spinosissima* Kröyer were taken from the beach or through the ice by means of screen traps or dredging. One ovigerous female (March 10, 1950) was carrying 227 white eggs in about the morula stage. Five eggs that were measured averaged 522 microns in diameter. This species varies from almost translucent white to pale tan. There is a band of reddish tan at the distal end of the second and the basal end of the third joint of the antennal and antennular peduncles. The whitish specimens have a few minute chalk-white and reddish-tan specks scattered over the body. The eyes are whitish with a little color toward the center. This species is also new to the western Arctic.

Dulichia arctica Murdoch and *Dulichia porrecta* (Bate) were also collected sparingly up to depths of 184 and 213 feet, respectively. The latter species has gray-brown markings on the body. The eggs are white.

Order EUPHAUSIACEA

In view of the fact that the collection of planktonic organisms was only incidental, it is not surprising that only three species of euphausiids were found. The writer is indebted to Dr. Albert H. Banner for identifying these (Banner, 1954).

Eight specimens of *Thysanoëssa raschi* (M. Sars) were taken in plankton tows near shore, one washed ashore, and one was taken from the stomach of a Sabine's gull. This is an Atlantic-Arctic-Pacific species. At Bernard Harbor it was found in the stomachs of the seal *Phoca hispida* and the fish *Salvelinus malma* (Schmitt, 1919). Dunbar (1942a) reported it from seal stomachs at Lake Harbor, eastern Canada.

About 25 specimens, mostly immature, of *Thysanoëssa longipes* Brandt were washed ashore and 2 specimens were taken in a plankton tow near shore on July 20, 1950.

Four specimens of *Thysanoëssa inermis* (Kröyer) were taken from the gullet of a Sabine's gull at Elson Lagoon on August 26, 1950, and one was taken in a plankton tow on July 20, 1950. This is the first record from the western Arctic.

Order DECAPODA

A total of 21 species of decapods—2 hermit crabs, 3 true crabs, and 16 shrimps (9 genera)—were collected. These were obtained by dredging only, for no special techniques or nets adapted to the taking of shrimps were used. I am indebted to Dr. Fenner A. Chace, Jr., for identifying a representative lot of decapods, and to my wife, Nettie MacGinitie, for identifying subsequent collections.

It is worthy of mention that all but four species of the decapods were a combination of red and white. One of the four species was chiefly an olive tan, one was a black-and-white mixture, and two were predominantly translucent green. At least at certain seasons of the year, even these two latter species had red markings. At the depth at which these decapods occur, the red color would be screened out and these red-and-white decapods would appear as black and white.

A single male specimen of *Pandalus borealis* Kröyer was collected on September 9, 1948, at 110 feet. This species is very common in Iceland, where it forms an important part of the food of the cod. Its wide distribution in cold north Atlantic waters, Spitsbergen, the Barents and Kara Seas, and the east coast of North America, together with the fact that the shrimp is not a littoral species, suggests strongly that collecting methods adapted to the taking of shrimps would show this species to be common at Point Barrow.

Eight specimens of *Spirontocaris arcuata* Rathbun, ranging in length from 38 to 54 mm., were dredged from six stations from 110 to 453 feet. The usual color of this animal is a mixture of red with chalk white and translucent white, but specimens in which the entire carapace is chalk white and the abdomen and appendages are entirely red are also found.

Ten specimens of *Spirontocaris phippsi* (Kröyer) were taken from five stations from 125 to 217 feet. They ranged in length from 19 to 35.5 mm., exclusive of the rostrum. One of the males was parasitized by *Phryxus abdominalis*. This species is a mixture of red and chalk white. The eggs are green.

Thirteen specimens of *Spirontocaris spina* (Sowerby), ranging from 25 to 57 mm. in length, were taken at 10 stations from 110 to 453 feet. This species is red and white with a few olive-tan spots and a few chalky-white streaks. The eyes are black. Heegaard (1941) found no more than two or three specimens per haul of this species around Greenland. It was always taken where *Balanus porcatus* occurs, for the shrimp hides among the barnacles. *Balanus crenatus* may form the refuge of this shrimp at Point Barrow. *S. spina* is new to Point Barrow.

The shrimp that was taken in the greatest numbers at Point Barrow was *Eualus gaimardi* (H. Milne-Edwards). The majority of the specimens were undoubtedly of the forma *belcheri*. There was considerable variation: several females were found in which the third abdominal segment terminated in a spine like that of the male, and several males were found in which the spine on the third abdominal segment was lacking; and there was variation in the relative proportions of the antennular palp and the antennal scale. This animal was parasitized by the isopod *Phryxus abdominalis* and the copepod *Choniostoma mirabile*. It is chiefly transparent pale green with markings of red. The eggs are green. Although this is an Atlantic-Arctic-Pacific species, it has not been reported previously from Arctic Alaska.

A few specimens of *Eualus fabricii* (Kröyer) were taken at 110 and 175 feet and one male of *Eualus macilentus* ? (Kröyer) at 175 feet. Five specimens of *Eualus suckleyi* (Stimpson) were taken from 125 to 741 feet. One female was fairly transparent, with reddish orange in the hepatic region, and an ovigerous female was translucent white with red markings.

Three specimens of *Lebbius polaris* (Sabine) were taken at 110 and 125 feet. Hofsten (1916) found that at Spitsbergen the size of this species increases with the increasing depth of its habitat, but Heegaard (1941) did not find this to be the case with the specimens from east Greenland. In Greenland egg-bearing females of this species were found in December, January, February, April, June, July, and August.

Two specimens of *Heptacarpus flexus* (Rathbun) were taken at 110 and 215 feet. This shrimp has a white body with red markings. In early stages of development the eggs are yellowish cream.

One male *Crago communis* (Rathbun) measuring 60 mm. in length was washed ashore on September 12, 1949. It has not been known north of Bering Strait previously.

Seven specimens of *Sabinea septemcarinata* (Sabine) were taken at four stations from 110 to 420 feet. The dorsal surface of this species has fuzzy-edged brown pigment spots resembling tufts of moss, and a few yellowish-green pigment spots. The under surface is light with a few red and reddish-orange spots, especially on the legs. The eyes are green.

The fairly large shrimp *Argis lar* (Owen) was taken at four stations: Elson Lagoon and at depths of 60 to 110 feet. One ovigerous female was taken on September 8, 1948. The eggs of this species are large (1.5 to 2 mm. in diameter) and Stephensen (1916) believes that the larvae leave the egg at a very late stage of development. Free-swimming larvae have been found only in stages that are almost postlarval.

Although no one haul brought up more than four specimens, *Sclerocrangon boreas* (Phipps) was the largest and most abundant of the larger shrimps taken at Point Barrow. Its slowness of movement probably accounts for the frequency with which it was taken. A total of 16 males, 7 nonovigerous females, and 2 ovigerous females was taken. A few washed ashore, 4 males were taken at 453 feet, 1 male at 420 feet, and the remainder from depths of 110 to 213 feet. This shrimp is brown and tan, with a few flecks of chalky white, green, and dull yellow. The orange eggs are about 3.5 mm. in diameter. This shrimp serves as host for a small leech (see "Hirudinea"), and other animals, such as encrusting bryozoans and barnacles, grow on its exoskeleton. Even a small specimen of the clam *Hiatella arctica* was found under one of the dorsal spines. The very large size of the egg of *S. boreas* suggests that in this shrimp metamorphosis takes place inside the egg. In *S. ferox* (Sars), which has an egg 3.5 mm. in diameter, development is direct and the young have the adult form when they hatch (Koelbel, 1881; Wollebaek, 1906). The unusually strong fourth and fifth pairs of pereiopods terminate in a sickle-like claw and for a while these young cling to the abdominal appendages of the mother. If, as seems probable, a similar phenomenon occurs in *S. boreas,* it would account for the transfer of the leech *Crangonobdella murmanica* from the adult to the young shrimps, for the leech hatches from its egg capsule as a young worm. The discovery of this shrimp at Point Barrow extends its range a few degrees both northward and eastward. The Point Barrow specimens (up to 124 mm.) exceeded the Icelandic specimens (up to 100 mm.) in length (Stephensen, 1939).

In view of the number of species in most groups, the small number of species of crabs and hermit crabs was somewhat surprising. Only two hermit crabs and three true crabs were taken—and one of the true crabs was only a sporadic visitor.

Apparently preferring a muddy bottom, *Pargurus splendescens*

(Owens) occurred at Eluitkak Pass and at depths of from 10 to 150 feet. The legs and thorax of this species are large in comparison with the abdomen. This hermit apparently prefers shells of *Natica* and *Polinices* for its short abdomen, or perhaps these shells were the most abundant form in the size appropriate for the small abdomen. The hermit never "wore" a shell large enough to withdraw into, and the large thorax and legs were always exposed. Unlike most of its relatives, it was usually not difficult to remove it from its shell, and it did not evidence the usual distress shown by hermit crabs without a shell. Specimens of this hermit were frequently brought up without any shells at all, but the shells were no doubt lost during dredging. Since plenty of empty shells of *Natica* and *Polinices* were available, the fact that large hermits of this species often wore shells so tiny that only the very tips of their abdomens were inserted in the shells is sufficient evidence of their lack of concern about having their abdomens housed. The carapace and legs of this species were a reddish, iridescent blue. The eggs were dark blue, but they turned to orange in preservative.

Pagurus trigonocheirus (Stimpson) was much more abundant in hauls than *splendescens*. It occurred at Eluitkak Pass and from 110 to 522 feet. Although a few were taken on muddy bottom at 80 feet, this hermit appears to prefer stony substrate or transitional areas between the muddy and stony bottom. Again, this may be more a matter of living where suitable housing is available rather than a preference as to bottom, for the shells of *Neptunea* and *Buccinum*, which this hermit inhabited, were found largely on stony bottom. In contrast with *splendescens, trigonocheirus* often uses shells that are much larger than necessary. Time and materials did not permit the preservation of more than a few of the specimens brought up in hauls. *P. trigonocheirus* is host to two parasitic cirripeds at Point Barrow: *Clistosaccus paguri* and *Peltogaster depressus* (see "Cirripedia"). Two large males had specimens of *Spirorbis* on their telsons and uropods, and a large female had a small colony of the octocoral *Eunephthya rubiformis* growing on its carapace.

The most abundant of the true crabs was *Hyas coarctatus alutaceus* Brandt, which was present in nearly every haul from 80 to 477 feet. Males (carapaces up to 75 mm. long) were larger than the females (carapaces up to 49 mm.). Ovigerous females with freshly deposited eggs were taken from the first of August to the middle of October. This species has a purplish-red carapace, and the legs are reddish brown above and light beneath. The lower two-thirds of the outer face of the hand is white and the lower half of the inner face is white with reddish-brown specks.

On August 12, 1948, a female king crab *Paralithodes camtschatica* (Tilesius), with a carapace 100 mm. long and the longest leg 185 mm. in length, was picked up near shore at Point Barrow base. Men working along the shore about half a mile from the base reported seeing a few others during the morning but an immediate search as soon as the information reached the laboratory failed to yield any other specimens. The crabs apparently had moved on. This female, which still had empty egg cases clinging to her pleopods, was cream with markings of brownish red. On September 4, 1948, an ovigerous female of this species was picked up near shore at the native village—and, needless to say, was summarily eaten. Although the beach at the base was patrolled more frequently in the summer of 1949 than in 1948, no more specimens were seen.

Chionocetes opilio (O. Fabricius) was taken at five stations from 30 to 110 feet and one male was taken at 438 feet. Those from the 30-foot depth were a muddy brown but those from deeper water were a reddish brown, the pigment extending onto the upper surface of the legs. The dactyls and the entire lower surface were white. No ovigerous females were found. With the exception of the one from 438 feet, all the specimens were taken in 1948, suggesting that they stay closer to the shore when ice floes are present than when the ice is completely absent.

Class ARACHNOIDEA

Order PYCNOGONIDA

About 10 species of pycnogonids, 6 of which have been identified, were collected. For these names the writer is indebted to Dr. Joel Hedgpeth, who is still working on about 30 lots belonging mostly to the genus *Achelia*, a difficult genus with more than its quota of taxonomic problems.

Nymphon brevirostre Hodge was taken at 150, 80, 125, and 110 feet (September 16, 1948). One of the specimens from 125 feet was a male bearing eggs. Known largely from the Arctic north of Norway and Russia and with a record from Kamchatka, this species is new to the western Arctic.

Nymphon grossipes (Fabricius) was the most abundant of the three species of *Nymphon*. An ovigerous male was taken at 125 feet and one at 120 feet (August 8, 1949), one specimen at 420 feet and one at 217 feet, and an adult and two immature specimens at 175 feet. The following were found on the beach in 1949: 2 on July 23; 28 (1 immature) between September 9 and 12; 9 (including 2 ovigerous males on September 26); and 2 (1 ovigerous male) on October 2. It is a circumpolar species, and this is the second record from Point Barrow and the western Arctic, Cole having reported it in 1921.

Fourteen specimens of *Nymphon longitarse* Kröyer were picked up on the beach between July 23 and October 2, 1949. One ovigerous male with four bright tan egg sacs 2 mm. in diameter was taken on September 12, 1949, and another on September 26. This is the second record from Point Barrow and the western Arctic, Cole having reported this species in 1921.

One specimen of *Phoxichilidium quadridentatum* Hilton was found among a mass of hydroids and bryozoans at Eluitkak Pass on August 10, 1948. The only other records of this pycnogonid are from San Francisco, Stewart Island, and one from Point Barrow.

Nineteen specimens of *Pseudopallene circularis* (Goodsir), 12 of which were juveniles, were dredged as follows: 1 male at 80 feet, 2 at 125 feet, and 2 at 110 feet (September 15, 1948); 1 juvenile at 110 feet (September 16, 1948), 3 at 420 feet, 1 at 184 feet, and 2 at 217 feet; 1 male at 341 feet, 1 male and 4 juveniles at 453 feet, and 1 juvenile at 175 feet. The male taken on September 9, 1948, was carrying young just ready to escape. (Stephensen, 1943a, reports an ovigerous male from east Greenland on August 11, 1932.) This is an Atlantic-Arctic-Pacific species.

Tanystylum anthomasthi Hedgpeth was dredged as follows: 1 female at 150 feet and 1 at 125 feet, and 1 male at 217 feet. This species has been reported previously from Hokkaido, Japan, and from Point Barrow.

Phylum MOLLUSCA

At least 128 species of mollusks, plus about 8 varieties, were collected. The approximate number in each group is as follows:

Pelecypods	30 plus 4 varieties
Gastropods	89
Pteropods	2
Opisthobranchs	12
Prosobranchs	70 plus several varieties
Amphineurans	2
Cephalopods	3

There is so much variation in the Arctic mollusks that identifica tion is often rendered extremely difficult. The complete synonymy for some species would cover several pages. An example of the difficulties encountered because of such great variation is given by Thorson (1944). He lists four varieties of one species, in addition to the typical form, and refers to intergradations between two of the varieties.

The bivalves include one new genus and species and several species that have as yet eluded identification. The prosobranchs include about 15 species that are either new or of questionable identity. I am indebted to my wife, Nettie MacGinitie, for identifying these groups and also the amphineurans. The results of her study will be published shortly. The opisthobranchs were sent to Dr. F. M. MacFarland, who died before the identifications could be made. They are now going to Dr. H. Lemche of Copenhagen. Dr. Grace E. Pickford identified the octopuses, and Gilbert L. Voss the single species of squid. Dr. Gunnar Thorson of Copenhagen is working on the egg capsules and larvae.

Class PELECYPODA

None of the bivalves was taken in sufficient numbers to be of economic importance, but bivalves do serve as food for other animals. *Serripes groenlandicus* and *Pecten islandicus* are large enough for food but they never appeared in sufficient quantity to make their collection feasible. *Macoma calcarea* is abundant, but it lives in such tenaciously sticky mud that dredging it is not practicable.

Nucula tenuis Montagu lives in muddy bottom and was common at depths of 72 to 122 feet, occurring occasionally in hauls down to 741 feet. A single specimen of *Nuculana arctica* (Gray) was taken at 28 feet, and one or two *Nuculana minuta* occurred in practically every haul from 70 to 741 feet.

Of the three species of *Yoldia* found at Point Barrow, *Yoldia myalis* Couthouy was the most abundant, occurring especially in hauls from 70 to 213 feet, but one specimen was taken at 246 feet, one at 295 feet, and one at 453 feet. About 18 specimens of *Yoldia hyperborea* Lovén were dredged from 72 to 477 feet. Shells of this species from 28 to 32 mm. long are from 2.5 to 3 years old. One shell of *Yoldia scissurata* Dall was dredged at 141 feet.

Pecten islandicus Müller usually came up singly in dredge hauls. Six adult specimens were taken from 175, 341, 420, 438, and 522 feet. Juveniles were also rare. The smallest living specimen, which was 13 mm. high, was found among foliaceous bryozoans.

Although *Mytilis edulis* Linnaeus is the commonest Icelandic bivalve (Madsen, 1949), only a single valve of this species was dredged at Point Barrow(Eluitkak Pass), undoubtedly because there is no place in the immediate vicinity where conditions are suitable for such tidal-zone animals as *Mytilus*.

Musculus discors var. *laevigatus* Gray and *M. corrugatus* (Gray) were common in hauls from 130 to 741 feet. Specimens of *laevigatus* under 20 mm. in length were found nestled in the interstices between barnacles and in old holdfasts of tunicates. Specimens exceeding 20 mm. in length were nearly always covered with a byssal net, although no eggs were found within the net. On the other hand, a specimen of *corrugatus* 12.7 mm. in length that was taken from 184 feet was surrounded by a byssal net that enclosed a large number of embryonic clams still within the egg membrane but with definite valves developed. Eight of the embryonic clams averaged 428.5 microns in length. *Musculus niger* (Gray) was less abundant than the above species. Only two specimens over 30 mm. in length were taken (one of these at 741 feet, the other washed ashore). The other specimens did not exceed 15 mm. in length.

About 16 specimens of *Astarte borealis* Schumann were dredged at depths of 80 to 438 feet, and others were taken from Eluitkak Pass. Old shells from Eluitkak Pass were filled with silt and so tightly closed that they were difficult to open. Since living shells as well as old ones are often badly eroded at the umbos, it was often impossible to distinguish between live and dead specimens without opening the shells. *A. montagui* Dillwyn compares favorably in abundance with *Hiatella arctica* and *Macoma calcarea*. It was dredged from 80 to 453 feet, being especially abundant at 216 and 453 feet. There is great variation in proportions and color in this species, with the result that it has been described many times. Even living shells are often encrusted with colonies of bryozoans or with small barnacles. A specimen 18 mm. long appears to be between 2 and 3 years old, and a specimen 25 mm. long is about 5 years old. This species, probably because of its accessibility, forms a favorite food of *Natica* and *Polinices*.

One to three specimens of *Cardita crassidens* (Broderip) were taken in nearly every haul from 80 to 453 feet. A *Cardita* 24 mm. long and 22 mm. high was 4 years old, and another 24 mm. long and 20 mm. high was 5 years old.

Four specimens of *Clinocardium ciliatum* (Fabricius), from 45 to 62 mm. in length were taken from 110, 152, 453, and 522 feet.

About 30 living *Serripes groenlandicus* (Bruguière) were dredged from depths of 80 to 420 feet, with no more than three in any one haul. The shell of this species is very brittle and often cracks when it becomes dry. In *Serripes* from Point Barrow the lines indicating a cessation of growth while the animal is producing eggs or sperm are about as marked as the annual lines of growth, making the determination of age difficult. A shell 36 mm. long shows an age of 2 or 3 years and three shells 47, 53, and 54 mm. each show an age of 6 years.

About 16 living *Liocyma fluctuosa* (Dall) were taken at depths of 152 to 741 feet. This clam forms part of the food of *Natica* and *Polinices* and drilled shells are not uncommon.

With the exception of *Hiatella,* probably the most abundant species of bivalve at Point Barrow is *Macoma calcarea* (Gmelin), which was taken from depths of 60 to 741 feet. The greatest number came from 72 feet, where the bottom is a stiff mud of great tenacity. The shells of this species exhibit great variation in the proportion of length to height, degree of inflation, and degree of roundness of the posterior end. Small specimens are higher in proportion to the length than older shells, and it is probable that young *calcarea* have been confused with adult *balthica.* Lines of growth are less distinct than in some species, but a shell 18 mm. long was obviously about 2.5 years old and one 39 mm. long was 5 years old.

A few specimens of *Macoma oneilli* Dall and *M. moesta* Deshayes were taken, the former from 80 to 148 feet, the latter from 50 and 80 feet.

A few living specimens of *Mya japonica* Jay and *M. truncata* Linnaeus were taken, the former mainly at Eluitkak Pass and at 10 feet along the shore, the latter from Eluitkak Pass and from depths of 122 to 477 feet. None of these specimens was large. The largest collected were those that washed ashore. Individuals of *truncata* with shells from 37.5 to 41 mm. long appear to be between 4 and 5 years old.

Three left valves of *Panomya arctica* Lamarck were dredged on August 17, 1949, at 522 feet and one shell of *Panomya ampla* Dall was taken at Eluitkak Pass.

The most abundant bivalve at Point Barrow is *Hiatella arctica* (Linnaeus) (=*Saxicava arctica*). It appeared in hauls from any bottom on which there was some object to which it could attach or some place in which it could nestle, therefore from 110 to 741 feet, and it was especially abundant at Eluitkak Pass. Even hauls along shore in the gravel zone yielded their quota, for in this region *Hiatella* attached to several pieces of gravel by means of byssus threads. This bivalve was found between barnacles, clinging to bryozoans, and among old holdfasts. An old shell of *Astarte borealis* contained 21 living *Hiatella* from 7 to 13.5 mm. in length. A haul from Eluitkak Pass on August 6, 1948, and one from 120 feet on September 15, 1948, contained many hiatellas 2.5 mm. and more long. About half of the mass brought up on August 23, 1948, from 150 feet consisted of old dead shells of *Hiatella*.

Class GASTROPODA

The Point Barrow gastropods present a great deal of data on problems of Arctic distribution, reproduction, and feeding. Variation within a species is often great. The majority of the species lay egg capsules containing large-yolked eggs or nurse eggs or some form of nutriment that permits the development of large nonpelagic larvae or larvae with a short pelagic life; a few retain their eggs until the larvae are in the crawling stage. Because of the rapid filling of the ocean bottom by erosion from shore, empty shells dredged at Point Barrow are never very old.

Order PTEROPODA

Although *Spiratella helicina* (Phipps) was reported to be abundant during the summer of 1947, only two specimens were collected during August 1948, and none was seen in 1949 and 1950.

Clione limacina Phipps was exceedingly abundant at times during the summer of 1948—on August 12, for example—and was common in 1949 and 1950. Larval forms were present in the plankton throughout the winter of 1949. Both larval and adult forms were plentiful alongshore on July 20, 1950. This species forms an important food for whales.

Order OPISTHOBRANCHIATA

A single specimen of *Retusa nitidula* (Lovén) was taken at 477 feet. One *Cylichna occulta* Mighels was taken through the ice on January 25, 1950, and another near shore on July 13 of that year. Two specimens of *Diaphana minuta* Brown were collected, one at 741 feet, the other at 295 feet.

What is believed to be *Aldisa zetlandica* (Alder and Hancock) was taken in the gravel zone in from 10 to 15 feet of water, one on July 20 and two on September 8, 1948. Three others washed ashore on October 16, 1949. This species seems to prefer the occasional patches of sand that have been segregated from the gravel. It ingests detritus containing considerable sand.

Eighteen specimens of what is believed to be *Dendronotus frondosus* (Ascanius) were washed ashore and three were dredged (140 and 150 feet). A translucent white species of *Dendronotus,* with the tips of the cerata chalk white, was infrequently washed ashore and two were dredged at 150 feet.

Four specimens of what may be *Coryphella salmonacea* (Couthouy) washed ashore on September 6 and October 16, 1949.

Several other nudibranchs and tectibranchs were collected but they were not even tentatively identified.

Subclass Prosobranchiata

Admete couthouyi (Jay) was found sparingly. Two young specimens from 453 feet are typical *couthouyi,* but others are quite variable. *A. middendorffiana* Dall was taken infrequently: at Eluitkak Pass, through the ice at 162 feet, and at other depths to 741 feet. A single specimen of *Admete regina* Dall was taken at 522 feet. Two types of egg capsules of *Admete* were collected.

Five living *Ptychatractus occidentalis* Stearns were taken from 341, 438, and 453 feet.

Two living *Pyrulofusus deformis* (Reeve) were dredged, one 142 mm. long, on September 15, 1948, at 130 feet; the other 35.9 mm. long, on August 17, 1949, at 438 feet.

Eleven specimens of *Volutopsius behringi kobelti* Dall were taken at Eluitkak Pass and from depths of 80 to 522 feet, seldom more than one per haul, although three were taken at 216 feet and two at 184 feet. Although Point Barrow is the type locality of *Volutopsius stefanssoni* Dall, only two empty shells were found. An empty egg capsule of the helmet-shaped *Volutopsius* type and of a size worthy of *stefanssoni* washed ashore on October 21, 1949.

Five living specimens of *Beringius stimpsoni* (Gould) were dredged at depths of from 125 to 522 feet. Egg capsules of a species of *Beringius* containing from one to three large embryos with their shells consisting of several whorls were taken shortly after the ice went out, and freshly deposited capsules were taken in the middle of October. This variation in age of embryos at the beginning and end of the open season suggests the possibility of two species or of two age groups of adults or, more likely, that the embryos spend the entire winter developing and are then ready to emerge as young snails as soon as the ice goes out.

Two specimens of *Plicifusus kroyeri* (Möller) were dredged in the rubble zone. Some egg capsules possibly of this species contained recently deposited eggs on October 14, 1949, and others contained from 5 to 9 young snails 3 mm. in length. *Plicifusus verkruzeni* Kobelt and *Colus spitzbergensis* Reeve were taken sparingly from depths from 125 to 522 feet.

Two unnamed species of *Neptunea* and *Neptunea ventricosa* (Gmelin) were taken sparingly in the rubble zone. Old shells were usually inhabited by hermit crabs. These shells, even those occupied by living snails, are often overgrown with bryozoan colonies and barnacles.

The genus *Buccinum* is well represented at Point Barrow, both as to number of species and number of individuals. Individuals within a species vary tremendously, making identifications exceedingly difficult. It is of interest to note that although there are 14 species of *Buccinum* in Greenland waters and at least 9 or 10 species at Point Barrow, only 3 species, *B. glaciale, B. tenue,* and *B. ciliatum,* are common to both places.

Both large and small masses of egg capsules of *Buccinum* were dredged and were picked up on shore. Time did not permit attempting to ascribe these masses to their respective species.

The most abundant species of *Buccinum* at Point Barrow were *B. plectrum, B. glaciale, B. tenue,* and *B. angulosum* in its several varieties. The first three species came largely from the rubble zone down to 522 feet, with two *tenue* from baited traps at 64 and 80 feet, and one *plectrum* from a baited trap at 64 feet (See "Trapping Through the Ice"). *B. angulosum* was obtained chiefly by means of traps through the ice. The majority of the *B. polare* collected were also obtained by means of traps. Two live specimens of *B. fringillum* Dall, formerly known only from 54 feet from Nunivak Island, were dredged at 453 feet.

A number of specimens of *Boreotrophon* that could be ascribed to *clathratus* (Linnaeus), not hitherto reported from the Pacific side of the Arctic, were taken from 125 to 341 feet. Several other species were common in hauls from 80 to 741 feet. Two egg capsules of *Boreotrophon,* containing two embryos each, were taken on August 30, 1948.

Three species of *Trichotropis*—*T. bicarinata* (Sowerby), *T. borealis,* and *T. kroyeri* Philippi—were taken sparingly in the rubble zone. A group of three egg capsules, possibly of *T. bicarinata,* with 13, 14, and 24 embryo snails, respectively, were taken on September 1, 1949, at 328 feet.

Three specimens of the rare *Aquilonaria turneri* Dall (only six other specimens known) were taken at 477, 453, and 151 feet.

Piliscus commodus (Middendorff) was fairly common from 120 to 543 feet, 39 coming from a haul on October 14, 1949, at 175 feet. *Crepidula grandis* Middendorff was also found from 120 to 453 feet, but sparingly, and the specimens did not live up to their name, for the largest shell was only 32 mm. in length.

Natica clausa Broderip and Sowerby is one of the more abundant gastropods at Point Barrow. Nearly 100 specimens, including about

30 percent empty shells, were taken from Eluitkak Pass and at depths of 100 to 741 feet. The sand-encrusted egg rings of this species appeared in the first dredge hauls of the open season and one that was taken on October 11, 1949, at 453 feet had one young snail in each egg space.

A few specimens of *Polinices pallidus* Broderip and *P. monteronus* Dall were taken at depths ranging from 120 to 741 feet. Egg collars of *Polinices* were dredged and others were washed ashore. A few small ones could be attributed to the above species, but the majority were so large that it did not seem possible they could belong to *monteronus* or to *pallidus* of the size that was collected. Another species may live farther from shore or larger *pallidus* may occur in deeper water or at some place outside the dredging area of this project.

One species of *Onchidiopsis,* possibly *glacialis* M. Sars, and three species of *Velutina* were taken in the rubble zone, mostly in the 400-foot range. Another *Velutina* was collected near shore and from the beach.

Lepeta caeca Müller occurred on rocks from depths of 125 to 477 feet, the majority being found at 217 feet or deeper. The body of the animal is white.

A few specimens of the tiny liotiid *Mölleria costulata* (Möller) came from 453, 477, and 741 feet.

The trochids were well represented by *Solariella obscura* (Couthouy) and *Margaritopsis grosvenori* (Dall) from the rubble zone, mostly from depths up to 216 feet; *Margarites vahli* (Möller) from 120 to 741 feet; *Margarites pribiloffensis* Dall from 477 and 741 feet; and two specimens of *Margarites vorticiferus ecarinatus* Dall from 217 and 341 feet. But much larger and more abundant than all the other trochids together was *Margarites costalis* var. *grandis* that occurred in hauls from 110 to 741 feet, the highest yields coming from 341, 453, and 420 feet. Several of these species are new to Point Barrow. On the basis of abundance of snails and corresponding abundance of egg masses, it seems possible that the egg masses so commonly found on the washerlike bryozoan *Alcyonidium disciforme* may belong to this abundant species of *Margarites.* In describing the egg masses of *M. cinereus* from east Greenland, Thorson (1935a) states that they "are laid on *Laminaria* leaves or other algae as flat, slimy plates." The egg masses on *Alcyonidium* might better be described as firm, jellylike masses. In the absence of algae at Point Barrow it would not be strange if *Margarites* chose to deposit eggs on the abundant *Alcyonidium.*

A single specimen of *Puncturella noachina* (Linnaeus) from 184 feet extends the range of the species to the Pacific side of the world.

Over 10 species belonging to the "Oenopota complex" were collected. The species *nazanensis, harpa, impressa, laevigata,* and *tenuilirata* came from the rubble zone and down to 477 feet. Several of these species are new to Arctic Alaska and some to the Pacific side of the Arctic. Several species have not been identified. Egg capsules of at least two species of *Oenopota* were taken in September and October. The capsules contained embryo snails with shells.

Class AMPHINEURA

Although only two species of chitons were collected off Point Barrow, both species were often present in hauls from suitable bottom. Both are new to Point Barrow, but have been known from the Atlantic, the Atlantic-Arctic, and the Pacific.

Symmetrogephyrus vestitus Broderip and Sowerby, represented by 42 specimens, came from depths of 138 to 741 feet. Although all but the very tips of the valves are covered by the girdle, young barnacles attach to these tips and foraminifers nestle in the depressions formed at the junction of plates and girdle.

The smaller *Trachydermon albus* (Linnaeus), the valves of which are white on the inside but more often brown on the outside, appeared in hauls from 120 to 522 feet.

Class CEPHALOPODA

Two species of octopuses and one species of squid were collected.

On October 6, 1949, a single specimen of *Benthoctopus hokkaidensis* (Berry), a gravid female, was taken at 216 feet. The body, light orange on a cream background, was 57 mm. in diameter and 85 mm. long and the arms were 150 mm. long. This species was taken off Japan by the *Albatross* and more recently by the Russians in the Okhotsk Sea and Bering Sea. The specimen from Point Barrow extends the range into the Arctic.

On September 27, 1948, a juvenile and an adult of a species of *Cirroteuthis* were taken with a dip net from the outer edge of an ice cake that had stranded alongshore. These peculiar animals, which resemble in shape a rag doll more than an octopus, were in about 6 feet of water, where they had obviously been carried by an upwelling of deep water resulting from 3 days of offshore wind. Unfortunately, the larger specimen was lost in transit and Dr. Pickford was unable to identify the species from the juvenile. The larger specimen, mostly pale maroon in color, had an over-all length of 25.7 cm. Other measurements were as follows: eye to end of body, 14.8 cm.; across open end of "skirt," 13.5 cm.; width at base of fin (posterior), 6.8 cm.; width of fin, 5.8 cm.; length of fin, 6.6 cm.; diameter of siphon, 5 mm.; diameter of eye, 9 mm.; diameter of pupil, 4 mm.

Three specimens of the squid *Gonatus fabricii* (Lichtenstein) washed ashore at Point Barrow on October 1, 1949. They were spotted with red on a cream background. Measurements (in mm.) of these three specimens taken after preservation are given below. The over-all length is to the end of the short tentacles.

Specimen	Over-all length	Length of body	Length of short tentacle	Length of long tentacle	Fin spread
1	110	72	36	42	37
2	92	63	27	41	38
3	86	59	26	37	33

Phylum ENTEROPNEUSTA

Four individuals of an unidentified balanoglossid, the largest measuring 35 mm. in length and 4 mm. in diameter, were taken: three at 125 feet and one at 110 feet (September 15, 1948).

Phylum TUNICATA

Class ASCIDIACEA

Order APLOUSOBRANCHIATA

Approximately 30 species of tunicates, only about one-fifth of which were compound forms, were collected. Not all the species have been identified. Because of the abundance of certain forms only a small portion of those collected could be preserved; many were examined and when the data were recorded the animals were discarded. The writer is indebted to Dr. Donald P. Abbott for identifying a representative lot of tunicates so that field and laboratory notes could be made. Dr. Abbott will complete the identifications and publish his results later.

Several colonies of *Amaroucium fragile* Redikorzev were dredged at 125 feet, and two species of *Amaroucium,* probably new, were found attached to hydroids and bryozoans at 125 and 140 feet. Several colonies of *Aplidiopsis pannosum* (Ritter), completely covered with sand grains, pebbles, and stolons and stems of hydroids, were taken at 125, 130, and 110 feet. This species is new to the Arctic.

The most abundant compound species was *Didemnum albidum* (Verrill), a soft, white encrusting form with stellate spicules in the test, making the surface gritty. It occurred in every haul from 110 to 741 feet (where it was growing on the tubes of *Pista maculata*). It grew on bryozoans, on barnacles, on stones, and on the holdfasts and stems of hydroids and bryozoans. It is new to Arctic Alaska.

Three specimens of *Ascidia callosa* Stimpson were collected from stones and bryozoans at 125 feet. Cream-colored organs showed through the transparent or translucent tan tunics. It is new to Arctic Alaska.

Chelyosoma macleayanum Broderip and Sowerby was common in hauls from 120 to 477 feet, usually attached to rocks but sometimes growing on other tunicates, such as *Styela*. Four individuals taken on October 14, 1949, had immature ovaries but well-developed testes. This species is new to Arctic Alaska.

Order STOLIDOBRANCHIATA

Dendrodoa pulchella (Verrill) was common in all hauls from 110 to 140 feet and also occurred at Eluitkak Pass. It was usually attached to stones but also grew on other tunicates such as *Styela* and *Boltenia echinata*. The tunic varied from flesh color to dirty flesh to muddy tan. It is new to Point Barrow.

Dendrodoa grossularia (van Beneden) was common on rocks from depths of 125 to 216 feet. Most specimens are characterized by a bluish tint around the siphonal openings. An individual taken on October 6, 1949, was filled with eggs 0.25 mm. in diameter. It is new to Arctic Alaska.

One of the commonest of the simple ascidians was *Styela rustica macrenteron* Ritter, which was found at Eluitkak Pass and was abundant in hauls from 120 to 453 feet. Bryozoans, young barnacles, and *Didemnum albidum* were often found growing on its cream-colored tunic. Foraminifers often nestle in the tunic, forming depressions so deep that the testes scarcely project above the surface of the tunic. Although numerous individuals were opened and examined for copepods, none was found. Individuals from 35 to 45 mm. in height that were examined on October 14, 1949, had immature or developing testes and well-developed ovaries. Specimens from 7 to 8 mm. high were found from the first of August to the middle of October. This species is new to Point Barrow.

Styela coriacea (Alder and Hancock), less abundant than the above species, was found at Eluitkak Pass and in all hauls from 110 to 140 feet. It may be present in unidentified material from deeper hauls. It is new to Point Barrow.

With the exception of *Rhizomolgula,* the most abundant simple ascidian was undoubtedly *Boltenia echinata* (Linnaeus) with its cream tunic tinged with red, especially around the apertures. Externally it resembles a cactus. From a few to many individuals were present in all hauls from 110 to 453 feet. One small stone from 217 feet had five *echinata* on it. Usually attached to stones, it may be found also on bryozoans and other animals. Young specimens up to 15 mm. were attached to *Porella compressa.* Numerous individuals were searched for parasitic copepods and a total of 10 specimens of a new species of *Doropygus* were found. *Boltenia echinata* represents a new host for this genus of copepod. In a specimen of *Boltenia* 17 mm. high taken on October 11, 1949, at 453 feet the ovaries and testes were about half developed.

Not far behind the above species in abundance was *Boltenia ovifera* (Linnaeus), also present in all hauls from 110 to 453 feet. Specimens with stalks up to 170 mm. long were taken. *B. ovifera* is found attached to rocks, bryozoans, other tunicates, and to old holdfasts of hydroids and bryozoans. Occasionally large clusters of small to medium individuals with intermingled holdfasts and stalks were brought up. Out of 63 individuals examined on October 14, 1949, 4 contained the parasitic copepod *Schizoproctus inflatus* Aurivillius. Two copepods were taken from 26 tunicates from 453 feet, and one young copepod came from a small tunicate from 341 feet. This species appears to have no definite breeding season. Specimens examined on October 11, 1949, had gonads in various combinations of development, some with full testes and fairly full ovaries, others with empty testes and full ovaries; in others both testes and ovaries were developing, and in still others one testis might be small, the other, half developed, and the ovaries fairly well developed.

The largest and most conspicuous, but far from the most plentiful, tunicate was *Halocynthia aurantium* (Pallas), with its flesh-white tunic with traces of yellow and with a deeper flesh-pink color on one side. From one to several specimens were taken in hauls from 110 to 217 feet. It is new to Point Barrow.

Perhaps often overlooked because of its small size, its transparency, and its habitat, *Molgula griffithsi* (MacLeay) was abundant at Eluitkak Pass and in hauls from 118 to 477 feet. It was commonly attached to the hydroid *Lafoeina maxima* which was also abundant, to other hydroids, and to bryozoans such as *Barentsia, Eucratea,* and *Dendrobeania.* At 477 feet it was attached to the tubes of *Pista.* Small as this species is, one individual had a species of *Tubularia* (hydroid) growing on it. An individual taken on August 1, 1950, at 118 feet contained pale coral eggs that appeared ripe.

Three specimens of *Molgula retortiformis* Verrill were taken at 120 feet (August 30, 1948), 125 feet, and 140 feet, and possibly a fourth from 741 feet.

Four individuals of a species of *Molgula,* probably new, were taken at 110 feet.

Another pebble-covered new species of *Molgula* was represented by 29 specimens from 110, 125, 130, 184, and 217 feet. Some of those from 184 feet were filled with eggs that had developed sufficiently that the "tapole" larval tail could be seen.

Rhizomolgula globularis (Pallas) is an almost spherical species about the size of a small marble and so sand-encrusted that when it is contracted the siphonal openings are difficult to see. It inhabits a sandy-mud bottom, hence in the vicinity of Point Barrow it is limited to a few spotty areas between the base and the village of Barrow. One such area was found from 75 to 150 feet from shore and another about a mile from shore, both at a depth of from 10 to 15 feet. Thousands of these tunicates live in these localities. One short haul brought up a dredge one-third full of little except these tunicates. The first time the Eskimo boatman saw them, he exclaimed, "Ha, raisins!" In 11 specimens examined on September 8, 1948, both ovaries and testes were developing; in one the testes had spawned out and the ovaries were not quite mature, in two the ovaries were spawned out and the testes were about half developed, and in another both testes and ovaries were small. It is new to Arctic Alaska.

One specimen of *Eugyra glutinans* (Möller), new to Point Barrow, was taken at 125 feet.

Among the unidentified species is a slender, baseball-bat-shaped tunicate that lives with the basal two-thirds embedded in the mud. It was obtained at 10 and 120 feet and on shore after storms. Another species that washed ashore was a stalked form with a clear tunic through which the white testes and orange ovaries were visible. Still another species of *Molgula* contained eggs approximately 0.7 mm. long.

Phylum VERTEBRATA

Class PISCES

Although fishes were not within the scope of this project, any that were found in the course of collecting invertebrates were preserved and turned over to the U. S. National Museum in 1948 and to Norman Wilimovsky in 1949 and 1950. Data furnished by the writer will be incorporated in Mr. Wilimovsky's report.

I had hoped to locate some new source of food for the natives—clams, shrimps, or perhaps some large fish that could be caught by methods other than those employed by the Eskimos. At first it was difficult to accept the statement by Eskimos that no large fish live in the ocean at Point Barrow. (A number of large fishes inhabit the rivers and lakes.) However, if large fish were present in the ocean around Point Barrow, the whalers would have discovered them in the hundred or more years they were whaling in that region even if the Eskimos had not. After dredging and becoming acquainted with the invertebrate fauna, it was realized that certain of the animals could not exist in such large numbers, especially on the smooth mud bottom where there is no refuge of any kind, if large, bottom-feeding fish were present. Admiral Byrd told me that on his expeditions they were never able to catch large food fish within the vicinity of the ice fields of the South Polar regions. Large fish apparently have not been able to adapt themselves to a temperature of $-1.8°$ C.

The most abundant marine fish at Point Barrow, and the most important from an economic standpoint, is the Arctic cod, *Boreogadus saida* (Lepechin). During the summer of 1948 these could be caught at almost any time by going out to a large ice floe and fishing through a crack in the ice. Fishing gear consisted of a wand or stick about 30 inches long, a piece of leader about the same length, and a small hook of some kind. The Eskimos usually use a barbless hook consisting of a small spatulate piece of ivory with a brass tack through the distal end. Almost invariably cracks from 3 to 6 inches wide in a large floe have Arctic cod swimming around in the water in them, and several dozen can be caught within a short time. But these fish form a precarious source of summer food because the possibility of catching them in this manner depends upon the presence of large ice floes. In the summers of 1949 and 1950 very few Arctic cod were caught by the Eskimos, and laboratory personnel could not obtain enough for physiological studies. But they were present in the offshore waters, as was evidenced by the fact that numerous individuals washed ashore during storms. During the winter the Eskimos obtain these fish by jigging for them in about 80 feet of water through a hole in the ice.

Another marine fish used by the natives is the capelin *Mallotus catervarius* (Pennant), a small fish about the size of a smelt that comes to the very edge of the surf to lay its eggs but does not spawn above the water as does the grunion along the coast of California.

The eggs are deposited in the gravel. During spawning these fish can be caught in considerable quantity with hand nets from the shore, and for a period of several weeks they frequent the shore waters in such numbers that a few can be taken by sweeping long-handled nets through the water.

Another marine fish that is eaten occasionally by the natives is a sculpin (*Myxocephalus quadricornis*) that was most frequently taken in nets at Elson Lagoon and occasionally along the ocean shore. During the first part of September gravid females were taken, and it is probable that this fish comes into Elson Lagoon or alongshore to spawn. With its large head and slender tail, the sculpin offers little flesh to reward one's efforts, but the Eskimos do not turn down anything that is edible.

The capelin and the sculpin are only seasonal visitors, or at least can be obtained only seasonally. The Arctic cod is plentiful only during those summers when there are large ice floes alongshore, and in the winter it cannot be obtained in sufficient numbers to constitute a dependable source of food. However, the fishes available from all sources must furnish an important supplementary food and a welcome variety to a limited diet.

All fish are directly or indirectly dependent upon the marine invertebrates for their food.

Class MAMMALIA

The marine mammals of the Point Barrow region are of great importance to the native Eskimos, for their presence or absence often means feast or famine.

A population of 125 to 150 at Barrow Village was supported by hunting; but during the past 25 years or so this has increased to over 1,000, by reason of the additional means of livelihood created by naval and other activities.

A curious fact about the Eskimo birth rate is that it greatly increases when the Eskimos eat "white man's" food. When hunting was the only means of subsistence, Eskimo women became pregnant only once in several years, but with the new diet they bear a baby about every year. The writer's boatman, Max Adams, had five girls, the eldest five years; his brother had four boys and one girl, the eldest five years. One of the laboratory Eskimo employees had ten children, another eight, and a third four, the eldest six years. What is going to happen when outside support is shut off is an important and serious problem. Some few fathers are training their boys in hunting and older Eskimo skills, but most of them are content to let the future take care of itself.

In contrast to the Indians, who are wards of the Government, the Eskimos are citizens and as such are subject to all laws governing citizenship. However, they are still allowed to hunt and kill game at will. In most places they not only kill to supply their own needs, but for food for their dog teams as well. The situation is fast becoming a problem difficult of solution.

Although the marine invertebrates of the Point Barrow region are not a source of food for the natives, they are nevertheless of great importance for they furnish food for the marine mammals that are eaten by the Eskimos.

The whales (mainly bowhead) are of first importance as a source of food for the Eskimos, several being taken in the spring of each year and the flesh stored underground in cellars, where it remains edible for three or four years. They feed on euphausiids ("krill" of the whalers) mysids, pteropods, and copepods of which there is an unlimited supply. This food is so abundant that the great blue whale can attain a weight of 60 tons in two years. Baleen whales probably lead the easiest life of any mammal. These enormous creatures have only to swim slowly through water which has about the same specific gravity as themselves, opening and closing their mouths and swallowing food.

To an Eskimo the most delectable food is whale muktuk, which consists of whale skin with about an inch of the underlying blubber. After freezing, the muktuk is cut into small squares and eaten raw. It has a nutty flavor and is really quite good.

Perhaps next in importance in the native economy is the bearded seal. This marine mammal, which reaches a weight of 500 to 600 pounds, feeds almost exclusively on amphipods, using its whiskers for sweeping them from the underside of the ice. The teeth are very small and are of little use for holding or masticating food. In winter these seals are hunted in offshore leads; they float when shot, so can be taken easily. In summer they are hunted in boats; they sink when shot, and if not immediately harpooned, are lost. I accompanied my two boatmen on a summer hunt and although 11 seals were shot, 7 were lost.

The little harbor seals are abundant and have habits much the same as those of the bearded seal, but they seldom if ever weigh over 50 pounds.

According to generally reliable information, the walrus is not nearly so abundant as formerly; seldom more than 25 walruses a year are killed at Barrow, and in those summers when the ice goes far offshore few, if any, walruses are taken. They feed on clams and perhaps to some extent on sausage worms (*Echiurus echiurus alaskanus*).

Of least economic value is the polar bear, for it is not prized as food by the natives. The skin is used, though not to the extent that sealskin is. The polar bear is afraid of nothing, for no animal of the Arctic except man is likely to injure it, and the chance of its encountering man in the vast expanse of ice over which it roams is remote. When a hunter is sighted, the bears will walk right up to him to investigate, and Eskimos often let them come as close as 25 or 30 feet before shooting them. Polar bears feed almost exclusively on the two seals mentioned above. They are usually infested with *Trichinella* worms, but from what source is not definitely known.

Before leaving the subject of marine mammals, mention should be made of the use of their skins, which supply certain special needs of the natives. (Caribou is the most widely used for clothing, and wolverine fur, which is unique in that it does not allow the breath to freeze on it, is often used to border parka hoods.)

Skins of the bearded seal are used for many purposes, especially for making soles for mukluks, covering boat frames, and making thongs to be used as ropes and cords. Skins of the little harbor seal are made into air floats that are attached to harpoon lines for floating whales so they can be located after they have died. Walrus skins are also utilized in various ways.

All these marine mammals, upon which the Eskimos are so dependent for food, clothing, and implements, are in turn dependent, either directly or indirectly (but largely directly), upon the marine invertebrates for food.

DISCUSSION

It is the practice in many ecological investigations to count every animal in every haul and give the total weight of each species. From the results the "dominant" animal is selected and the animals to be found at certain depths are listed. This is very time-consuming, and the results do not justify the amount of time spent.

There are many factors in addition to the type of bottom and the depth that determine the number of animals taken in any one dredge haul. Some, such as certain snails and ophiurans, congregate for mating, and a dredge haul through a congregation of such animals would give an entirely erroneous idea of the "dominant" animal in that locality. Others, such as certain sea urchins, habitually move about over the ocean bottom in colonies, and might be at one place one day and at another several weeks later. Sometimes an animal is vastly decreased in numbers by predators. When the food is gone the predators decrease in numbers, and then their prey increases in numbers. The time of dredging in relation to this cycle would affect the number of certain species.

Still other factors have a bearing on the number of species found in any locality. When larvae settle out of the plankton to become bottom dwellers they may scatter, or they may settle in large numbers in a small area. Sometimes the bottom is unsuited for that particular species; or, if the bottom is suitable, conditions existing at the time of settling influence the number that survive. Under favorable conditions a large number of individuals of a species may become established, but if conditions are adverse only a few survive even though a large number of larvae of that particular species are settling to the bottom. For instance, if the bottom is already well populated, fewer larvae can become established than if the bottom were sparsely populated. Also the presence of large numbers of other bottom-dwellers that feed on settling larvae will greatly reduce the species.

The futility of trying to collect weight–numbers data for a locality is well demonstrated by the results of the investigation at Point Barrow. Such data for the entire rubble zone in 1949 would be entirely different for the same area in 1950 after the deposition of mud during the fall of 1949. The animals found at depths of 100 to 200 feet in 1948 and 1949 were not the same as those found at the same depths in 1950. A station that yielded a certain fauna one summer might yield an entirely different fauna a year or two later after it had been gouged out by an ice floe.

An enormous amount of time and dredging is required to acquire weight–numbers data, and it seems much more to the point to learn more about the animals themselves—how and on what they feed, how and when they reproduce, how fast they grow, how long they live. Production of food in the economy of the sea depends on the rate of reproduction and the rate of growth and these characteristics are too often neglected in order to present pretty pictures of animals on the ocean bottom in an attempt to illustrate relative abundance and "dominance."

In certain instances in treating the individual species in the "Discussion of Animals by Phyla," a comparison or contrast is made with the same species from Greenland or Iceland. Detailed comparisons would be a work in itself and is out of the question until identifications are complete, but a few are of interest.

Because of less variation in ecological factors, there is little doubt that the region of Point Barrow supports a fewer number of species than do such regions as Greenland and Iceland. The waters around Greenland are showing much more effect of the warming of the Arctic that is taking place at present than are the waters around Point Barrow for, as far as could be determined, no changes have taken place in the Chukchi Sea comparable to those around Greenland, where the cod, for instance, has migrated 1,000 miles northward.

In both Greenland and Iceland there are fjords and rocky shores that provide habitats for different types of animals—a condition in contrast to the open water around Point Barrow and entire absence of any shore fauna. The total absence of macroscopic algae (except for about two species in Elson Lagoon) excludes certain animals from the Point Barrow region.

The investigation at Point Barrow extended only a few miles out from the base; whereas the work along east Greenland covered an area from the 60th to beyond the 77th parallel of latitude, including the intensive investigation of many fjords in addition to offshore dredging. The Icelandic investigations covered the entire coast as well as offshore work.

Despite the differences in ecological factors and extent of the investigations, in regard to time, depth, and territory covered, the number of animals found at Point Barrow compares very favorably with those from Greenland and Iceland, as the following table shows.

TABLE 9.—*Comparison of the fauna of Point Barrow, east Greenland, and Iceland*

Animal Group	Number of species		
	Point Barrow	East Greenland	Iceland
Priapulids	2	3	3
Sipunculids	2	6	6
Echiuroids	2	2	2
Brachiopods	2	5	9
Amphipods	100	153	181
Pelecypods	38	?	88
Prosobranchs	70+	84	132

The amphipods from Iceland were collected from the surface down to depths of about 1,250 feet, and a few in deeper water. Most of the dredging at Point Barrow was done at depths of less than 200 feet, only 14 of the 65 stations exceeding 200 feet, and 8 exceeding 300 feet, and the greatest depth being 741 feet.

Table 10 gives the approximate number of species of animals in each group, the number of new species if known, and a general idea of the extension of range of the species. In several of the groups the animals have not all been identified. For example, few of the coelenterates, about 20 out of approximately 30 species of tunicates, and 14 of an approximate 21 species of copepods have been identified. Literature on extent of the range of some of the animals was not available, so that these data could not be given. For example, out of 21 species of decapods, 1 is new to the Arctic, 2 to the western Arctic, 1 to Arctic Alaska, 4 to Point Barrow, 1 has been reported previously from Point Barrow, and exact data are lacking on 10 species. By "western Arctic" is meant any place west of the American Archipelago along the Canadian or Alaskan coast. "Arctic America" excludes Greenland.

TABLE 10.—*Synopsis of the invertebrates of Point Barrow, Alaska*

Invertebrates	Total No. of species	New to Arctic	New to Arctic America	New to western Arctic	New to Arctic Alaska	New to Alaska	New to Point Barrow	New species
Protozoans			Distribution data lacking					13
Foraminifers	75							
Poriferans	10		Distribution data lacking					3
*Coelenterates								
Hydroids	21 ?		1	1	1		1	
Trachyline medusae	3							
Scyphozoans	3							
Anthozoans	9							
*Ctenophores	3							
Platyhelminthes								
Turbellarians	2			1				1
*Cestodes	2							
*Nematodes	?							1
Nemerteans	24	10					11	0
Sipunculids	2						1	0
Priapulids	2		1			1		0
Echiuroids	2	1	1					0
Chaetognaths	3							0
Brachiopods	2						1	0
Bryozoans	99	8	12	38	6	6	10	13
Entoprocts	2	0	2					0
Annelids								
Polychaetes	88	2	9	10	54		13	1
Hirudinea	1		1					0
*Echinoderms	20			3	5	1		
Arthropods—Crustaceans								
Ostracods	5				1	3		0
*Copepods	17+		3	1	7			2-3
Cirripedes	5						2	0
Mysids	3			1				0

TABLE 10.—*Synopsis of the invertebrates of Point Barrow, Alaska*—continued

Invertebrates	Total No. of species	New to Arctic	New to Arctic America	New to western Arctic	New to Arctic Alaska	New to Alaska	New to Point Barrow	New species
*Cumaceans	9	4			2			3
*Tanaidaceans	1							
*Isopods	11	2		1			1	1
Amphipods	100	3	43	12	3	6	13	8
Euphausiids	3		1	1				0
Decapods	21	1		2	1		4	0
*Arthropods—Pycnogonids	10			1		1		
Mollusks								
*Pelecypods	38	2	2	2	1	1	16	1
*Gastropods	89	12	4	3	10	2	23	4-10
Amphineurans	2						2	0
*Cephalopods	3							1
*Enteropneusts	1							
*Tunicates	30				1		19	?
Totals	721	44	80	77	92	21	117	53-59+

* Indicates that not all the species have been identified.

Even though the data on the ranges are still incomplete, the ranges of 339 animals have been materially extended and new locality records have been established for an additional 90 species. In addition there is a minimum of 52 new species. The large number of animals with extended ranges is not surprising in view of the fact that the total number of invertebrates collected is approximately 722, whereas the International Polar Expedition to Point Barrow collected only 188, including a few fresh-water species.

The distribution of the species according to oceans is set forth for a few groups in the table below:

TABLE 11.—*Number of species common to the Arctic and adjacent oceans*

Invertebrates	No. of species	Arctic, Atlantic, Pacific		Arctic Atlantic		Arctic Pacific		Arctic	
		No.	Percent	No.	Percent	No.	Percent	No.	Percent
Sponges	10	0	0.0	4	40.0	3	30.0	3	30.0
Nemerteans	24	6	25.0	5	20.8	12	50.0	1	4.2
Bryozoans	84	39	46.4	26	31.6	14	16.5	5	5.8
Polychaetes	88	75	85.2	3	3.4	5	5.7	5*	5.7
Amphipods	100	37	37.0	31.0	31.0	7	7.0	25	25.0
Decapods	19	5	26.3	2	10.5	12	63.2	0	0.0
Pelecypods	33	20	60.6	2	6.0	11	33.3	0	0.0
Prosobranchs	70	26	37.1	10	14.3	32	45.7	2	2.8
Totals	428	208	48.6	83	19.3	96	22.4	41	9.6

* Includes two species common to the Arctic and the Antarctic.

The totals in the above table show that 48.6 percent of the animals collected at Point Barrow are common to three oceans and 41.7 percent are common to two—19.3 percent to the Arctic and Atlantic, 22.4 percent to the Arctic and Pacific; while 9.6 percent have been found in the Arctic only (two of the species also found in the Antarctic). These figures bring out some facts that stimulate one's curiosity to say the least. Why have animals that have found their way into one ocean below the Arctic not found their way into the other? From what has been said under "Distribution," there must be factors other than the rate of distribution that account for the range of these animals. Temperature may be one of them but its limited variation in the Arctic-Pacific should make it possible for any animal that lives in the Arctic-Atlantic to extend its range into the Pacific. Perhaps the constant flow of water from the Pacific into the Arctic may be an important factor but if so, any animal found in the Arctic-Pacific should also be found in the Atlantic. Such speculation could go on endlessly, but it is of little value unless followed by the actual testing of theories.

From table 11, some interesting comparisons can be made between the individual groups: 85.0 percent of the annelids are found in both adjacent oceans, while only 60.6 percent of the pelecypods and 37.1 percent of the gastropod prosobranchs are found in both the Atlantic and Pacific. More mollusks are common to the Arctic and Pacific than to the Arctic and Atlantic. (This discrepancy may disappear when the remaining 10 or 15 gastropods, which are either new or else Atlantic forms, are identified, for they certainly are not Pacific forms.) Of the amphipods 31.0 percent are common to the Arctic and Atlantic while only 7.0 percent are common to the Arctic and Pacific, and 25.0 percent are restricted to the Arctic. Two and a half times as many nemerteans are common to the Arctic and Pacific as to the Arctic and Atlantic.

In general, it would seem that there should be more species common to the Arctic and the Atlantic because of the greater variation in ecological factors on the Atlantic side. However, the totals show that 19.3 percent of the species are common to the Arctic and Atlantic as against 22.4 percent common to the Arctic and Pacific.

The large number of annelids that range outside the Arctic is interesting and, because of the thorough study of this group by Dr. Pettibone, the figures must be so accurate that it is safe to assume there will be little change in them as future work goes on. Annelids would seem to be more adaptable to varied conditions than are other marine invertebrates, especially such groups as the brachiopods.

ACKNOWLEDGMENTS

No project of this scope could be accomplished without the assistance and cooperation of various people. Under the discussion of the various phyla, acknowledgment has been made for the identifications of animals, without which a work of this kind is meaningless.

I am indebted to the administrative officers of the California Institute of Technology and the Johns Hopkins University: Dr. DuBridge and Dr. Beadle for granting leave of absence and assisting with the contract for 1948; Dr. Bronk and Mr. McCauley for assistance and direction in the contract with the Office of Naval Research for 1949-50; and to Dr. Burford and Mr. Spence of the Institute for Cooperative Research for technical and business assistance.

Various officials of the Pasadena and Washington offices of the Office of Naval Research were helpful and cooperative beyond the call of duty: Captain Thomas, Captain Rice, Dr. McClosky, and Commander Bolay; Dr. Shelesnyak, Dr. Field, Dr. Galler, and Dr. Quam. Mrs. Yvonne Reamy at the Washington office, and Miss Ruth McKee and Mrs. Frances Schillinger, administrative aides for the Arctic Research Laboratory at the Institute for Cooperative Research, gave invaluable assistance in overcoming the disadvantages of distance between Point Barrow and Washington and Baltimore, especially in connection with my duties as Scientific Director of the Arctic Research Laboratory.

I wish to express deep gratitude to certain members of the staff of the U. S. National Museum: Dr. Waldo L. Schmitt, Dr. Paul Illg, Clarence R. Shoemaker, the late Austin H. Clark, Dr. Harald A. Rehder, R. Tucker Abbott, and especially Dr. Fenner A. Chace, Jr., who was untiring in his efforts to obtain identifications of animals.

I am also indebted to Navy personnel both at Fairbanks and at Point Barrow, for their assistance in carrying out this project and their cooperation with the Scientific Director of the Arctic Research Laboratory: Commander Fisher, Commander Aubey, Lieutenant-Commander Gill, Lieutenant Jackson, and M. E. Cunningham. Without the support of Commanders Fisher, Aubey, and Gill, the addition of Building 251 to the Arctic Research Laboratory could never have been accomplished.

Thanks are also due many of the officials of the Arctic Contractors both at the Fairbanks office and at Point Barrow: Mr. Davis, Mr. Mathews, Mr. Spaulding, Mr. Adams, Mr. Nicholson, Mr. Shurlock, and many foremen and their crews who never hesitated to lend a helping hand.

I also wish to express appreciation to the crew at the Arctic Research Laboratory for their faithful service: Harry Balvin, John Huff (especially for his assistance with work on the ice), Frank Talbert, Calvin Scougal, Chester Lampe, Pete Sovalik, Max Adams, and Olaf Ovenasook.

I am indebted also to my research assistants Howard Feder and Gail Grodhaus. Mr. Feder performed the routine tasks of taking water samples and temperatures and attending the traps set through the ice. And to my wife and research associate, Nettie MacGinitie, thanks are due for her constant help and her contribution to this paper of the section on mollusks.

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