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THE ANNUAL AVIAN BREEDING CYCLE AT HIGH LATITUDES IN THE CANADIAN ARCTIC

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THE ANNUAL AVIAN BREEDING CYCLE AT HIGH LATITUDES

IN THE CANADIAN ARCTIC

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CHAPTER I

INTRODUCTION

Arctic birds were well known long before man explored the New World north of the 79th parallel. The chief interest in arctic birds in those early days lay in the northern limits of their distribution. Having pushed the frontier of ornithological knowledge to the 83rd parallel, Feilden (1877: 401-2) speculated on the breeding of birds in the polar basin. His observations on the abundance of terrestrial insects and marine amphipods and on the power of wind in transporting seeds convinced him that land, if it existed beyond the 83rd, would be hospitable to birds. Today, land is not known to exist far beyond Feilden's frontier, but speculation on bird distribution continues. The presence of birds far out over the polar pack is not fully understood. The finding of birds on gravel-bearing ice islands suggests the possibility of a breeding ground beyond the northernmost lands known; but this, like conceivable migration routes over the polar

basin, is still speculation.

Until fairly recent times, most works on arctic ornithology have been brief annotated lists of species. This initial work, primarily distributional, must continue, for the arctic remains mostly unexplored. With superior transportation facilities, the great voids in arctic ornithology are gradually diminishing. The exacting requirements of the arctic environment have stimulated interest in physiology and ecology, and research in these zoological disciplines is fast spreading to both polar regions. Equally pressing problems have to do with the numbers of arctic birds, their cyclic fluctuations, and their genetic makeup. Recent attempts have been made to present data concerning large areas, e.g., Pleske's "Birds of the Eurasian Tundra" (1928) and Salomonsen's "Birds of Greenland" (1950-51). A synthesis on the origin, distribution, and taxonomy of the entire arctic bird fauna recently has been undertaken by Johansen (1956-).

Statement of Problem

The purpose of this investigation was to obtain information on the breeding cycle of birds in the far north. Ellesmere Island, in the Canadian Arctic Archipelago, was attractive because of its high latitude--the more so since weather stations on its north and west coasts were regularly serviced by military airlift. The west coast, close to Axel Heiberg Island, promised to be the most productive. S. D.

MacDonald, of the National Museum of Canada, Ottawa, was my field companion. MacDonald made extensive biological collections, whereas I concentrated on the birds.

The crux of my problem was this: Has selection been at work among birds breeding at high latitudes in such a way as to bring about more expeditious establishment of nest-territories, more rapid nest-building, a shorter incubation period, a shorter fledging period, and an overlap of brood-rearing and post-nuptial molting by way of accommodation to shortness of summer? If so, in what species has this speeding-up been sufficient to allow two-broodedness?

CHAPTER II

AREA OF INVESTIGATION

The principal area of investigation was the Fosheim Peninsula, a 2000-square-mile area of mountains and tundra plain lying north of the 79th parallel (Fig. 1). To the west, beyond Eureka Sound, sprawled Axel Heiberg Island. To the north lay Greely Fiord, to the east Canyon Fiord. About 600 square miles of the peninsula were visited, but the most intensive study was carried on in an 80-square-mile area north of Slidre Fiord, a 16-mile-long indentation of the west coast.

Base camp was the joint Canadian-U.S. Weather Station of Eureka (80°00'00"N. 85°56'25"W.) on the north shore of Slidre Fiord (Fig. 2). Eight miles northeast of Eureka we established another camp at the south foot of Pterophorid Hill (after Bruggemann), a mile west of Eastwind Lake.

From the time of our arrival, April 16, until late May we travelled extensively, northward nearly to Greely Fiord, southward to Blue Man Cape, and southeastward to points 15-20 miles from the head of Slidre Fiord. In late May and throughout most of June we worked within five miles of the north shore of the fiord. From late June to mid-July,

with our base at Eastwind Lake, we reached several northern parts of the peninsula, even Iceberg Point, the northwesternmost extremity. From mid-July to mid-September we concentrated on Slidre Fiord, traveling up and down both coasts as ice permitted. Our attempt to reach Iceberg Point by boat on August 11 was blocked by ice. In late August we visited points five and six miles south of the fiord. In September we visited Eastwind Lake twice--for several days early in the month, again from the 18th to the 23rd. We left Ellesmere Island September 27.

Topography

In westernmost Fosheim Peninsula the land gradually rises from sea-level in the north to a bold coastal ridge whose highest summits reach about 2000 feet. The ridge is divided by Slidre Fiord, the part to the north being called Northwest Ridge, the part to the south Harecape Ridge. At the south foot of Northwest Ridge is a projection of flat land known as Musk Ox Point. The north end of Harecape Ridge, Hare Cape itself, is a bold and important landmark. The south end is much lower, the two summits there each reaching about 1000 feet.

Although its entrance is dominated by high land, Slidre Fiord is surrounded largely by low, thick, sedimentary deposits which contain little rock except where sandstone outcrops along ridges and in gullies. Gravel is fairly ex-

tensive in delta areas, but scarce elsewhere. The fiord slopes are frost-heaved, cracked, and deeply gullied. The fiord itself is very deep and averages two to three miles in width.

North of Slidre Fiord, between Northwest Ridge on the west, Greely Fiord on the north, and Black Top Ridge (3000 feet) on the east lies a plain whose drainage is so good that there is only one notable body of water in it--Eastwind Lake (526 feet elevation). This lake, one of the largest on the peninsula, is about a mile wide and a mile and a half long. It is fed by a creek from Black Top Ridge and its outlet flows northward. South of Eastwind Lake the plain is drained by two major streams, Black Top Creek and Station Creek. Ptarmigan and Redpoll creeks (after Bruggemann) flow directly into Slidre Fiord west of Eureka. North of Eastwind Lake the plain is drained by streams which flow into Greely Fiord. As far as I know none of them have official names.

Iceberg Point was named Isfjeldodden by Fosheim (in Sverdrup, 1904, 2:205). The land there is low and a cluster of lakes lies near the point. Five miles east of the point is Mt. Lockwood (1300 feet), a double peak sometimes called Two Humps. Ten miles farther east a horseshoe-shaped hill (1000) feet cradles a large lake. From this hill eastward a low plain extends all the way to Canyon Fiord.

This same plain extends southward far past Black Top

Ridge to mountainous country. Slidre River flows westward through it, becomes braided, and enters Slidre Fiord. The lower valley and adjacent flats are peculiar in that the ground is covered with loose sand and silt. Bruggemann (1954) states that during dry and windy weather a pall of dust sometimes hangs over the area, extending inland along the west slope of Black Top Ridge. Romulus Lake, sterile and deep, is not far from the head of Slidre Fiord. Drainage is often sluggish. Lakes, ponds, and marshes are fairly numerous in the northeast.

Parallel to Canyon Fiord is a coastal range which at Cape With, a point due east of Slidre Fiord, attains an elevation of 2000 feet. Here is the only sheer sea cliff of the peninsula. South of Cape With rugged glaciated mountains cross the peninsula in a northeasterly-southwesterly direction. The usually dark, 4000-foot peaks, separated by broad, shimmering valleys of ice, are clearly visible at Eureka, 40-50 miles away, and the apt name Sawtooth Range (Fig. 3) has been given to them. Fosheim's famous Ulvedalen (Wolf Valley) of "glorious memory" (in Sverdrup, 1904, 2:281) runs from the head of Canyon Fiord into this range. Fosheim attempted to cross the peninsula following the valley, but a mountain blocked his way.

South of Slidre Fiord there are comparatively few lakes. The plain which extends from Harecape Ridge eastward and southward becomes a plateau west of Sawtooth Range. Con-

spicuous are the outcrops of bedrock sandstone. These are noticeable near Slidre Fiord where streams have cut outlets through them. East of Harecape Ridge, along the south shore of the fiord, a narrow sandstone scarp with vertical west front runs southwestwardly. It is highly weathered, attains a height of 750 feet, and unofficially is called Sandstone Ridge. Several miles inland it abruptly disappears. Where it reappears it resembles a medieval fortress with sheer walls 100 feet high. Wind has cut bizarre formations and pinnacles on both sides. A talus slope of sand gives access to the top. Everywhere the sand is deep and pure and without plants of any kind. Gyrfalcons (Falco rusticolus) resided here in 1955 and probably have done so for many years. Having failed to find a name for the rock, official or otherwise, we call it the Falcon Castle (Fig. 4).

Black Top Ridge is a mountain of "intrusive rocks of dolerite overlapping sandstone" (Tener, 1954:2-3). It rises above the tundra plain, is 11 miles long, and is the dominant mountain of the Slidre Fiord area. Its west front is unclimbable except near its middle where it is nearly severed by Gate Valley (after Bruggemann), a stream-cut gorge. Its lower end gradually descends, by a series of bluffs, to sea-level at the head of Slidre Fiord. Through this bluff country the waters of Geum Creek (after Bruggemann) have cut a deep gorge in which gulls nest. Frost has everywhere shattered the rock of the mountain into sharp angular pieces that cover

whole slopes and ridge tops. Above great banks of scree hang sheer cliffs. It is these cliffs, dark and prodigious, that give the mountain its name. When climbing the front, the horizontal parts are as impressive as the vertical: broad terraces, broken by gorges and piles of fallen rock, rise stepwise towards the top.

According to Troelsen (1952:199-210) a primary folding took place on Ellesmere Island before Middle Carboniferous times, and although Middle Carboniferous, Permian, and Mesozoic deposits are poorly known there, it is certain that these were subjected to a secondary folding before the formation of the Upper Cretaceous or Cenozoic coal beds. During Pleistocene time the region had a continuous ice cover whose center was probably in eastern Ellesmere Island. As the ice receded, the sea advanced across the low plain of the Fosheim Peninsula, falling back as the land rose. Shells are conspicuous on the surface of this raised sea-bottom. The highest marine beach measured by Troelsen at Slidre Fiord was 465 feet above sea level.

Although Schei (in Sverdrup, 1904, 2:460) reported Mesozoic formations along both coasts of Eureka Sound, Troelsen (1952:208) states that the only Mesozoic deposit known with certainty from Ellesmere Island previous to 1952 was the Triassic Blue Mountain formation. In 1952 Troelsen found additional Mesozoic formations on the plains around Slidre Fiord and in northeastern Fosheim Peninsula, a notable item

being the remains of a plesiosaurus in shale about two miles from Eureka. In 1955 a petrified tree trunk, supposedly Cretaceous, was found on the plain east of Slidre Fiord. Sandstone strata with coal beds, apparently Cenozoic, lie exposed on the peninsula. Intrusive rocks may not exist in the Caledonian area of Canyon Fiord (Troelsen, 1952:206). According to Schei (in Sverdrup, 1904, 2:462) the "greater injections" of eruptive masses on Ellesmere Island "seem pre-eminently confined to two lines--those of Smith Sound and Heureka [=Eureka] Sound."

Climate

Latitude. There is a sunless winter period varying from a minimum of one day just north of the Arctic Circle to a maximum of six months at the North Pole, and the sun is above the horizon for an equally long period of continuous daylight (Rae, 1951:4). On the Fosheim Peninsula continuous darkness lasts from about October 22 to February 20 and continuous daylight from about April 14 to August 31. During constant daylight the sun dips toward the northern horizon every 24 hours. When the sky is clear the light is never too poor at this time for photography, although light intensity is low in the deeper gullies and on shady slopes. The summer twilight, from about 8:00 p.m. to 2:00 a.m., is somewhat like the night of temperate regions. According to Rae the length of the dark period significantly lowers winter temperatures, and the heating effect of continuous solar radiation is re-

duced by obliquity of the sun's rays and by the extensive cloud cover over the Arctic Archipelago in summer.

Air Pressure. Air pressure influences wind and weather, and therefore avian habitat, profoundly. Ray (1951: 4-5) states that the ridge of high pressure which forms along the west shore of Hudson Bay from January to March spreads over the entire Canadian Arctic Archipelago by April; that there are maximum mean monthly pressures in May; that mean pressures then drop so unequally that by July a pressure gradient hardly exists over the entire Archipelago; that a weak trough of low pressure covers most of the Archipelago (including Ellesmere Island) in August; that September and October are transitional months in which mean pressures gradually rise until in November a trough develops over Davis and Hudson straits and a ridge from Ellesmere Island southwestward to Great Bear Lake; that there is a winter maximum mean pressure in November or December, after which mean pressures "decline to a shallow mid-winter minimum in January."

Ice and Open Water. New ice at Slidre Fiord has been known to reach a depth of eight feet (Tener, 1954:4). By August it is broken and pushed about by wind and water currents. What remains is caught by new ice. Much of the frozen sea is thus rough and hummocky. To this is added the incredible bergs that occasionally drift in and out of Slidre Fiord. Over fifty years ago Fosheim (in Sverdrup, 1904, 2: 276), gazing upon the frozen seas beyond Iceberg Point, saw a

mass of icebergs, some small, some standing like gigantic runic stones, strewn among old floes and rubble ice. It is the same today. Rae (1951:6) states that there is sufficient radiation through ice even six feet thick to warm the air moderately above it, resulting in less severe winter temperatures than land areas would have. Since open waters also modify temperatures, there is virtually no decrease of temperature with increase of latitude during summer in the Canadian Arctic Archipelago. On the other hand the icy waters so cool the warm air from the south as to cause uniformly cool summers throughout the Archipelago.

Topography. Rae (1951:6-7) states that the high mountains of eastern Baffin, Devon, and Ellesmere islands act as a mechanical barrier preventing the free transport of air from one side to the other. That this is probably significant, at least in so far as Ellesmere Island is concerned, can be seen by comparing temperatures and precipitations of the Fosheim and Bache peninsulas, located at about equal latitudes on opposite sides of the range, the mean annual temperature and total annual precipitation for the former (Eureka) being -4°F. and 1.74 inches, respectively, for the latter, +4°F. and 5.19 inches. The Fosheim Peninsula is surrounded by high, ice-covered mountains which influence the climate. As illustrated by Baird (1955:96-7), the ice caps of "Grant" lie to the north, of "Grinnell" to the east, of "Ellesmere" to the southeast, of "North Lincoln" to the south, and of Axel

Heiberg Island to the west. The land masses of Grant Land and Axel Heiberg Island modify climatic influences of the Polar Sea. The only glacier-covered mountains of the peninsula are the Sawtooth Range. Lesser mountains or ridges (1000-3000 feet) also influence the climate profoundly, and the warm valleys of the peninsula lie east of them. Most of these ridges lie in a north-south direction. That their influence is protective is readily perceptible when the land lying about them is compared with that of the northwest part of the peninsula. Here cold winds from the polar pack sweep down Nansen Sound, rushing over Iceberg Point and the plains to the southeast, creating a desolate lowland.

Air Temperature. It is believed that the "cold pole" for North America is located on northern Ellesmere Island where the January mean is near -40°F. (Rae, 1951:10). Thus the Fosheim Peninsula lies within one of the coldest parts of the Canadian Arctic Archipelago. Eureka has had annual mean temperatures of -4°F. Its annual range in mean temperature has been 84°F., one of the greatest for the Archipelago. An extreme low of -63°F. and an extreme high of 66°F. have been recorded.

Temperatures (Fahrenheit) recorded at Eureka during our residence in 1955 are summarized below:

	April	May	June	July	August	September
Mean max. temp.	- 8.6	16.2	36.6	42.4	42.8	23.7
Mean min. temp.	-22.5	1.7	31.8	35.2	34.6	16.1
Monthly mean	-15.5	8.9	34.2	38.8	38.7	19.9
Highest temp.	18.9	32.9	42.7	48.8	55.8	35.8
Lowest temp.	-43.8	-19.1	21.1	31.1	26.3	-1.8

For many visiting the high arctic, winter seems endless and the advent of spring ever so tardy, for although rising May temperatures hint of spring, the country remains cold and wintry into June. In this freezing weather there is, however, much evaporation of snow. As early as May 13, 1955, snow rapidly disappeared on a ridge 2000 feet above sea level. Although the maximum temperature at Eureka that day was only 8.5°F., the dark rocks of the ridge absorbed enough heat to melt the snow about them. A peculiar phenomenon, noticeable at this time, was the gray, sand-covered snow which lay in quantity along banks and gullies. This gray snow, particularly on steep south-facing banks, was largely gone before the regular thaw set in. Each sand grain was a heat absorbing unit; together the grains absorbed enough heat to destroy the snow prematurely. By May 18 whole banks of snow were deeply pitted. Mud formed at the foot of some of them and here early grass appeared.

The regular thaw began in lower stream beds near the coast. On May 27, water trickled down some of the steeper

gully banks; the high recorded at Eureka that day was 30.3°F. On May 28 Eureka recorded its first above-freezing temperature for the year with a high of 32.9°F. Although the temperature dropped to a high of 24.0°F. on May 29, there were numerous slush pools in the gully beds by May 30 (high of 32.4). The next above freezing temperature occurred June 4 with a high of 32.5°F. Above these lower coastal places there was no significant thaw, and the upper slopes were white with hard snow even as late as June 4. Eureka recorded a high of 36.2°F. on June 5. Most of the land birds had arrived by this time.

On June 6 the thaw began in earnest. Eureka had an unexpected high of 40.2°F., and the country was transformed from winter into spring in what seemed to be a single day. A river of slush crept down the dry bed of Station Creek, spilling over the ice of the fiord. The fast waters of the creek could hardly be forded the following day, and a lake formed on the ice beyond the delta. At one point the rushing fresh waters cut through the sea ice and a dangerous whirlpool formed. Within the week the first of the truly aquatic birds arrived.

Temperatures did not again reach 40°F. until June 18. Much of the snow was gone and ill-defined leads had formed along the coast by that time. Tidal action at Slidre Fiord is slight, extremes of high and low tide being less than two feet apart. According to Tener (1954:3) this suffices to

break the ice along the shore and to form leads. Some inland lakes accommodated water birds as early as June 14; others retained ice as late as July. At Eureka the highest June temperature, 42.7°F., occurred June 30. There was no snow on low level ground by that time.

The shore leads of Slidre Fiord were very wide by mid-July, and boating up and down the coast was possible. The main body of ice commenced breaking at the head of the fiord and by late July it was breaking everywhere. On August 1 we boated across the fiord straight away from Eureka. Snow fell several times during the summer. All hills over a thousand feet high were white with new snow July 28. Temperatures topped 50°F. only twice at Eureka--50.6°F. and 55.8°F., on August 5 and 7, respectively.

All fresh waters froze over solid September 4-5. Slidre Fiord remained open nearly two weeks longer. New ice along the shore forced us to stop dredging after September 11. From the hills north of Eureka I detected no open water on the fiord September 17, but water-clouds hung low over Eureka Sound.

Precipitation. The Canadian Arctic Archipelago is one of the driest regions in the world; it is comparable to deserts of temperate latitudes (Rae, 1951:16). North of the Parry Islands the annual precipitation is less than five inches, but it increases south of there; at Eureka it is less than two inches. The extreme dryness is not apparent to the

casual observer, for the snow that collects on the lea of slopes and in depressions and gullies is often very thick. Snow-banks 100 feet high and slopes waist deep in snow are not exceptional in late winter and spring. All this gives the impression of heavy snowfall. But nowhere did we find areas that were difficult to cross on foot. Even much of the drifted snow was hard and supported a man's weight. With the coming of the thaw and cloudy weather the country appeared anything but dry. From the second week of June to early July mud was everywhere except on the gravel banks and rocky ridges, but a thin crust soon dried and walking became easier. In August most areas still did not look like desert. The rivers, though reduced to mere creeks, were fed by the last snows of the high interior and vegetation was lush about the ponds. The high relative humidity, fog, and drizzling rain abetted this illusion. Only after the September freeze-up did the land take on the dreary, dry, monotonous appearance of desert. Even then the stormy weather made the dry land seem wet.

The peninsula has experienced above-normal precipitation. As much as 2.49 inches of rain fell in August, 1953, and 1.48 inches fell in July, 1954. The effects of two consecutive wet summers were a slight rise in the water-level of lakes and ponds, "fair amounts" of water in streams until freeze-up, a more lush growth of plants in the better vegetated areas, a retarded growth in some species of plants, and a greater abundance of mosquitoes (Bruggemann, 1954).

The dryness of the Fosheim Peninsula in 1955 is shown in the table below:

	April	May	June	July	August	September
Rainfall (in.)	0.0	0.0	0.22	0.26	0.07	trace
Snowfall (in.)	0.8	0.2	0.08	0.2	trace	1.9
Total (in.)	0.08	0.02	0.3	0.28	0.07	1.9
No. days of measurable precipitation	7	2	7	7	3	6
Depth of snow last day of month	7.0	6.5	0.0	0.0	0.0	1.0

Cloud and Fog Conditions. Arctic cloud and fog conditions are related directly to open water. In the high latitudes cloudiness and fogginess accompany the June thaw, climb to a maximum in summer, fall off sharply after the freeze-up in September, and reach a minimum in winter. Low overcast and clammy mist are characteristic of the Canadian Arctic Archipelago during late spring and summer. Resolute recorded only 48 hours of sunshine out of a possible 662 hours in August, 1948 (Rae, 1951:4). Eureka is said to be one of the sunniest places in the Archipelago. Why this is so I do not know. Possibly the great land masses surrounding Fosheim Peninsula have something to do with it. I could not fail to notice that when gray clouds hung low over most of the land, a strip of blue sky often showed above the glacier-covered Sawtooth Range. When the sky was everywhere clear, clouds and fog banks often hung above the open waters of the sea.

During our residence on the Fosheim Peninsula, we had many sunny days in April and May, fewer in June, July, and August, and fewer still in September. Maximum and minimum ceilings recorded at Eureka in 1955 are summarized below:

	Max. Ceiling (hundred feet)	April	May	June	July	August	September
no. of days	no ceiling	27	30	23	23	22	19
	150 - 200	1		1		3	1
	100 - 149			1	1	2	2
	50 - 99	2	1	4	6	4	6
	10 - 49			1	1		1
	5 - 9						1
	- 5						

	Min. Ceiling (hundred feet)	April	May	June	July	August	September
no. of days	no ceiling	10	17	5	4	5	3
	150 - 200	3		1	1		
	100 - 149	1	1		2	3	1
	50 - 99	3	9	6	7	11	4
	10 - 49	7	4	15	12	9	10
	5 - 9	3		2	5	3	4
	- 5	3		1			8

Rae (1951:27-29) states that visibility in arctic regions is generally best during late spring before there is extensive open water and when temperatures are sufficiently high to reduce ice crystal fog (water vapor condensed as ice crystals). Visibility, reduced as it was by blowing snow, rain, and fog, was poorest in April and September in 1955. The maximum and minimum visibility recordings (up to 20 miles) at Eureka are summarized below:

Max. Visibility	April	May	June	July	August	September
20 miles	18	24	21	28	28	21
15 miles	7	6	9	3	2	4
5-10 miles	5	1			1	3
- 5 miles						2

no. of days

Min. Visibility	April	May	June	July	August	September
20 miles	5	18	10	16	19	6
15 miles	5	4	12	4	3	4
5-10 miles	4	2	3	9	6	5
- 5 miles	16	7	5	2	3	15

no. of days

Winds. In summer the entire Canadian Arctic Archipelago is in a very flat high pressure area; there is a shallow low over Baffin Bay, and consequently the pressure gradients are weak and poorly defined and wind directions are governed chiefly by land and sea breezes, local topography, and travelling cyclones (Rae, 1951:32-3). In 1955, southwest winds were very infrequent. The prevailing winds in April and May were eastern; in June, northwestern and southeastern; in July, northwestern; in August, northwestern and southeastern; in September, northwestern.

According to Rae (1951:33-4) the mean annual wind-speed of the Archipelago is not appreciably different from that of southern Canada, calms are most frequent in late winter or early spring, and mean wind-speeds are usually highest in September and October. In 1955 the largest number of calm periods occurred in April and May, July was the windi-

est month, and the greatest wind velocity (40 mph) occurred April 19-20.

Snow crystals in the Archipelago are usually small and sandlike. According to Rae (1951:30) these are easily picked up and carried aloft by winds of 15 mph or more. Visibility is reduced to near zero in winds greater than 40 mph, a fact that was very apparent to us during a blizzard April 19-20. This sandlike snow blows back and forth across the high arctic throughout the cold months. The sweeping action of the wind, the low precipitation, and the peculiar snow flakes give the high arctic the sharp contrast of deep, compact drifts and snow-free areas.

On May 18 we saw snow funnels or tornadoes on the tundra plain west of Black Top Ridge. Some of the funnels rose several hundred feet and were spectacular, to say the least, against the cloudless sky.

Relative Humidity. According to Rae (1951:35) average relative humidities over the Polar Sea and Canadian Arctic Archipelago have a mean winter value near 100%. There is a gradual decrease in mean relative humidity after April, a low point being reached in summer when temperatures are highest, and a gradual increase with decreasing fall temperatures. The average relative humidity of the Archipelago in July is 83%. Eureka has had July averages as low as 76%. Extremes of relative humidity recorded at Eureka from mid-April through September, 1955, were:

Relative humidity (%)	April	May	June	July	August	September
Maximum	92	96	100	100	100	96
Minimum	68	59	66	48	50	52

Vegetation

The vegetation of the Fosheim Peninsula is thin and scattered. Nowhere are the woody plants more than a few centimeters high. Willow (Salix arctica), dwarfed and spreading, is abundant, but it does not cover the ground. Employing the Clark Point Sample Method in an extensive area of variable habitats north of Slidre Fiord, Tener (1954:8-33) found that only 14.5% of his sample had vegetative cover. Gravel, rock, silt, and clay covered 85.5% of the surface. The most abundant plant species was an avens, Dryas integrifolia, although collectively three grasses of the genus Poa were more abundant. Willow was second. Poa was present in 299 of 10,000 points (in 1000 quadrats) checked, Dryas integrifolia in 269, Salix arctica in 248, Carex rupestris in 181, the grass Alopecurus alpinus in 108, and the grass Agropyron latiglume in 72. Mosses and lichens were uncommon.

Arctic vegetation furnishes an index to micro-climate, macro-climate, and relief. Certain flowering plants indicate the extremes of micro-climate and relief, for plants of the same species bloom at wholly different times even though not far apart. Long after Saxifraga oppostifolia had ceased blooming on the warm lowlands in 1955, it bloomed for the first time near the retreating snows of the high interior in

late summer. Plants were unbelievably late in blooming on the bleak lowlands of Iceberg Point. The relationship between vegetative cover and snowmelt was close. Lowland areas which were snow-free in winter had comparatively few plants. Here the surface dried rapidly after the thaw. Areas rich in vegetation almost invariably were snow-covered in winter and remained wet until August. Plant density often attained a maximum at the edge of slowly receding snows. Here arctic heather (Cassiope tetragona) grew profusely, darkening the landscape. These so-called "snow patches" were wide-spread but local. Heather occurred in only 15 of the 10,000 points in Tener's (1954:33) sample.

There was much hummocky tundra on the inland plains, especially on the broad ridges and in areas bordering marsh. Much of this tundra was thinly covered with snow that thawed rapidly. Sheltered places between the hillocks trapped moisture and the vegetative cover was good. Many birds nested in this habitat.

Marshy ponds upgrown to sedges (Carex, Eriophorum) were common, but some of these fresh waters were devoid of plant life. In general, vegetation was most lush about ponds in valleys or depressions. Even on the Iceberg Point barrens low ponds were sedgy.

The slopes about Slidre Fiord are mostly non-vegetated and the region has a desolate appearance. To the north the greenest land is near Eastwind Lake. To the south, where

there are few lakes, vegetation reaches its greatest density in the old creek beds. The plain east of Black Top Ridge supports much vegetation. According to Bruggemann (1954), several plants grow here, and probably nowhere else, on the peninsula. The high ridges and mountains are mostly barren, though I saw plants at 3000 feet. On the west front of Black Top Ridge vegetation was dense along certain creeks, but not elsewhere.

Flora and Fauna

In the main body of this dissertation I discuss the relationships of the more important plants and animals to each species of bird. Since the flora and fauna of the peninsula are fairly well known, I made no attempt to list all of the species that have been seen or collected there.

In 1953-54 Bruggemann, at that time of Canada's Department of Northern Affairs, studied the flora. He found about 100 species of flowering plants, including the rare Geum rossii. In 1955 MacDonald collected a few plants. MacDonald and I found Geum rossii not only on the peninsula but also, on July 23, on Axel Heiberg Island (80°42'40"N. 90°59'W.).

Several persons have studied the fauna of the peninsula. C. O. Handley noted birds and mammals during his brief visits to Slidre Fiord August 9-10, 1947, and August 28, 1948. D. Hatfield, officer-in-charge at Eureka in 1949, supplied

Handley with additional notes on the birds and mammals of the region. In 1951 Tener, Canadian Wildlife Service, studied the muskox herds in conjunction with the range studies mentioned earlier, and this work was continued by Bruggemann in 1953-54. Bruggemann studied insects too, and, like Tener, made a cursory study of the birds. In 1955 MacDonald collected marine invertebrates, fishes, birds, and mammals. The geologist Troelsen (1952:209-10) collected some plants and insects and noted the wildlife, particularly the mammals, during his stay on the peninsula in 1952.

In 1955 mosquitoes emerged in late June and reached maximum abundance three to four weeks later. We last saw them August 22. MacDonald found them very abundant on the eastern plain in late July, but west of there they were local and presented no problem. North of Slidre Fiord they were most abundant at Eastwind Lake. We did not find them at Iceberg Point, July 10-12.

The mammals of the peninsula always have had special appeal for explorers and investigators. Fosheim (in Sverdrup, 1904, 2:281, 283) stated that there were "animals without end," that every day they passed "herd after herd of polar oxen," and that "certain places simply swarmed" with hares. Fosheim's "polar oxen" are still abundant, and enormous numbers of arctic hares (Lepus arcticus) have been seen there since his day. In 1955 the hare was the most abundant mammal. It was especially common on the higher ridges. Although the

largest group (Fig. 5) we saw numbered only 17, the thousands of tracks leading in one direction suggested mass migration or irruption. The arctic fox (Alopex lagopus) was conspicuous at Eureka, where it pilfered food scraps. Elsewhere it was common, and we saw it or its tracks nearly everywhere. Foxes were the chief mammalian predators of birds. Another fairly common predator was the arctic wolf (Canis lupus). The collared lemming (Dicrostonyx groenlandicus), so far as I can determine, has been scarce on the peninsula from 1947 to 1955 inclusive. This seems strange in view of the fact that foxes and long-tailed jaegers (Stercorarius longicaudus) have been abundant. During our residence we saw only four lemmings, one of which was a small young one dead in a nest. From their tracks we judged that they continued to increase slightly throughout our stay. The arctic weasel (Mustela erminea) was exceedingly rare; we noted its tracks only once. The white-faced muskox (Ovibos moschatus) was common and conspicuous whereas the Peary's caribou (Rangifer pearyi) was rare. We saw only three caribou on the peninsula, but I saw a herd of 11 on the Schei Peninsula, Axel Heiberg Island, July 25. Although not a true predator, the muskox probably destroys many bird nests by stepping on them. Herds (Fig. 6) often remain in an area for several days, and the hoof prints of even a few animals are thickset and deep. On occasion I drove muskoxen from areas containing nests under observation. Although usually seen singly or in small groups of less than

a dozen individuals, a herd seen by us numbered 78--a truly remarkable gathering. Hoof prints of muskoxen were as characteristic of the summer tundra as dryas and willow. The prints remain preserved for years in this desert country.

The marine waters were as poor in mammals as the land was rich. Troelsen (1952:210) frequently observed seals on the sea ice of Canyon Fiord, Greely Fiord, and Eureka Sound, but we saw very few. The only species we identified with certainty was the ringed seal (Phoca hispida). Under the circumstances it did not surprise us that we saw no polar bears (Thalarctos maritimus). Tracks of the polar bear were found near Iceberg Point by Fosheim (in Sverdrup, 1904, 2: 275). Notes on the species are recorded in the Eureka files, but these notes are vague. Sverdrup (1904, 2:189) found the species fairly abundant farther south in Eureka Sound.

Eskimo Habitations

No Eskimos inhabit Ellesmere Island today except for a few families at the Royal Canadian Mounted Police posts at Alexandra Fiord and Craig Harbour on the east and south coasts respectively. None of these people are native to the island. They have been brought in from the outside as guides for police patrols. Old Eskimo camp sites are widely scattered along the coasts, even up through Eureka Sound. One of these is on the north shore of Slidre Fiord several miles east of Eureka.

Visits to Regions other than Fosheim Peninsula

During May and July we accompanied a Canadian geological expedition to several regions west and north of the Fosheim Peninsula. These trips were first undertaken by snow-equipped aircraft and later by land-based helicopters. From one to six hours were spent at each of the following places:

May 13-14. Strand Fiord, west coast, and Mökka Fiord, east coast, Axel Heiberg Island;

July 23. 80°42'40"N. 90°59'W., 18 miles northwest mouth of Stang Bay, east coast Axel Heiberg Island;

July 24. 80°46'N. 88°23'40"W., 18 miles southeast of Otto Fiord, northeast coast Nansen Sound, Ellesmere Island;

July 24. 80°57'N. 88°44'W., south shore Otto Fiord, Ellesmere Island;

July 25. 81°18'40"N. 92°40'W., eight miles southeast Cape Stallworthy, north coast Axel Heiberg Island;

July 25. 80°20'N. 89°16'W., five miles west Flat Sound, east coast Axel Heiberg Island;

July 25. 80°12'N. 87°54'W., three miles northeast isthmus of Schei Peninsula, east coast Axel Heiberg Island;

July 26-27. Mökka Fiord.

Ornithologically, the most significant result of these trips was our failure to find gull and alcid colonies from the west end of Greely Fiord northward on both sides of Nansen Sound nearly to Cape Stallworthy on the Polar Sea. From a helicopter we had an excellent view of magnificent cliffs that towered precipitously 2000 feet or more above

the sea. I attributed the complete absence of sea birds to the closed sea. Shore leads at that late date were narrow, and in most cliff areas ice locked the shore. Other significant finds were: many large flocks of greater snow geese (Chen hyperborea atlantica) on Axel Heiberg Island; a displaying Baird's sandpiper (Erolia bairdii) on Axel Heiberg Island; and a small breeding colony of ringed plovers (Charadrius hiaticula) southeast of Otto Fiord.

In addition to the above, V. Sim and M. Marsden noted the wildlife of the Caledonian Bay area of Canyon Fiord east of the Fosheim Peninsula July 23-27, and R. Thorsteinsson recorded the activities of geese at Strand Fiord August 1-18.

CHAPTER III

BIRDS OF THE FOSHEIM PENINSULA

The birds of northwestern Ellesmere Island have received little attention from ornithologists. Since waters along the west coast of Greenland have at times been navigable, several early explorers were able to reach northeastern Ellesmere Island and the reports concerning their expeditions included some bird material. The Nares Arctic Expedition visited the north coast in 1875-76. In 1882-83 the United States Expedition to Lady Franklin Bay explored the interior of Grinnell Land and reached Greely Fiord; but the west coast of Ellesmere Island was not explored in its entirety before 1901, when the Norwegian Polar Expedition (Second Fram Expedition of 1898-1902) travelled north through Eureka and Nansen sounds all the way to Lands Lokk and in so doing nearly encircled the Fosheim Peninsula. Both the Crocker Land Expedition (1913-17) and the Danish Thule-Ellesmere Island Expedition (1939-41) touched on the peninsula. All of these parties, including RCMP patrols, travelled by sledges. Those that visited the Fosheim Peninsula and adjacent areas did so before the spring thaw and consequently before arrival

of most birds. The only mention of birds by Fosheim (in Sverdrup, 1904, 2:275) concerns a few ptarmigan tracks seen near Iceberg Point May 6, 1901. The birds of this region were practically unknown before the establishment of Eureka at Slidre Fiord. However fragmentary, the ornithological records of Handley, Hatfield, Tener, Troelsen, and Bruggemann form an invaluable background to this dissertation. Bruggemann, especially, contributed much basic data on the birds of the peninsula. Both Handley and Tener collected bird specimens. Those taken by Tener have been carefully examined and reported on by Godfrey (1953:89-93).

These investigators saw a grand total of 20 bird species. We added three more. Of the 23, seven were rare, nine were decidedly uncommon, three were fairly common, and four were common and widespread. The nests of 15 of the 23 species have been found, and the finding of unfledged young and adults with brood patches indicates that at least four more species nest there. In any event, the avian breeding density of this high-arctic locality is not by any means as great as that of many low-arctic areas. Brandt (1943:169-70) found "more than 500 nests of Alaskan shorebirds" at Hooper Bay with the help of several Eskimos, but no such feat would be possible at 80°N. in either the new world or the old. The birdlife of the Fosheim Peninsula is a remarkable mixture of new world and old world forms. Several of the species are at the very northern, eastern, or western edge of their range. Not

only are they local or thinly dispersed, but they are also skittish and difficult to approach. Feilden (1877:403) was struck with the "extreme shyness" of birds in the far north.

From what I gather, the total bird population of the Fosheim Peninsula (i.e., the total number of individual birds) is probably greater than that of other known areas of similar size in the high latitudes of Canada. The number of species is lower, however, even than that of more northern coasts of Ellesmere Island. Noteworthy is the fact that not a single alcid is known to inhabit the peninsula or adjacent waters, and not even the common eider (Somateria mollissima) has been identified with certainty. These voids themselves could account for the paucity of species. The purple sandpiper (Erolia maritima), found nesting at 76°30'N. in King Oscar Land by the Second Fram Expedition (Schaanning, 1933:156), the parasitic jaeger (Stercorarius parasiticus), found nesting at 82°N. in eastern Grant Land by MacMillan (1918:404), and the ivory gull (Pagophila eburnea), found nesting at 79° 41'N. near Cape Hayes, Grinnell Land, by Feilden (1877:409), are three well-known species which were not seen by us in 1955. Too, we failed to note the following species that have been seen in other parts of Ellesmere Island: fulmar (Fulmarus glacialis), reported by Feilden (1877:410) and Bay (in Sverdrup, 1904, 2:482); gray sea eagle (Haliaeetus albicilla) and golden plover (Pluvialis dominica), reported by Greely (1886, 2:378); black-bellied plover (Squatarola squatarola),

reported by MacDonald (1953:8); kittiwake (Rissa tridactyla), reported by Greely (1886, 2:374) and Bay (in Sverdrup, 1904, 2:480); iceland gull (Larus leucopterus), reported by Greely (1886, 2:374); and Sabine's gull (Xema sabini), reported by Greely (1886, 2:374) and MacMillan (1918:406). Finally, we did not find either the rough-legged hawk (Buteo lagopus) now known to breed as far north as Prince Patrick Island (MacDonald, 1954:225) or Ross's gull (Rhodostethia rosea), whose nesting in the new-world arctic has yet to be confirmed.

In the species accounts below, I follow Johansen's (1956) recent handling of the various arctic subdivisions. The Fosheim Peninsula lies far north of the southern boundary of the Canadian high arctic. The high arctic, in this sense, comprises all regions with a July air temperature mean below 41°F.

CHAPTER IV

RED-THROATED LOON

The red-throated loon (Gavia stellata) is a circumboreal species that breeds from the upper coniferous forest zone to the extreme northern limits of land. It inhabits almost the entire Eurasian tundra region (Pleske, 1928:347). In Greenland, where it is the "most wide-spread" water bird, it is "found virtually on all coasts," being scarcest on the north coast (Salomonsen, 1950:13). In arctic Alaska it is the "most common diver," being "very common around Barrow and to the eastward" (Bailey, 1948:143-4). It ranges over all of Canada, breeding "north of regular settlement through the Arctics" (Taverner, 1947:40).

Ellesmere Island. Feilden (1877:411) thought he saw a red-throated loon (September 2, 1875) on the north coast where both MacMillan (1918:403) and MacDonald (1953:7) later found the species breeding. On the east coast in 1883, one was collected at Cape Baird on June 18, and a pair was seen near Dutch Island on July 18 (Greely, 1886, 2:372). The species was not common in King Oscar Land where, according to Bay (in Sverdrup, 1904, 2:481), two were shot; Schaanning

(1933:149) said that a clutch of two eggs was collected there July 21, 1901.

The red-throated loon has been uncommon on the Fosheim Peninsula. Tener (Godfrey, 1953:89) believed that two pairs bred about Slidre Fiord in 1951. Bruggemann (1953, 1954) believed that one pair nested there in 1953; in 1954 he saw four birds alight on a pond already occupied by a nesting pair. In 1955 we found it thinly dispersed. Probably not more than four pairs nested among the numerous ponds between Slidre and Greely fiords. No other loon is known to inhabit the region.

Axel Heiberg Island. At 80°12'N. 87°54'W. on the Schei Peninsula, we noted a pair with two downy young near a nest on July 25.

Arrival. Salomonsen (1950:18) states that the red-throated loon arrives in high-arctic Greenland from early to mid-June, three to four weeks later than it does farther south, and when the "sea is still covered with ice and the fresh-water lakes are still frozen over." On the north coast of Ellesmere Island, MacDonald (1953:7) first noted the species on July 19 (one bird).

At Slidre Fiord in 1951 Tener (Godfrey, 1953:89) first noted the species on June 16 (one pair). In 1953 Bruggemann (1953) first noted it on June 19 when he saw two birds, possibly a pair. In 1954 Bruggemann (1954) first observed it June 26 (one pair), and the birds were inland, not

on the fiord. In 1955 we first observed the species on June 11 when a single individual alighted on the inundated sea ice near Station Creek delta, five days after the stream first flowed. On June 18 MacDonald saw one far out in a lead extending across the fiord west of Eureka and Sim and Marsden saw one on a lake 18 miles northeast of the head of Slidre Fiord. They had not seen one there June 14, although the lakes had been partially open and were occupied by other water birds.

We did not observe red-throated loons at Slidre Fiord again until July. Whether the loons were paired on arrival is questionable. They return to Greenland breeding areas singly and in full summer plumage (Salomonsen, 1950:18). We witnessed no courtship at the fiord but later saw courtship displays at a nesting pond.

Nesting. A nest found in 1951 by Tener (Godfrey, 1953:89) at a pond south of Eastwind Lake was more than likely the same one found near the tip of a narrow "tongue of partly-submerged land" by Bruggemann (1954) in 1954 and by us in 1955. Sutton (1932:22) noted the re-use of nests on Southampton Island. The Fosheim Peninsula nest was a conspicuous mound of mud and plant debris with a bowl at the top. Its size alone suggested long use. When first seen by Tener on June 23 there was one egg; by Bruggemann on June 26, two eggs; by us on June 28, two eggs. The incubating loon could easily be seen a half mile away from higher ground. The eggs

were not pipped when last checked July 15, 1955. MacDonald found the nest empty on July 30 and a single young and its parents on the water near by. In 1954 Bruggemann had a similar experience in finding the nest empty and only one chick thereabout on July 19. Sutton (1932:22) states that the period of incubation is about 29 days.

On July 2 Sim and Marsden observed three loons on lakes near Iceberg Point. MacDonald and I visited this area on July 11 and found a remarkably fearless loon on its nest in one of the marshy networks of small ponds. The nest was an inconspicuous shelf of mud at the edge of a grassy islet 20 feet from shore. I collected the two eggs, which were nearly fresh, and the incubating female.

On July 18 MacDonald spotted a red-throated loon on its nest from a helicopter while flying over marshy tundra 18 miles east of Slidre Fiord.

While observing the nesting loons south of Eastwind Lake, we noted that one of the pair often flew directly south towards the fiord. Since no ponds were along the flight line, the birds probably went to the fiord where we occasionally saw them feeding in wide leads along the north shore during July. The largest number observed by us there at one time was seven (July 18). They were scattered widely along a six-mile stretch of shore. Salomonsen (1950:19) states that in Greenland the majority of red-throated loons "appear to be dependent on the sea for food" and that there is a "consider-

able traffic in the air between the breeding-places and fjords." On Southampton Island red-throated loons "procure most of their food in the salt-water" (Sutton, 1932:22).

On the open waters of Slidre Fiord we noted three red-throated loons August 4; one August 5; one August 7; three August 13; five, including a flock of four, August 20; three August 23; two August 28; and two August 29.

Departure. Fall migration in high-arctic Greenland takes place from early to mid-September (Salomonsen, 1950:21). MacDonald (1953:7) last noted the species on the north coast of Ellesmere Island on August 22 (two birds). Bruggemann (1953, 1954) observed it last at Slidre Fiord in 1953, on June 25 (one bird); in 1954, on August 4 (two birds). We do not know when the loons left inland waters in 1955. On September 4 Eastwind Lake and adjacent ponds were fast freezing over and no loons were there. In Greenland, red-throated loons desert the fresh water altogether in latter August (Salomonsen, 1950:21). At Slidre Fiord I heard one offshore from Eureka on September 1 and 3. Sim and Marsden saw one east of Eureka near the fiord shore on September 6. We last recorded the species September 10. MacDonald saw two flying southwestwardly together high over Slidre Fiord at 3:00 p.m. By September 15 the fiord was freezing rapidly.

Description of Specimens. The Iceberg Point female (DFP 110) measures: wing, 280 mm.; tail, 53; culmen, 52; tarsus, 68 (ovary 45 x 36; largest ovum, 24 x 20). It showed

no molt; its stomach held a few fish vertebrae. The eggs (DFP 55-10) measure 71.0 x 45.0 and 70.0 x 45.5.

Annual Breeding Cycle. Red-throated loons appear singly and in twosomes on leads in Slidre Fiord from about June 10. Inland flights to fresh waters commence shortly after mid-June. The preferred nesting places are grassy lowland tundra ponds, not large deep lakes and sterile mountain ponds. Egg-laying takes place from about June 20 to about July 10. Both sexes incubate and attend the young. Hatching occurs as early as July 19. Allowing 29 days for incubation, hatching at one nest (Iceberg Point) would have taken place about August 7. Adult loons commonly feed in Slidre Fiord all summer. The species leaves the Slidre Fiord area by mid-September.

CHAPTER V

GREATER SNOW GOOSE

The breeding distribution of the greater snow goose (Chen hyperborea atlantica), a nearctic bird, is poorly known. Two small colonies in the Thule District, Greenland, are only an offshoot of the American population, but they have been reported repeatedly (Salomonsen, 1950:69). Ornithologists agree that this bird breeds at high latitudes in eastern parts of the Canadian Arctic Archipelago. A female and a downy young were collected on Somerset Island on July 18, 1938 (Shortt and Peters, 1942:341). Clear cut information exists concerning its nesting on Bylot Island and in northeastern Baffin Island. It has also been found nesting on Devon Island (White and Lewis, 1937:443), Ellesmere Island (MacDonald, 1953:7), and Axel Heiberg Island (Porsild, 1955: 64-5).

Ellesmere Island. Feilden (1877:401-12) did not record the greater snow goose, but Greely (1886, 2:376) mentioned two pairs seen in 1882--one near Fort Conger on June 12, the other at Sun Bay (Grinnell Land) on June 13. Bay (in Sverdrup, 1904, 2:477-83) did not list it for King Oscar Land.

Occasional migrating flocks have been seen in June at Craig Harbour, and Eskimos have reported its nesting at Lake Hazen (White and Lewis, 1937:442). MacDonald (1953:7) found it uncommon on the north coast (Alert); he secured a well-grown but flightless young bird at the head of Hilgard Bay on August 10, 1951. Handley (unpubl. ms.) collected nine adults 12 miles northeast of Eureka on August 9-10, 1947. The form nests on the Fosheim Peninsula. In 1955 it was the sixth commonest bird, only the snow bunting (Plectrophenax nivalis), turnstone (Arenaria interpres), knot (Calidris canutus), long-tailed jaeger, and old-squaw (Clangula hyemalis) being commoner.

Arrival. At Thule, Greenland, the greater snow goose arrives in early June (Salomonsen, 1950:69). MacDonald (1953: 7) first noted it at Alert on June 13 (seven birds) in 1951. Bruggemann's (1953, 1954) records for Slidre Fiord are: 1953, one bird May 13, two birds June 12; 1954, two birds June 5. In 1955, Sim and Marsden first recorded it on June 1--a flock of 10 birds flying north several miles east of the head of Slidre Fiord. They continued to see it there--the largest flock (27 birds) on June 3. Some pairs appeared to have reached their breeding places as early as June 4, i.e., they did not migrate farther north. In 1955, most of the geese migrated east of Black Top Creek, and they were not often seen near the fiord west of Eureka where, on June 17, Mac-Donald collected the male of a pair flying east. It was the

only greater snow goose taken by us on Fosheim Peninsula.

Nesting. Since the establishment of Eureka in 1947 there have been numerous reports on the nesting of snow geese in the vicinity. Some of these reports, recorded in the station yearbooks, are vague. According to the 1947 yearbook, one pair nested near a small tundra pond close to Eureka. That year Handley (unpubl. ms.) was told that geese had nested at two "large lakes" 12 miles northeast of Eureka, but when he visited the nest area on August 9-10 he saw 150 adult birds, but no young.

In 1953 Bruggemann (1953) found the remains of a goose nest in the narrow gravel belt between the tundra and the beach of Slidre Fiord east of Black Top Creek on June 23. The nest had been "destroyed by wolf." On the south shore of Greely Fiord he saw a pair of geese with four downy young on July 11. In the vicinity of Eastwind Lake he recorded a pair with downy young on July 12; four pairs, with seven, five, four, and one young respectively, on July 22; 10 pairs with 30 or more young on July 23. He later estimated that there were 30 adults and fifty goslings there. At a small pond near Eureka he saw two pairs with six young "barely able to fly" on August 19. In 1954, he found a nest with seven eggs on a point of land in a pond south of Eastwind Lake on June 26. On July 15 the nest and egg remains were scattered. On August 5 he saw a pair with one young on the Fosheim Peninsula; on August 19 four adults and four young.

Almost the entire population of snow geese in the Slidre Fiord area failed to nest in 1955. We first thought these large numbers of non-breeding birds were immature, and probably many of them were. But in watching the flocks, we noted that many geese moved about in groups of two. The flocks seemed to be composed mostly of paired birds. Some of these geese engaged in courtship after the usual egg-laying season. On June 18, at a lake 18 miles northeast of the head of Slidre Fiord, Marsden saw 13 geese which were joined by others

> until there were 18, all paired but clearly not nesting. Some were dabbling in water, others pecking about in grassy areas. One male was extraordinarily aggressive. He lowered his head threateningly, sometimes charging the others. Before and after each threat he stood on tip-toes and flapped his wings. At times he even by-passed some to reach a more distant adversary. One approached the niggly one's mate while he was away attacking a more remote member, but the aggressive one hurried back. He rushed and flushed two individuals and then followed in flight. They circled back over the flock and others joined them until twelve flew yammering up and down the valley, finally settling. These flights were frequent and I did not often see what started them off. There was no actual mating anywhere.

Sim and Marsden searched the land thereabout but found no nests.

On a small islet in one of the larger ponds south of Eastwind Lake we found the remains of a goose nest on June 28. Shell fragments were on the marsh tundra about 50 yards from the islet. We concluded that this nest was destroyed when

ice still covered the lake, for the water separating the islet from the main shore was deep. No other geese nested in the vicinity, though a number of them fed in the lush grassy areas just east of the lake. The largest number seen at the lake was 35 (flocks of 24 and 11, June 29).

During a 40-mile-hike north of Eastwind Lake June 30-July 1, we saw a number of snow geese but found no evidence of their nesting. The largest flock seen numbered 27. All of these birds could fly and many of them were paired.

On July 2 Sim and Marsden found a nest eight miles south of Iceberg Point, three miles inland at 700 feet elevation. The goose incubated with neck outstretched along the ground while the gander stood guard near by. Once flushed, both flew out of sight. There were six eggs. MacDonald and I made a special trip to see this nest, arriving June 11 when two of the eggs were pipped. As we approached, the goose suddenly dropped her head as if to conceal herself. The gander, close by, was not aggressive. Both flew out of sight. The nest (Fig. 8) was a 14-inch-wide scrape neatly lined with small feathers and down. Tufts of moss plucked within one foot of the nest were mixed with the down. Most interesting was the habitat (Fig. 7), for this was the last place we would have looked for a nest. The ground was dry and sandy with scattered pebbly debris and practically no plants. The closest lake was five miles away.

On July 18 we found the remains of another nest.

This was near the beach of Slidre Fiord, in a vegetated, trough-like depression in the gravel of the Black Top Creek delta. A broken shell was close by. Sim and Marsden had seen a pair of geese in this area June 24, but they did not search for a nest. This site was used by geese before 1955. In pawing at the nest, the predator had exposed an old one directly beneath it.

According to Ekblaw (in Salomonsen, 1950:69) the period of incubation is four weeks. Egg-laying at one nest on the peninsula must have commenced about June 8, since the eggs were pipped by July 11. The occurrence of a brood on July 11 and another on July 12 (see above) likewise indicates the completion of the clutch before mid-June. Salomonsen (1950:69) states that egg-laying in Greenland "takes place after mid-June," hatching "about mid-July," thus allowing only 28 days or less. This accounts for the incubation period of "four weeks" but not for egg-laying.

We saw few young geese in 1955. Eureka personnel reported seeing six "gray" goslings that could "barely fly" with two old birds near the south shore of the fiord on August 25. We investigated the following day, finding four adults and four goslings on a delta well back from the beach. Three adults immediately flew off, but the fourth led the young to water. In a boat we followed the swimming birds. About a mile from shore we overtook them; now two of the young flew strongly up-fiord, but the other two, after making

several short flights, made no further attempt to rise from the water. The diving ability of these two birds was amazing. One dove to a depth of five or more feet and swam 20-30 yards before surfacing. This it did repeatedly for 20 minutes. Finally we caught and banded it (498-54904). When released on the beach, it ran clumsily, dragging its wings as it went. Almost immediately a glaucous gull (Larus hyperboreus) attacked and would surely have killed it had we not intervened. We then tried to run the gosling down, but when cornered it flew 50 yards and flopped into the water. We abandoned the chase.

The species displays more latitude in choice of nest-site than any other bird of the peninsula. It places its nest just above the beach very near salt water, on a river delta, at the edge of or on an islet in a fresh water pond, and far from water on a high desolate slope. Its choice of nest-site, in the long run, is all-important to its nesting success. Throughout our residence we carefully noted the movements of two major goose predators--the fox and wolf. These animals regularly patrol the shores of both fresh and salt waters. Snow geese nesting there are in great danger of losing their eggs. So common were foxes and wolves in 1955, that I wondered how a goose nest on any shore could escape destruction. A nest in the desolate interior, on the other hand, is comparatively safe from these predators. One has to note the movements of the predators day after day to appreciate this fact.

Why so few geese nested on the peninsula in 1955 I do not know. True, the spring thaw was late; but the 1954 thaw was early and only a few geese nested that year. Bruggemann (1954) calls attention to the "striking contrast" between the abundance of nesting geese in 1953, and their scarcity in 1954. In 1951 Tener (Godfrey, 1953:89) "encountered no evidence" of nesting on the peninsula. Greater snow geese may rotate their nesting sites as appeared to be the case on Bylot Island in 1953 (Scherman, 1956:231); but geese were on the breeding grounds of the Fosheim Peninsula in large numbers in 1955. Most of them simply did not nest. Whatever the causes, the geese do not breed successfully on the peninsula each year. When conditions are right they probably form loose colonies and produce many young; otherwise only a few nest in widely separated pairs.

Molt. According to Salomonsen (1950:69) adult greater snow geese in Greenland regularly shed their remiges in late July, and some "immature, non-breeding" birds regain their flight powers by August 6. This gives the impression that non-breeding birds molt early, a probability confirmed by our Fosheim Peninsula observations. Tener (Godfrey, 1953: 89) saw 32 flightless geese as early as July 8 in 1951. Flights of geese fell off sharply after July in 1955. Whether these early-molting birds are immature or adult or both is uncertain. The 150 adult (possibly subadult) geese seen by Handley on August 9-10, 1947, all were able to fly.

Departure. The southward migration of greater snow geese from northern Greenland occurs "slightly before mid Sept., as soon as the moult is finished and the young are fledged" (Salomonsen, 1950:70). Non-breeding birds leave the Fosheim Peninsula much earlier. We saw flocks migrating south before some goslings fledged. On August 20 a clamorous flock of 30 flew directly south several thousand feet above ground. Another clamorous flock of 36 flew directly south high above the peninsula on August 23. Most of the geese were gone by August 26. In 1954 Bruggemann (1954) saw 215 geese on August 20, but none after that. The latest record I have for the species on the peninsula is August 28 (1955). Six adults and five young birds, all flying well, were seen by Eureka personnel on the fiord on that date.

Axel Heiberg Island. Our record for Axel Heiberg Island is noteworthy. On July 23 MacDonald and I spent several hours at 80°42'40"N. 90°59'W., 18 miles northwest of the mouth of Stang Bay. In high, rocky, well-vegetated country about three miles from the coast, we collected a pair of greater snow geese and their two downy young at a small completely-thawed lake. The adults had not yet shed their remiges. Within a mile of there we saw six adults upslope from a still partly-frozen lake. The geese stood in pairs but no young were with them. From the helicopter we counted over 400 adults (no young), scattered in groups up to 30, on lakes and ponds of the Schei Peninsula. All of them appeared

to be molting and flightless. They invariably bunched when we passed above them. A separate pair had several small young.

On July 25, at 80°20'N. 89°16'W., five miles west of Flat Sound, I found old broken shells of goose eggs. They were between low rocky ridges on a well-vegetated slope not far from a series of tiny tundra ponds. At 80°12'N. 87°54'W., on the Schei Peninsula, I saw four flocks (25-30 birds in each) of snow geese that apparently were flightless and without young. Two of these flocks occupied one lake.

R. Thorsteinsson also observed this species on the west-central coast of Axel Heiberg Island. August 1-3 he saw a pair with three large, flightless goslings on a small lake near South Fiord. At another lake, several miles away, he noted 30 adults. When first observed August 9, about half of these were flightless; all flew well by August 13. At Strand Fiord, August 18, he saw two widely separated groups, one containing six adults and 14 young, the other, 16 adults and 14 young. None of these birds were flightless. It is now certain that this species breeds extensively on Axel Heiberg Island.

Description of Specimens. Measurements (in millimeters) of two adults collected on Axel Heiberg Island July 23, 1955 are:

DFP No.	Sex	Wing	Tail	Culmen	Tarsus
118	female	433	131	58	79
117	male	444	144	69	86

DFP 117 weighed seven pounds one ounce; its testes measured 15.0 x 8.0 mm. and 13.0 x 6.0. It did not have a brood patch. DFP 118 weighed five pounds nine ounces; its ovary measured 29.0 x 2.5, its largest ovum, 0.2. A brood patch was present. Neither specimen was fat; both had recently eaten grass.

Of the two downy young collected, DFP 119, a female, weighed 250 grams; its culmen measured 24 mm., its tarsus 38. It had recently eaten grass. Bill, eyes, legs, and feet were brown. There is a pronounced contrast in down color of the dorsal and ventral surfaces. The downy young illustrated in Kortright (1942:453) does not show this pronounced contrast in down color and the legs and feet are shown as pinkish, similar to that of adults. DFP 119 closely resembles the gosling illustrated in Delacour (1954:192). The upper parts of DFP 119, however, are more brownish, less grayish, and the tips of the wings are decidedly gray, being separated from the brown of the upper wing by yellow down.

Annual Breeding Cycle. Greater snow geese usually arrive at the Fosheim Peninsula in early June. The species on arrival remains inland, occurring uncommonly near the coast. The nest site is varied. Egg-laying commences before mid-June and the thawing of fresh water lakes. The clutch-size is 6-7. The female incubates while the gander stands

guard. Hatching commences as early as July 11. The young are led to water and are attended by both sexes. Fledged young occur as early as August 18, unfledged young as late as August 26. Non-breeding birds commence molting early in July, breeding birds in late July. Family groups remain inland or at the coast until their departure. Non-breeding birds migrate south as early as August 20, probably earlier. Snow geese have not been observed on the peninsula in September.

CHAPTER VI

BRANT

The taxonomy of the brant (Branta bernicla) is anything but clear. Some ornithologists are of the opinion that it is a single species composed of several subspecies. If this be true, Branta bernicla is circumpolar in distribution; but if there are two full species then neither of them is circumpolar. Salomonsen (1950:85) is of the opinion that B. b. hrota, the so called light-bellied, American, or West Atlantic brant, breeds on Spitzbergen, Greenland, northern Ellesmere Island, and Axel Heiberg Island. Sutton (1932:41), Barry (1956:193), and Johansen (1956:54) believe that this race breeds as far south as Southampton Island in the Canadian Arctic Archipelago. Delacour (1954:189) and Johansen (1956:54) believe that it breeds also in the Franz Josef Archipelago. Its breeding in northern Nova Zembla is questionable. Handley (1950:128-32) found it breeding with the black brant (B. b. nigricans) as far west as Prince Patrick Island. Noteworthy is Salomonsen's (1950:78) statement that its breeding area "lies farther north than that of any other bird." Most ornithologists agree that the breeding range of B. b. hrota includes Ellesmere Island.

Ellesmere Island. On the north coast Feilden (1877: 412) reported the finding of many brant nests in 1876, but MacDonald (1953:7) noted brant only once (June 21, four birds) in 1951. MacMillan (1918:408) noted brant "flying along northern shores of Grant Land in June, 1909." On the east coast brant were "comparatively numerous" in the vicinity of Discovery Harbor in 1881-83 (Greely, 1886, 2:376). They were seen at Cape Sabine in 1884 (Greely, loc. cit.). In southern Ellesmere Island brant bred abundantly in 1900-02 (Bay, in Sverdrup, 1904, 2:480-1). Two nestlings were taken at The Little Sandbar, Ellesmere Land, July 11, 1900, and six more nestlings, a brood about nine days old, at Winter Harbor, King Oscar Land, July 21, 1901, by the Second Fram Expedition (Schaanning, 1933:146-7). Not all observers since 1947 have seen brant on the Fosheim Peninsula. Hatfield (in Handley, unpubl. ms.) saw many there in 1948 but none in 1949; he later informed Handley that the birds he saw were "definitely black-breasted." In 1951 Tener (Godfrey, 1953:89) saw 11 brant "in northerly flight" on June 7. Bruggemann (1953-1954) saw no brant during his extensive travels in 1953-54.

Knowing how infrequently this species had been seen on the peninsula, we looked carefully for it in 1955. MacDonald and I saw no brant whatsoever. Sim and Marsden saw "7 dark geese," probably brant, near snow geese at Iceberg Point on July 2. I have seen no brant specimens from northwestern Ellesmere Island and suspect that none have been collected.

CHAPTER VII

OLD-SQUAW

The old-squaw (Clangula hyemalis), a circumboreal species of wide distribution, breeds from tree-line to the Polar Sea. In Greenland it is most numerous in the high arctic, being "rather common" even as far north as Peary Land (Salomonsen, 1950:105). In Eurasia it breeds as far north as Spitzbergen, Nova Zembla, Eastern Taimyr, and the New Siberian Archipelago, but apparently not on the Franz Josef Archipelago (Pleske, 1928:442-3). It "breeds abundantly" from Wales northward along the entire Alaskan coast (Bailey, 1948:167). In the Western Canadian Arctic, it probably breeds as far north as Prince Patrick Island (MacDonald, 1954:225).

Ellesmere Island. The "few" pairs of old-squaw seen by Feilden (1877:411) on the northern shores of Grinnell Land in 1876 were "evidently breeding." Greely (1886, 2:376) found the species "not uncommon" in the vicinity of Discovery Harbor and the interior of Grinnell Land in 1881-83. In King Oscar Land, Bay (in Sverdrup, 1904, 2:481) often found their nests "near freshwater lakes." A clutch of three eggs was collected by the Second Fram Expedition at Indre Eide, Elles-

mere Land, on July 21, 1901 (Schaanning, 1933:147). MacMillan (1918:407) found a nest with five eggs on the north shore of Grant Land on June 28, 1909. MacDonald (1953:7) considered the species a "rather common breeding duck" in the Alert area in 1951; he observed a brood of two young.

On the Fosheim Peninsula, in 1955, the old-squaw was a fairly common bird. It was widely dispersed and we noted it at most lake areas visited in June and July. During August and the first half of September, it was by far the commonest bird on the open waters of Slidre Fiord. Everywhere it was more common than the king eider (Somateria spectabilis).

Axel Heiberg Island. At 80°12'N. 87°54'W. on the Schei Peninsula, I collected a female and six downy young at a small tundra pond on July 25, 1955. Close by was another female with five downy young.

Arrival. In northern Greenland old-squaws return to their breeding grounds June 5-18; usually in pairs, they make their way north as soon as the "solid ice along the coast is broken by the first leads" (Salomonsen, 1950:106). Greely (1886, 2:376) reported early specimens obtained by them on June 17, 1882, and June 6, 1883, on the east coast of Ellesmere Island, presumably near Discovery Harbor, and birds seen on June 1, 1884, at Cape Sabine. In 1951 MacDonald (1953:7) first noted the species at Alert on May 28 (four birds). In 1951 Tener (Godfrey, 1953:90) first noted the species at

Slidre Fiord on June 16 (two pairs). Bruggemann (1953, 1954) noted it first on June 6 (eight birds) in 1953, and on June 5 (two birds) in 1954.

In 1955, we first observed old-squaws on June 11--five days after the streams had spilled over the fiord ice. At 8:30 p.m. three males and two females were on the inundated sea ice west of Station Creek delta. A flock of six flew by an hour later. On June 13 MacDonald collected a pair at the Station Creek delta. On June 16 we saw two separate pairs. On June 18 we saw two separate pairs, a single male, and a flock of three (at least one a male).

We continued to see old-squaws on the shore leads during June. As early as June 14, Sim and Marsden saw them well inland also--18 miles northeast of the head of Slidre Fiord; some were on temporary "slush-bottom runoffs," others on such lakes as were thawed, and one pair occupied a lake with king eiders and snow geese. Returning to the same area on June 18, they noted at least 10 old-squaws.

Nesting. In 1955 pairs of old-squaws were well established at the inland breeding places by late June and early July. We noted two pairs on ponds south of Eastwind Lake on June 28 and three pairs there on June 29. On a 40-mile walk June 30 and July 1, we noted 12 scattered pairs on the plain north of Eastwind Lake. Sim and Marsden saw about 14 pairs in the lake area near Iceberg Point on July 2.

On July 9 we spotted an old-squaw on her nest on one

of several dry, willow-covered hummocks (538 feet elevation) a mile south of Eastwind Lake. We photographed the bird from eight feet before she flushed (Fig. 12). In the nest were six nearly fresh eggs. These we marked and covered with down. The nest was between two small pools and a hundred paces from a much larger pond. On July 12 the nest held four eggs only, but these were warm and down-covered. On one egg we found dried yolk but there were no shell remains in or near the nest. The duck had flushed from one of the nest pools as we approached. She alighted on the larger pond and there remained, highly agitated, until we left. On July 14 the nest was devoid of eggs and abandoned. Long-tailed jaegers, several pairs of which patrolled the tundra thereabout, probably ate the eggs. Had a wolf or fox eaten them the whole clutch would have been taken and the nest scattered. This was the only old-squaw nest we found on the peninsula, but on July 30 MacDonald saw a female with six downy chicks at a lake (700 feet elevation) on the barren west slope of Black Top Ridge, and as late as September 2 we saw flightless young (ten with an adult female) in Slidre Fiord.

On August 9-10, in 1947, Handley (unpubl. ms.) saw five "nearly full-grown" and two adult old-squaws in Slidre Fiord, and one female with five young 12 miles northeast of Eureka. Hatfield (in Handley, unpubl. ms.) saw broods in 1949 but recorded no precise data. Bruggemann (1953, 1954) saw three females, each with five downy young, respectively

near Eastwind Lake on July 23, 1953, in the same area on July 20, 1954, and in Slidre Fiord on August 10, 1954.

Summer Flocking. Tener (Godfrey, 1953:90) observed flocking of drakes at Slidre Fiord in early July, 1951. In 1955 we last saw drakes on inland waters in mid-July. On July 11 MacDonald and I saw two pairs in lakes near Iceberg Point, an area in which Sim and Marsden had seen many old-squaws on July 2. In July we occasionally saw small flocks (both sexes) on Slidre Fiord, but we did not record large numbers there until August 1, on which date 50 were seen by Sim and Marsden. Bruggemann (1954) first recorded large numbers in the fiord on August 1 in 1954. On that date he counted 302. By September 5, 1955, inland waters were covered with an inch or more of ice. Eastwind Lake was frozen shut except for a pool kept open in the middle by an active flock of young and adult old-squaws. The young birds were large but they may not have been able to fly well. From August 20 to September 9, we saw flocks of up to about 200 birds of both sexes on the fiord.

Many old-squaws molted on the fiord. In certain places the water was covered with feathers. We saw birds which we knew to be flightless adults August 20-26, but did not see any such birds in September. A male and female collected September 2 had new remiges and were flying well. These two birds were not birds of the year, but whether they had bred or not is a question.

Departure. In northern Greenland fall migration starts as early as the first days of September (Salomonsen, 1950:111). Two birds were shot on the north coast of Ellesmere Island on September 16, 1875 (Feilden, 1877:411). Bruggemann (1953, 1954) saw six old-squaws at Slidre Fiord on September 10, 1953; in 1954 he counted 315 of them on September 14 but saw none thereafter. In 1955 we noted no large flocks after September 9, but we continued to see scattered birds until September 15, on which date we saw small companies (six to nine birds) feeding in such waters as were still open. The fiord was freezing rapidly shut at this time.

Description of Specimens. Measurements (in millimeters) of three old-squaws collected in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
122	July 25*	female	201.0	77.0	26.5	30.5
162	Sept. 2**	female	193.0	62.0	26.0	30.5
161	Sept. 2**	male	204.0	88.0	27.0	32.0

* Schei Peninsula, Axel Heiberg Island
** Slidre Fiord

DFP 161 and 162 are in heavy body molt. The central rectrices of the male are incoming and still sheathed at the base.

DFP 122 is an adult female collected before it had shed its remiges. Three of its six downy young, DFP 123, 124, 125 (all females), weighed 26.0, 31.5, and 30.0 grams, respectively. The underparts of DFP 123 are buffier than those of its siblings but like those of a male Baffin Island

specimen in the Sutton Collection, GMS 11798.

Annual Breeding Cycle. Old-squaws usually arrive at Slidre Fiord from early to mid-June. Some of these birds appear to be paired on arrival. They feed and rest in the leads of the fiord until the fresh waters open. Egg-laying probably takes place from late June to mid-July. During this period from one to several pairs occupy a tundra pond or larger lake. The only nest we found was well away from water. Males gather in flocks in the first half of July. Young commence hatching as early as July 20. Broods number five or six chicks. These are attended by females. Some young birds may attain virtually full growth as early as August 10, others remaining flightless as late as September 2. Large flocks of adults and young gather in Slidre Fiord in early August and hundreds of birds molt there. Flightless adults have been seen as late as August 26. Some birds remain in the fresh waters until freeze-up in early September. Most birds leave the region by September 10, but a few remain until mid-September, feeding in such waters as remain open.

CHAPTER VIII

KING EIDER

The king eider (Somateria spectabilis), a holarctic species, nests in the northernmost lands known, including Spitzbergen and the Franz Josef Archipelago (Pleske, 1928: 338). In Greenland, it breeds farther north than Somateria mollissima, even in Peary Land, where it is common (Salomonsen, 1950:132-5).

Ellesmere Island. Several king eider nests with fresh eggs were found at Floeberg Beach, on the north coast, in mid-July, 1876 (Feilden, 1877:412). Apparently Greely (1886, 2:376) did not note a nesting of this species on the east coast. In King Oscar Land it was observed "frequently" by the Second Fram Expedition, but no nests were found (Bay, in Sverdrup, 1904, 2:481). A male was collected at Craig Harbour on August 26, 1938 (Shortt and Peters, 1942:342). MacDonald (1953:7) found it quite common at Alert in 1951, but he saw no nests or young.

Axel Heiberg Island. The king eider probably breeds on Axel Heiberg Island. At 80°12'N. 87°54'W. on the Schei Peninsula, I saw a single female inland on July 25.

So far as I know, Somateria mollissima has never been recorded in or about the Fosheim Peninsula. Owing to the ice-blocked seas and the lack of nesting islands, it is unlikely that the species breeds anywhere in the region. All eiders seen inland I refer to spectabilis, on the assumption that mollissima would not normally be found there. Non-breeding young king eiders probably do not summer in this region (Bent, 1925:112).

Arrival. In Greenland the king eider moves north in April and May as far as the ice permits, arriving in Peary Land as early as June 8 (Salomonsen, 1950:132). On the north coast of Ellesmere Island, Feilden (1877:412) noted several mixed flocks of 10-20 birds at the end of June, 1876. The earliest recorded date for the Alert area is June 19 (two birds) in 1951 (MacDonald, 1953:7); for Discovery Harbor, June 11, 1883 (Greely, 1886, 2:376); for Cape Sabine, May 26, 1884 (Greely, op. cit.). In 1951 Tener (Godfrey, 1953:90) first noted king eiders at Slidre Fiord on June 16 (two pairs). Bruggemann (1953, 1954) first recorded them there on June 12 (eight pairs) in 1953 and on June 27 (flock of three males and four females) in 1954.

The first king eiders appeared at Eureka in 1955 on June 11 (one pair, flying westward). The following day we saw a separate pair flying and four males and four females together on the shore lead west of the Station Creek delta. June 13, we saw two males flying down-fiord and a single male

that had alighted on the inundated sea ice.

Nesting. Bruggemann (1953) believed that two or three pairs of king eiders nested on the Fosheim Peninsula in 1953. That year he saw eight birds on June 12, eight June 13, five June 19, four June 21, two July 2, two July 10, three (including two young) July 21. In 1954 Bruggemann (1954) noted 58 birds, including 12 young, between June 27 and September 3. In 1955, king eiders were conspicuous and widely distributed, but not abundant. We saw them inland a number of times. On June 14 Sim and Marsden saw three males and four females together on a lake 18 miles northeast of the head of Slidre Fiord. At the same place on June 18 they saw at least six birds (sex not recorded) at one pool, four pairs with old-squaws at another pool, and two pairs among old-squaws and snow geese on a large lake.

The species nested in the vicinity of Eastwind Lake. Here we saw up to 12 drakes June 28-29, but none thereafter. On July 10 we saw two hens flying in low from the east. After alighting along the northeast shore, they were joined by a third. On July 30 MacDonald saw a hen with six small young in a pond south of the lake.

On June 30 I walked northward from Eastwind Lake nearly to Greely Fiord, covering the tundra ponds and lakes in my search for waterfowl. At 6:10 p.m. I observed a pair of king eiders in a marshy pond; at 7:40 p.m., a drake in a similar pond several miles farther on; at 8:30 p.m., three

pairs together on a large lake and two more pairs in a group on a smaller lake close by. On my return I saw the species first at a shallow lake in high gravelly country at 2:15 a.m., July 1: a male and two females sleeping on a mud bar, and two males and a female swimming. Thus did I find only 20 king eiders in a 40-mile search through what appeared to be one of the most promising areas of the peninsula. This thin scattering of S. spectabilis on inland breeding grounds is characteristic. S. mollissima, on the other hand, usually breeds colonially on islands off the seacoast (Salomonsen, 1950:132-5).

On July 2 Sim and Marsden visited Iceberg Point and observed among the ponds there a total of four drakes and nine hens. On July 11, when MacDonald and I visited this area, we saw no drakes, but a flock of seven hens flew past.

After July 2 we saw no drake inland. We last saw a female inland on July 30, but hens with young must have been there much later. I estimate the 1955 king eider population north of Slidre Fiord (excluding birds seen by Sim and Marsden northeast of the fiord June 14-18) to have been about 15 pairs, with a possible surplus of females.

MacDonald and I found the king eider difficult to approach. We did not even obtain a specimen. Some birds seen by Sim and Marsden on June 18, however, were extremely tame. Marsden belly-crawled along marsh tundra to within 15 feet of two pairs, stood up, photographed at will, and finally

waded after them. The ducks merely swam off.

As far as I know, no one has found a king eider nest on the Fosheim Peninsula. Young birds, however, have been seen there. The hen and brood seen by MacDonald in 1955 are mentioned above. August 9-10, 1947, Handley (unpubl. ms.) saw two family groups, including 10 quarter-grown young on a lake 12 miles northeast of Eureka. Hatfield (in Handley, unpubl. ms.) saw downy chicks on the fiord in 1949, but did not record the date. Bruggemann (1953, 1954) saw a female with two or more young on July 21, 1953; in 1954 he saw two females with 12 young seven miles east of the head of Slidre Fiord on August 3.

During August we saw brown eiders, supposedly spectabilis, infrequently in Slidre Fiord. On August 3, west of Eureka, a flock of at least 25 flew down and then up the fiord. The following day a lone individual swam off the delta of Station Creek. We did not record the species again until August 26 when we saw a flock of 12 near the south shore. On August 28 Eureka personnel reported seeing a flock of six "large brown ducks" near the south shore. None of these birds were flightless.

Departure. In 1951 Tener (Godfrey, 1953:90) saw males "in flocks" in the Slidre Fiord area as late as July 9. In 1955 we saw a lone drake swimming in the fiord not far from Eureka on August 4. This was our latest date for a drake. Salomonsen (1950:135) states that as soon as egg-lay-

ing starts the drake "disappears and moves to the coast where it soon begins to migrate southwards." Salomonsen (1950:136) further states that the breeding-area is vacated by females with young in late August and early September, but that "very little" is known about their southward migration.

Bruggemann's (1954) latest date for the species at Slidre Fiord: September 3, 1954 (20 or more birds in flock). Our latest date: September 2 (one in flight near Eureka). Latest fall record for northern Greenland: September 11, Peary Land (Salomonsen, 1950:135).

Annual Breeding Cycle. Drake and hen king eiders arrive together at Slidre Fiord after the shore leads start to open in June. They abandon the leads and go inland in mid-June. Flocking continues until early July, but by this time most birds are paired. The species nests non-colonially inland on the tundra. Egg-laying probably begins in late June. Drakes leave the nesting grounds in early July, but some continue to frequent the fiords until early August. Young hatch in late July. The only eiders seen on Slidre Fiord in August and early September are brown. The species departs for the south or for areas in which there is open water by early September.

CHAPTER IX

GYRFALCON

The gyrfalcon (Falco rusticolus) breeds circumboreally from the coniferous forest zone northward into the high arctic. Opinion differs as to how many races should be recognized. A very white form, candicans, is the only form found in high-arctic Greenland (Salomonsen, 1951:447). The breeding distribution of the species in Canada is poorly known (Godfrey, 1953:90).

Ellesmere Island. Both MacMillan (1918:409) and MacDonald (1953:7) reported gyrfalcons (but not eyries) from the vicinity of Cape Sheridan on the north coast. Feilden (1877: 403) did not observe this species north of 79°47'N., but mentioned a nest found by Hart on the east coast, at Cape Hayes (79°41'N.). Greely (1886, 2:380) also noted it on the east coast but apparently did not find a nest. Several gyrfalcons were shot in southern Ellesmere Island by members of the Second Fram Expedition (Bay, in Sverdrup, 1904, 2:479). The "Falkberget" referred to by Sverdrup (1904, 2:308-9) almost certainly was the nesting place of gyrfalcons (specimen shot). A "near-adult" gyrfalcon was collected in the vicinity of

of Craig Harbour in 1939 (Godfrey, 1953:90). It breeds on the Fosheim Peninsula.

Arrival. The gyrfalcon returns to high-arctic Greenland in late April or early May (Salomonsen, 1951:454). MacDonald (1953:7) saw a single bird at Alert, Ellesmere Island, on May 23, 1951. Bruggemann (1953, 1954) saw one at Slidre Fiord May 25, 1953, another May 22, 1954. In 1955 we first saw the species on May 12--a white individual flying low and southward towards Eureka.

Nesting. Bruggemann (1953, 1954) heard the "unmistakable noise of a young falcon being fed" on the west slope of Black Top Ridge on August 10, 1953; he thought that a pair nested along the same ridge the following year, but in neither year did he find the eyrie.

In 1955 we looked in vain for a nest along the entire west slope of Black Top Ridge. On July 6 MacDonald saw a white bird north of Gate Valley. On July 3, Sim and Marsden saw a white bird on a pinnacle 13 miles northwest of Eureka. On August 19 we saw a white bird, chased by arctic terns (Sterna paradisaea) and long-tailed jaegers, flying northward past Eureka.

On August 22, on a sandstone scarp six miles south of Slidre Fiord, I found an eyrie. Two young falcons were sitting together on a pinnacle close by. An adult, among higher rocks, called continually in loud screams or squeals, occasionally flashing out overhead. From below the pinnacle I

photographed, then shot, the young. Both were fledged. The adult, which flew off and did not return, was very white though its plumage obviously was worn and dirty. Beside the dead young bird on the pinnacle, and at the base of a high rock near by, I found the remains of two young long-tailed jaegers. These explained the peculiar maneuvers and distressed cries of an adult jaeger I had watched while approaching the eyrie. Elsewhere along the scarp I found numerous pellets and remains of snow buntings and hares.

The nest-ledge, which I could look into but not climb to, was partially overhung with rock and faced east. It was about 20 feet above a ledge to which I did climb. Nearby were several white-washed ledges--perhaps old nest-sites. Loose sand covered much of the scarp. Falcon tracks, the claw marks clearly visible in the sand, were everywhere.

Departure. Fall migration of F. r. candicans in northwest Greenland takes place from early September to late October, in northeast Greenland from late August to the end of September (Salomonsen, 1951:455). Gyrfalcons have been seen regularly in fall at Eureka. Handley (unpubl. ms.) saw one there on August 28, 1948. Hatfield (in Handley, unpubl. ms.) noted a few of them in the fall of 1949, as many as four appearing at one time, some remaining for several days. Two specimens were collected on September 4, 1950 (Godfrey, 1953: 90). Bruggemann (1953, 1954), in 1953, saw two on August 30, two September 8, two September 13, one September 14, and one

September 17; in 1954 he saw one September 14. Most of these birds were white, but Hatfield (in Handley, unpubl. ms.) said that an individual seen once in the fall of 1948, was "light slate thruout."

In 1955, we saw the species several times in the fall. A white bird seen by Sim several miles south of Slidre Fiord on August 23 probably was not a transient. But a white young bird shot by MacDonald near the delta of Station Creek on September 9, almost certainly was from afar. The crop and stomach of the bird contained the remains of four snow buntings. That same evening another white bird flew in from the west, attempting to alight on an antenna mast.

On September 10, MacDonald flushed a white gyrfalcon from a large icefloe near Eureka. We last saw the species September 13. That morning we saw a white bird on an antenna mast. It flew out over the fiord, cackling loudly. The cries were unlike those heard at the nest-scarp.

Description of Specimens. The young male (DFP 150; weight, 1266 grams) taken August 22 is more heavily streaked with brown than its sibling, a female (Canadian National Museum). Many head and body feathers and all the flight feathers (remiges and rectrices) are sheathed at the base. The wing measures 304 mm., the tail 173, the culmen from cere 20.5, the tarsus 60. The wing and tail measurements fall far short of the average of 15 adult Greenland birds measured by Friedmann (1950:637).

Annual Breeding Cycle. The gyrfalcon arrives at Eureka in mid-May. In high-arctic Greenland egg-laying never takes place until the end of May and young fledge in the latter half of August (Salomonsen, 1951:454-5). Near Eureka a brood fledged about the third week in August, 1955. Fall migrants, probably attracted by large numbers of snow buntings, appear both singly and in small flocks along the coast of Slidre Fiord from late August to mid-September.

CHAPTER X

ROCK PTARMIGAN

The rock ptarmigan (Lagopus mutus) is a holarctic species that ranges northward to the Polar Sea. Johansen (1956:84) calls it circumpolar-panarctic-alpine. As many as 26 races are recognized by Peters (1934:32-5). In the easternmost parts of the Canadian Arctic Archipelago the rock ptarmigan shows an extraordinary variation since it is influenced by several distinct races (Salomonsen, 1951:165). Two or three races may influence the populations of Ellesmere and Axel Heiberg islands.

Ellesmere Island. The rock ptarmigan has been reported on repeatedly from all coasts and from parts of the interior. Feilden (1877:405) procured the species at 82°46' N. Greely (1886, 2:379) reported traces of it found by Aldrich at Cape Columbia (83°06'N.). MacMillan (1918:409) observed it on Ward Hunt Island (83°7'N.). The Second Fram Expedition found it at many localities on Ellesmere Island, but the only specimen was a nestling collected July, 1899, at Hayes Sound (Schaanning, 1933:159-160). Two males and one female were collected at Craig Harbour from June 12 to July 10

in 1936 (Godfrey, 1953:90). Several specimens from Ellesmere Island (coll. Feilden, Vibe) have been examined by Salomonsen (1951:164).

Rock ptarmigan records for the Fosheim Peninsula are few. Fosheim (in Sverdrup, 1904, 2:275) saw a "few" tracks at Iceberg Point on May 6, 1901. Handley (unpubl. ms.) collected several birds from a flock of 25 near Slidre Fiord on August 9, 1947, and noted several groups there on August 28, 1948. Hatfield (in Handley, unpubl. ms.) found the species not common in the spring of 1949. In 1951 two males were collected at Slidre Fiord, one on May 28, the other on June 13 (Godfrey, 1953:90). Bruggemann (1953, 1954) noted only 28 ptarmigans, including flocks of seven and nine birds, during his extensive travels on the peninsula in 1953 (estimated breeding population: four or five pairs); in 1954 he noted only 20 birds, including flocks of five and seven young.

In 1955 we found the rock ptarmigan widely dispersed at various elevations on the peninsula; Roots saw two hens (no broods) at 80°46'N. 88°23'40"W. on the northeast coast of Nansen Sound on July 24.

Axel Heiberg Island. In 1955 we noted a pair near the head of Mökka Fiord on May 14; recently-shed feathers at 80°42'40"N. 90°59'W., 18 miles northwest of the mouth of Stang Bay, on July 23; and recently-shed feathers at 80°20'N. 89°16'W., five miles west of Flat Sound, on July 25.

Spring Records. The rock ptarmigan is generally

resident in Greenland except in the "farthest north" (Salomonsen, 1951:176). At 83°7'N. on the north coast of Ellesmere Island, MacMillan (1918:409) observed it as early as March 21 in 1909. At Cape Sabine on the east coast, two were seen as early as March 7 in 1884 (Greely, 1886, 2:258). Bay (in Sverdrup, 1904, 2:479) states that the rock ptarmigan is to be found "all the year round" in southern Ellesmere Island, but that "many" migrate south in winter. Interestingly enough, MacMillan (loc. cit.) saw the species at 4,700 feet elevation while crossing the Beitstadt Glacier, Ellesmere Land, on March 19, 1914, when air temperatures were -50°F.

Rock ptarmigans were on the peninsula when we arrived April 16. Staack had seen a flock of five near the airstrip (one mile northeast of Eureka) as early as April 1 (air temperatures -40°F.). According to the station personnel none had been seen in winter. On April 17, among parallel ridges just east of Black Top Ridge, not far from the head of the fiord, we noted recent ptarmigan tracks among those of snow buntings, foxes, hares, and muskoxen.

On April 21 we noted fresh ptarmigan tracks and heard a cock "belch" a mile or so north of Eureka. On April 22, near the fiord west of Eureka, we saw our first ptarmigans--all in winter plumage, some in pairs. One which was crouched on a rock rose as we approached, stretched its neck, uttered several low notes, and flew off, alighting up-slope. Another, flushed by a fox, alighted near us, ran abreast of us for

several hundred feet, and disappeared over a rise. A pair, feeding in a deep gully, flew off, the hen first, then the cock.

On April 23 we climbed Northwest Ridge to about 1500 feet elevation. Ptarmigan tracks and roost-beds became steadily less common as we climbed. Nowhere did we see evidence of flocking. The following day the Eureka cook, L. L. Bradbury, saw three pairs within a mile of Eureka and found several roost-beds, some of which occupied our own footprints; Staack saw tracks near Romulus Lake; and Marsden saw a pair 30 miles east of the head of Slidre Fiord.

In May we continued to find ptarmigans in certain places along the north shore of the fiord--one pair in a deep ravine just north of the airstrip, a cock and three hens in the valley of Ptarmigan Creek, a pair in the lower gully of Redpoll Creek.

By mid-May some hen ptarmigans showed traces of summer plumage. One seen on May 12 was all white. Another, seen on May 13, had several dark crown feathers. The one seen at Mökka Fiord on May 14 had several brown crown feathers. By May 23 the hens were mottled on the head, neck, and back. Most of the males retained their winter plumage until at least late June, but some of them showed traces of the summer plumage late in May. A cock seen May 31 had several colored crown feathers (Fig. 9). This bird's mate had lost half of her winter plumage.

Nesting. Bruggemann (1954) nearly stepped on a nest with six eggs "among Cassiope-covered hummocks on the bank of Station Creek" five miles north of Slidre Fiord on July 14, 1954. The incubating hen, "with a great flutter of wings, hissing, and snapping of bill," almost flew into his face.

The favorite haunt of the ptarmigan pair which inhabited the deep ravine north of the Eureka airstrip was the lower part of a northward facing slope. The terrain thereabout was highly eroded, part of it being barren, part vegetated. On June 10 the hen was in summer plumage except for a scattering of white body feathers. For some time I watched her moving slowly about, picking at the vegetation. She did not go to a nest. As I was leaving I heard the cock belch and turned in time to see him spring from the ground. Calling loudly, he rose to a height of 30 feet, then abruptly descended with fluttering wings and spread tail. Almost immediately he made a return display-flight, alighting near the hen.

I returned the following day and flushed the cock from a high frost-heaved mound. He flew out of sight up a valley to the east. Several hours later I saw the hen, followed by the cock, walking deliberately toward the mating area a hundred yards away. Although I watched these birds repeatedly and searched the tundra carefully, I never found the nest. I last saw the hen on June 11. The cock, when last seen (June 20) was dirty and bedraggled, but white. No brood was raised there.

A pair of ptarmigans inhabited a lush valley near the headwaters of a little stream a mile north of the fiord. On June 17 MacDonald saw the cock chase five long-tailed jaegers from the valley. On June 19 we searched the slopes but failed to flush the hen. The cock, white and soiled, squatted on a high bank watching us. On our next visit to this area (July 21) we saw no ptarmigans anywhere.

We noted ptarmigans regularly along the bed of Ptarmigan Creek from April 22 on. A cock and three hens inhabited the area (for polygamy in this species as observed in Greenland see Nicholson, 1930:427). Their favorite area was a stretch of snow-free hummocks along the west bank. Here, by mid-May, were scores of feathers shed by the females. On May 23, all four birds were much attached to the area. The piebald hens ran about with heads and tails lowered. The cock, pure white of body plumage, held his partly spread tail horizontally as he followed them. On May 30 there were only two hens with the cock. From June 4 on we rarely saw the hens, but the cock was noisy and conspicuous. His lookout was a rocky prominence at the upper end of the valley. Here, visible for a half mile, he squatted on a rock. Only once did we see this cock give a flight-performance. On June 17 he flew down-valley, belching. Having reached the lower end he gave a flight-song. We dragged the area but failed to flush an incubating hen. We did, however, find an old nest in which there were bits of shell and bleached membrane. When we last

saw the cock (June 25) he was still white of body plumage.

In approaching the valley from the east on July 5, I heard and caught a glimpse of a hen ptarmigan flying down the creek bed. I followed and found it on its nest (Fig. 10) in a barren patch of clay a third of a mile from the fiord at 106 feet elevation, and about 200 yards from the mating ground. Although we had searched the tundra thereabout time and time again, we had kept mostly to the vegetated spots.

I stroked the ptarmigan's back before it left the nest. Now it puffed, spread its tail, dropped its wings, and charged several times without striking. The nest was a natural depression lined with a few dry grasses and feathers. It held 10 eggs, nine of them pipped. The hen returned to them as I departed.

I returned with Sim and Marsden the following morning, July 6, and banded the hen (506-74762). I also painted its wings red for convenient field identification. It did not return to its eggs this time, but flew upslope and walked about nervously until we left the area. At 6:30 a.m., the last egg was pipped and the bills of some chicks were protruding.

The last of the brood hatched by 4:32 p.m. At this time: "hen fluttered from nest scattering 2 shells--one with loose yolk. All 10 chicks were in a mess of shells, some more lively than others. One got up and walked away. The rump of one bedraggled-looking chick was still in the shell.

Interrupted by the mewing of three jaegers overhead, we left in a hurry. Hen chased me for 50/60 yards. It then flew as nearly as I can judge right to the nest. Jaegers soon sheared off so all was well" (from Marsden's field notes).

Allowing 21 days for incubation (Salomonsen, 1951: 173), the clutch of this nest was completed by June 15; the laying of the first egg (allowing a minimum of 24 hours between eggs) was not later than June 5. In 1953, a brood of rock ptarmigans hatched in southern Baffin Island about July 6 (Sutton and Parmelee, 1956:53). Salomonsen (1951:173) states that egg-laying takes place no later in high-arctic Greenland than it does in low-arctic Greenland.

Fledging Period. Bruggemann (1953, 1954) saw a female ptarmigan with two young near Slidre Fiord on July 28 in 1953; in 1954 he "flushed a hen with 7 half-grown chicks" and came upon "5 more young, apparently only part of a brood" near the head of the fiord on August 3.

Although we did not find a second nest at Ptarmigan Creek in 1955, two broods were raised there that season. On July 16 I found the banded hen and her brood (now seven chicks) a half mile north of the nest. The 10-day-old chicks ran swiftly but did not fly. On July 21 I found two broods--that of the banded hen and a brood of 11 with an unmarked hen. The broods were about a half mile apart. The banded hen's brood (now five chicks) was about three quarters of a mile north of the nest. The hen still wore its red-marked

old outer primaries. All of the young could fly, three of them so well that I could not catch them. The weakest I caught by hand (10:50 p.m.) after it had made three very short flights (six to eight feet). This chick (female, DFP 115; weight, 97.5 grams; crop and stomach, seeds and decomposed insects), which was approximately 15 days, 6 hours, 18 minutes old, was not, in my opinion, fully fledged. Salomonsen (1951:174) states that a less than 10-day-old chick can fly "up to 10-15 m."

Early the following morning I found the unbanded hen and 11 chicks where I had seen them a few hours before. These chicks could fly, but some flew more strongly than others. They scattered in all directions. I caught one (female, SDM 158; weight 89.5 grams; stomach empty) by hand after it had made several flights of about 10 feet each.

The two broods seemed to me to be of about the same age. When I chased the chicks, the hen in each case charged in and displayed. Once the chick was caught the hen lost interest and was drawn to the cries of others. After July 22 we saw no ptarmigans, young or old, along Ptarmigan Creek.

On August 23 Sim and I saw a hen ptarmigan with eight young a mile and a half south of the fiord. The chicks were three-quarters grown. I shot the hen (DFP 152) and the young flew off strongly, staying together. We saw no cock in the vicinity.

The Cock During July and August. Salomonsen (1951:

173-5) says that the cock ptarmigan abandons the hen slightly before hatching time, usually moving into higher country to molt, and returning when the young are two-thirds grown. In 1955 we saw very few cock ptarmigans anywhere in July. Sim and Marsden saw one with a hen on Northwest Ridge on July 1 and a cock by itself about 200 yards from Greely Fiord shore on July 2. A hen seen by Sim nine miles east of Slidre Fiord July 15 behaved as if young birds were close by. No cock was seen anywhere in the vicinity.

All of the cocks seen by us in August were in more or less dark plumage. One shot by MacDonald on August 4, four miles west of Eureka near the fiord, was dark except on the wings and lower belly. Two (DFP 146, 147) collected by me on August 20, a mile south of Slidre Fiord, had been molting heavily, particularly about the neck. These birds were together and neither hens nor broods were in the vicinity so far as I could ascertain. Two seen by me in the same area on August 23 were extremely wary. I collected one (DFP 151), finding its neck to be white with new winter feathers. I saw neither hens nor young near by.

Flocking and Departure. The earliest fall flock reported for the Eureka area was seen August 9, 1947 (Handley, unpubl. ms.). MacDonald came upon a compact flock of ptarmigans near Eureka on the morning of August 24, 1955. From the numerous fresh droppings it was evident that the 19 birds spent the night together. Of the 11 specimens collected four

were adult (two males, two females) and seven immature (four males, three females). All were molting. One of the adult hens was the one we had banded at the nest on July 6 about a mile from the spot at which it was shot.

Although we frequently saw fresh tracks of large flocks on the slopes north of the fiord, we did not see ptarmigans again until September 15, on which date MacDonald flushed a roosting flock of about 30 birds a mile south of Eastwind Lake. He could not see them clearly in the half-light, but they appeared to be largely white. Some birds of a flock of 30 seen September 21 near Eastwind Lake retained a few brown feathers. Of the four specimens collected two (DFP 171, 172) were young birds in almost complete winter feather.

We last noted the species September 22, when MacDonald saw a flock of five near camp west of Eastwind Lake. All appeared white. Eureka personnel kept watch for ptarmigans after our departure. They saw a flock of five in winter plumage near the airstrip on September 29. The air temperature that day averaged about +8°F.; the depth of snow was 1.0 inches. Bruggemann's (1953) latest date for the species at Slidre Fiord: September 17 (seven birds).

Predation. We found surprisingly few ptarmigan "kills." At a gyrfalcon eyrie visited August 22-23 there were no ptarmigan remains of any sort. In early September near Eastwind Lake we found old, scattered remains of a bird

in winter plumage. The above discussion makes clear that one ptarmigan brood under observation was depleted rapidly in July, but we obtained no evidence that the chicks had been killed by a predator.

On April 24, Marsden saw a fox stalking two ptarmigans on a ridge 30 miles east of the head of Slidre Fiord. The ptarmigans "allowed the fox to come within a couple of yards and then took off in a tremendous uproar, only to come down again 25 yards on...they disappeared over the ridge still playing this game."

Description of Specimens. Measurements (in millimeters) of eight Slidre Fiord specimens are:

DFP No.	Date	Sex	Age	Wing*	Bill**
146	August 20	male	adult	205.0	11.0
147	August 20	male	adult	203.0	10.0
151	August 23	male	adult	198.0	10.0
155	August 24	male	immature	192.0	10.0
172	Sept. 21	male	immature	204.0	10.0
152	August 23	female	adult	189.0	10.0
154	August 24	female	adult	188.0	10.0
171	Sept. 21	female	immature	197.0	9.5

* primaries flattened
** anterior end of nostril to tip

The August adults are undergoing the winter molt. The primaries have been replaced except for the 9th and 10th in DFP 152. However, some of the primaries are not quite fully developed and the above wing measurements are therefore not wholly satisfactory. This is particularly true of DFP 151 and 152, in which the 8th (longest) primary is decidedly

undeveloped. DFP 152, the hen of a late brood, clearly shows a delayed molt of the head, body, tail, and leg regions.

DFP 155, the immature male taken August 24, was undergoing its first-winter molt when collected. Its wing measurement is also shorter than what it should be, for the 8th primary is undeveloped. Since the 9th and 10th first-winter primaries develop first and are then followed in order by the 1st-7th, the 8th is actually shorter than either the 7th or the 9th in a bird of this age. This is rightly described by Salomonsen (1939:56) and clearly illustrated by the above specimen. Apparently the immature birds (DFP 172, 171) in first-winter plumage give an accurate wing measurement since there is no difference in the mutual lengths of the primaries in young and adult wings (Salomonsen, loc. cit.). Unlike DFP 155, both show the diagnostic blackish spots on the tips of the first-winter 9th primary. All three show the equally diagnostic blackish spots on the outermost primary coverts, although they are much less pronounced in DFP 155 and 171 than in 172.

DFP 115, the Slidre Fiord juvenile of known age closely resembles three juveniles of unknown age taken in southern Baffin Island in 1953; they measure (in millimeters) as follows:

No.	Date	Sex	Wing	Tail	Bill*
DFP 115	July 21	female	97.0	31.5	6.0
GMS 11784	July 22	male	98.0	40.0	6.0
GMS 11785	July 22	female	97.0	37.0	6.0
GMS 11786	July 22	female	102.0	39.0	6.0

* anterior end of nostril to tip

The only significant difference appears to be the less-developed tail of the Ellesmere Island specimen. All three Baffin Island birds flew exceedingly well whereas the Ellesmere Island bird did not. The close correlation in size is also indicative of a close correlation in the time of nesting. Although there are no profound differences in the juvenal plumages of the above specimens, DFP 115 had noticeably fewer and lighter dark markings about the eye region. All possess minute 9th and 10th first-winter (white) primaries.

Much comparative material is needed to determine the subspecies of rock ptarmigan on Ellesmere Island. Both Godfrey (1953:90) and Salomonsen (1951:164) believe that an intergrade exists on Ellesmere Island, but until more is known of this interesting phenomenon, I refer my specimens to Lagopus mutus only. I call attention to the fact that all females in winter plumage observed by us on the Fosheim Peninsula, as well as at Mökka Fiord, Axel Heiberg Island, had a black loral streak which often extended even beyond the eye as in males. Except when paired, we were never certain of the sex of birds in winter plumage. DFP 171 clearly shows

this loral streak which, in this case, extends for at least 12 mm. behind the eye (exact measurement obscured by a few underlying brown feathers). If Salomonsen (1951:164) is correct in believing that females of L. m. saturatus and L. m. rupestris "never" have this black loral streak, this is indeed good evidence that the ptarmigans of Ellesmere and Axel Heiberg islands are influenced by L. m. captus, apparently the only American form possessing the loral streak in female winter plumage.

Annual Breeding Cycle. Rock ptarmigans occur in flocks on the Fosheim Peninsula as early as April 1. Some pair by April 22; these soon become strongly attached to certain areas which are not noticeably defended against other ptarmigans when the population is small. In 1955 one cock mated with two (perhaps three) hens. Hens commence molting by mid-May, well before egg-laying. By late May they are half white and half brown. By June 10 the summer plumage is nearly complete. Some cocks have brown crown feathers as early as May 31; others show no molt as late as June 25. The nest is placed in both barren and well-vegetated areas. Egg-laying starts in early June, but eggs have been found as late as July 14. The hen incubates and is deserted by the cock before hatching, which commences early in July. Chicks hatch and leave the nest almost simultaneously; these are attended by the hen until after they are fledged and probably more than three-quarters grown. Fledging varies within the brood.

Some 15-day-old chicks are very weak flyers and not fledged; others of the same age are strong flyers and fledged. Adult primaries are replaced by August 20. Delayed molting may occur in females with tardy broods. The winter-molt proceeds rapidly and most ptarmigans, young and old alike, are white by September 20. Fall flocking occurs as early as August 9, being common in late August and September. Ptarmigans have not been seen on the peninsula after September.

CHAPTER XI

RINGED PLOVER

The ringed plover (Charadrius hiaticula), a common old world species, breeds also in eastern Arctic America. Its distribution in Greenland is peculiar: it breeds commonly on the east coast south to Angmagssalik and in the Thule District on the northwest coast, but it is local and erratic elsewhere (Salomonsen, 1951:187). Specimens have been taken in northern and eastern Baffin Island (Soper, 1928:103; Dalgety, 1936:585; Shortt and Peters, 1942, 343; Bray, 1943:518; Wynne-Edwards, 1952:367-9). Elsewhere in the Canadian Arctic Archipelago this species has been noted only infrequently. The breeding ranges of C. hiaticula and the semipalmated plover (Charadrius semipalmatus) have met on Baffin Island at Cumberland Sound (Kumlien, 1879:83-4) and Clyde Inlet (Wynne-Edwards, loc. cit.).

Ellesmere Island. Feilden (1877:406) collected a female with brood patches at Buchanan Strait (78°48'N.) on August 4, 1875. The five plovers "found breeding" at about 81°35'N. 74°W., on the banks of the Very River, Grinnell Land, on July 1, 1882, were probably of this species (Greely, 1886,

2:378). Apparently Bay (in Sverdrup, 1904, 2:477-83) did not find the species in southern Ellesmere Island. In recent times MacDonald (1953:8) collected one (male with brood patches) of two birds seen on the north coast, at Parr Inlet, on July 18, 1951.

On the Fosheim Peninsula the species has been seen with certainty only once. In 1954 Bruggemann (1954) saw one near Eastwind Lake on June 26. This bird appeared not to be nesting. In 1955, neither MacDonald nor I saw it anywhere on the peninsula, although we were always watchful for it.

On July 24 we encountered the ringed plover at 80°46' N. 88°23'40"W. on the northeast coast of Nansen Sound, about 18 miles southeast of Otto Fiord. Our helicopter landed near the wide delta of a braided stream whose gravelly bottom could be seen for miles. I immediately looked for ringed plovers. A male flew toward me, alighted, and feigned injury. I collected it. The timid female I did not get. Another pair, on the far side of the stream, I observed until I located the area they defended, and collected both. I did not have time to look for nests or chicks. All three of the specimens had brood patches. The ovary of the female measured 11.0 x 7.0 mm., the largest ovum, 1.5. The larger testis of one male measured 5.5 x 2.0, of the other male, 7.0 x 3.0. None of these birds was molting heavily.

The first male collected, DFP 121 (wing 125.5 mm., tail 59.5, culmen 14.0, tarsus 23.0), is similar in size to

that taken by MacDonald at Alert in 1951 (Godfrey, 1953:90). It weighed 55.4 grams. The pectoral band is broad, measuring 22 mm. (mid-ventrally). Between the inner and middle toes the web is not developed as in C. semipalmatus. The ringed plovers of Ellesmere Island, as well as those of Baffin Island, Greenland, Iceland, and the Fåroes, are said to be smaller than those of northern Europe. That they are subspecifically distinct is, however, doubted by most taxonomists (Peters, 1934:247; Salomonsen, 1951:184; Godfrey, 1953: 90).

CHAPTER XII

EUROPEAN TURNSTONE

The turnstone (Arenaria interpres) breeds extensively in the Holarctic Region. The range of A. i. interpres, the so-called European turnstone, is fairly well known but that of the ruddy turnstone (A. i. morinella) in America is ill-defined at best. The two forms come together in Alaska and in the Canadian Arctic Archipelago. The turnstones of Greenland all belong to the nominate race. The European turnstone is one of the few Greenland birds with continuous breeding range along the entire north coast (Salomonsen, 1951:205).

Ellesmere Island. Feilden (1877:405) found the turnstone "tolerably abundant" in Smith Sound and along the north coast. Greely (1886, 2:378) found it "quite abundant" near Fort Conger. Two juveniles were collected by the Second Fram Expedition at Cape Rutherford, Grinnell Land, on August 3, 1899 (Schaanning, 1933:153-4). Bay (in Sverdrup, 1904, 2:481) found the species "very common" in southern Ellesmere Island. Soper (1928:104) states that this species was quite common at Craig Harbour on August 6 and 12 in 1923; according to Godfrey (1953:91) 14 juveniles were collected there, 12 of them August

6-12, 1923, two on August 9, 1928. MacDonald (1953:8) found the species a "common breeder" at Alert, where he collected eight adults and a juvenile between June 13 and July 30, 1951. At Slidre Fiord 12 specimens were collected prior to 1955--two juveniles on August 28, 1948, 10 adults between May 31 and June 14, 1951 (Godfrey, 1953:90).

In 1955 the turnstone was the second commonest bird of the Fosheim Peninsula, the snow bunting being commonest. Sim and Marsden noted several in the Caledonian Bay area of Canyon Fiord east of the peninsula on July 23. I saw four adults attending young at 80°46'N. 88°23'40"W. on the northeast coast of Nansen Sound on July 24.

Arrival. In Greenland the spring migration of turnstones is rapid; the species appears in low-arctic latitudes in middle or late May and reaches its high-arctic breeding ground early in June (Salomonsen, 1951:207). In the vicinity of Cape Sheridan, northern Ellesmere Island, in the spring of 1876, Feilden (1877:405) first saw the species on June 5. In this same area, in 1951, MacDonald (1953:8) first saw it on June 2 (one bird). At Cape Baird on the east coast in 1883 it was first seen on June 2 (Greely, 1886, 2:378). At Slidre Fiord it arrives in late May. In 1951 Tener (Godfrey, 1953: 91) first saw it on May 31 (eight birds). In 1953 and 1954 Bruggemann (1953, 1954) first recorded it on May 26 (seven birds) and May 30 (one bird), respectively.

In 1955 we first saw the turnstone on May 27--a single

bird west of Eureka, flying erratically up-fiord. The following day a very few were seen or heard. On May 29 two were seen, both near Eureka. On May 30 turnstones were everywhere along the fiord beach and on slopes near by. So far as I could see they had come to stay. I am not certain which sex arrived first. Specimens taken on May 30 were of both sexes.

Courtship and Pairing. The display and posturing of the turnstone is little known (Witherby, 1948, 4:224). Ekblaw (in Bent, 1929:280) states that in northwest Greenland the turnstones "begin mating as soon as they arrive, and many a bitter struggle and amorous courtship takes place...during the first two weeks of June." In 1955, we observed pursuit-flights even following the period of egg-laying, but not once did we see the sweeping back and forth a foot or so above the shore described by Ekblaw. In 1951 Tener (Godfrey, 1953:91) observed large flocks at Slidre Fiord until June 3, but smaller "courting groups" after that. In 1955 the turnstones did not go to their nesting areas immediately on arrival. They remained mostly near the coast, along the dry stream beds, or in barren areas. Here, in companies of up to 30 birds, they courted. Courtship reached its height by June 5. Now the bright males sparred and displayed. Repeatedly we saw one bird dash at another, driving it off; or two birds facing each other with heads lowered, jabbing at each other with their bills. Males did not always fight. Frequently one crouched, lowered its head, lowered and rapidly vibrated

its tail, and uttered metallic clicking notes which increased in tempo, ending in a rattle. Occasionally wings were lifted high above the back. When the flocks were large, the noise was continuous and loud.

During the very first days of June, lone individuals often flew erratically far across the tundra, usually within a hundred feet of the ground, and often several miles inland over high ground. Most of these flights were parallel to the long axis of the fiord. Both mono- and polysyllabic calls were given. These singular flights occurred at all hours, but usually when the sun was low and when many turnstones were roosting.

Some turnstones were going about in pairs by June 6. That day a dull female and a brightly colored male visited a feeding area where I had scattered oats near the delta of Station Creek. The female moved about over the wet ground, picking up oats with precise regularity. The male, close by, hunched up, vibrated its tail, and uttered low rattling noises. Three times it lifted its wings high. Not once did it pick up food or flip a pebble. Both departed together. Three bright males then arrived and fed concordantly without display. When a fourth arrived a flurry immediately took place, and after much chasing three flew off. The remaining bird was soon joined by a female. Both flew up-creek together. Another pair, believed to be the same in each case, frequently visited this area that day.

We saw no flocks of adult turnstones along the fiord shore or about the deltas after June 6. Their numbers declined dramatically at Eureka; only three were seen June 7. The entire population seemed to settle on the nesting grounds at once. Indeed, the first eggs were laid only three days later--June 10. A few individuals, occasionally a pair, continued to visit the station area for several days, but the visits were always brief. They appeared from up-creek, fed quickly, and departed. One such visitor was 502-75203, recognizable by a spot of red paint that we had put on its breast after banding it on June 5 (on June 25 we collected this bird near its nest a mile and a half northwest of Eureka). On June 9 MacDonald caught a female by hand on the delta. Thoroughly soaked with mud, it was unable to fly. We dried and banded it (502-75205). It flew when freed. Thereafter we saw no adult turnstone at Eureka or the delta near by.

Nesting. Most of the turnstones settled in the well-vegetated inland hummocky areas where knots and long-tailed jaegers were common. On June 10 these areas were mostly snow-covered, but numerous spots of exposed ground and turf, irregular in size and shape, pock-marked the white ridges (Fig. 13). In one such snow-free place on the ridge west of Black Top Creek, a turnstone flushed from underfoot, spread and dragged a wing, and fluttered off to join its bright mate in vigorous protest. The nest was eggless. The bird must have been ready to lay an egg! Fearing that the turnstones

would easily desert at this stage of nesting, I did not return until the following day at which time there were two eggs (Fig. 14).

We continued to find nests. Thirteen were in the vicinity of Eureka, five near Eastwind Lake, and two east of Black Top Ridge. Data concerning these nests are summarized below:

Nest No.	Date found	Contents when found	Clutch-size	No. young hatched	Date of hatching
1	June 10	0 eggs	4	4	July 5***
2	June 12	3 eggs	4	4	July 4
3	June 13	3 eggs	4	4	July 4-5
4	June 13	3 eggs	4	4	July 4-5
5	June 14	2 eggs*	?	0 (destroyed)	
6	June 14	4 eggs	4	collected June 14	
7	June 14	4 eggs	4	?	
8	June 17	4 eggs	4	collected June 17	
9	June 17	4 eggs	4	collected June 17	
10	June 17	4 eggs	4	collected June 17	
11	June 17	4 eggs	4	collected June 19	
12	June 18	4 eggs	4	?	
13	June 20	4 eggs	4	3**	July 6****
14	June 22	4 eggs	4	?	
15	June 28	4 eggs	4	?	
16	June 28	4 eggs	4	4	July 4
17	June 28	4 eggs	4	0 (destroyed)	
18	June 29	4 eggs	4	4	July 4-5
19	June 30	4 eggs	4	3	July 5****
20	July 4	3 young, 1 egg	4	4	July 4-5

* a third egg lay broken on the ground close by
** fourth young died while emerging from egg
*** we removed last egg from nest on July 5; it hatched at Eureka on July 6
**** approximate dates

Eggs collected on June 14 were nearly fresh; those collected on June 17 all contained small embryos; those collected on June 19 all contained embryos about the size of peas. Each

of these many eggs probably had been laid during June 10-14.

I find no record of a turnstone nest for Ellesmere Island. In 1951 Tener (Godfrey, 1953:91) thought that the species confined its nesting to dry ridges and gentle slopes covered with dryas and heather. In 1955, the majority of turnstones nested in the well-vegetated, often wet, hummocky areas where willow, dryas, and heather were noticeable. Pools, ponds, and lakes were not requisite. The nest-site was varied. Some nests were in dense vegetation, others in dry earth, others in wet mud. Those in vegetation or dry earth were scantily-lined; those in mud were large and well built, being composed of twigs, grasses, and dry leaves. Scarcity of vegetation did not force the species to nest in the mud, for thick vegetation was close to all the "mud nests" found. In Greenland the nest of the turnstone is a "mere depression in the stony ground occasionally lined with a few straws... generally sheltered by some heath-bush" (Salomonsen, 1951: 208). None of our nests were in stony areas and none were sheltered. Once found, the eggs could be seen a long way off, sometimes thirty paces or more depending on the terrain. One nest was at 165 feet elevation, another at 643 feet elevation. One nest was about a mile from the coast; none were found closer; two were nearly 20 miles inland.

Egg-laying Period. In 1955, as stated above, most turnstones probably laid their first eggs about June 10. Eggs were laid daily. On two occasions we witnessed copula-

tion. On June 12 we saw a female stop and crouch after being chased, permitting the male to mount from behind. The nest, about 50 yards away, held three eggs. On June 13 we saw another pair behave in the same way. The nest, about 25 yards away, held three eggs.

We did not observe what we recognized as territorial defense before or during egg-laying. From the very first of their actual nesting the turnstones seemed to be completely tolerant of one another and also of the knots. Twice we saw a knot within a few yards of a turnstone's nest and on neither occasion did the turnstone show animosity. Other species they chased hard, particularly the long-tailed jaeger and, surprisingly enough, the snow bunting.

Incubation Period. The incubation period of the species has not been known (Bent, 1929:284; Witherby, 1948, 4: 224). In 1955 the last egg of one Fosheim Peninsula nest was laid between 10:20 a.m. and 4:15 p.m. on June 13 and hatched at 3:15 a.m. on July 5. The incubation period was at least 515 hours, at most 520 hours (21.4 to 21.7 days). For two other eggs, in separate nests, the period was between 21 and 22 days. The incubation period of the black turnstone (Arenaria melanocephala) is stated to be 21 days (Brandt, 1943:163) or 21-22 days (Bent, 1929:300).

The female is on the eggs repeatedly, the male sporadically, throughout the incubation period. Jourdain (Witherby, 1948, 4:224) is correct in stating that incubation

is done "chiefly by female until near hatching," but it should be made clear that the male does not take over near the end of the period. His urge to attend young increases at that time, and he visits the nest often. At Nest 13 we killed the male bird on June 20. The female alone cared for the eggs until they hatched on July 6. The brood perished shortly thereafter, probably from neglect or exposure.

Our only observation of broken-wing behavior has been described above (p. 95). The incubating bird always left the nest long before we reached it, for the bird on guard, usually the male, invariably gave a loud, metallic "teuk" or "keu" of warning (Witherby, 1948, 4:224). We never escaped notice while passing through nesting areas. Where turnstones were numerous, calls were constant and all about us. Various renderings of the cries are given by Bent (1929:281), Sutton (1932:116-7), Brandt (1943:160) and Witherby (1948, 4:224). Two variations that I wrote down were: whichy-whichy-whichy-chee-chee-chaw and awhich-awhich-awhich-chee-chee-chee-eh; both of these were followed by a rattle.

Whenever we sat down and remained motionless both birds of the pair (especially the female) walked slowly and methodically about, poking at holes and crevices as if seeking food. This distraction behavior told us that a nest was close by. Similar behavior has been observed in the horned lark (Eremophila alpestris) in southern Baffin Island (Sutton and Parmelee, 1953:3). The turnstones practiced this "stud-

ied aimlessness" as long as we remained quiet, but if we moved they instantly resumed their noisy calling and flashing flight.

Occasionally while we were near a nest the female ran directly to her eggs. Usually she walked cautiously to a point several feet from the nest, leaped suddenly into the air and, flying a foot or two above the ground, fluttered down to her eggs. These short flights to the nest were characteristic and conspicuous. On Southampton Island, Sutton (1932:118) watched a female approach a nest in a long, low flight. As she reached a point perhaps three feet above the ground, she "fluttered down directly upon her nest."

Both sexes incubated high with heads elevated. Their sharply-contrasting underparts made them very conspicuous, and they could be seen at incredibly long distances.

Throughout the egg-laying and incubating periods the turnstones joined the knots in low, circling flights over the tundra. Such flocks, once formed, almost invariably increased in size. We first thought that these parties were composed of non-breeding birds, but more than once we saw single and paired birds dropping out of the flock and returning to nest areas. The largest mixed flock we saw was one of seven turnstones and 11 knots. Another was composed of 12 knots and a single turnstone.

Pursuit flights or chases among the turnstones occurred less frequently as the season advanced. Two or

three, sometimes four, individuals took part in the fracases. Calling excitedly, they flew rapidly and erratically about, often only a few feet above the tundra. We last observed such a flight on July 5.

Hatching Period. In 1955 most turnstones hatched July 4-5. The period of hatching (from first young to last young) was 15 hours and 50 minutes at one nest, about 11 hours and 30 minutes at another, less than 11 hours at another. The third egg (of four eggs) at one nest was the third to hatch; in three nests the fourth egg was the last to hatch. A five-hour-old chick that ran from a nest as we approached remained in the nest when replaced; an 11½-hour-old chick from the same nest would not stay put when replaced. At another nest, a 13¼-hour-old chick had moved six feet from the nest cup, and it likewise would not stay put when returned to the nest. Chicks 15 hours old ran well. At one nest we found and banded three chicks, returned later, and found the banded chicks as well as an unbanded sibling--fair proof that chicks may return to the nest cup to be brooded.

The hatching chick, without help from either parent, wriggles through a surprisingly small hole at the large end of the shell. A parent picks up the empty shell, flies off with it, and drops it some distance away. One male carried shells only 20 to 30 yards. He grasped the edge of the shell, flew off low, alighted, and dropped it. A female carried one 40 yards and dropped it in a similar manner. Another female

carried shells 200 yards or more. Whenever we put a shell back in the nest, the first parent to return carried it off. They did this repeatedly. At one nest the male attempted to brood empty shells. The female, however, rolled the shells about, gently thrust her bill through the openings several times, grasped a shell, and flew off.

Newly-hatched turnstones have well-developed legs. At Nest 1 we banded three newly-hatched chicks (502-75247, -48, -49) on July 5; at Nest 2 four chicks (502-75230, -31, -32, -34) on July 4; at Nest 3 three chicks (502-75235, -36, -37) on July 4 and one chick (502-75238) on July 5; at Nest 4 four chicks (502-75244, -45, -46, -50) on July 5; at Nest 16 three chicks (502-75208, -09, -10) on July 4; at Nest 18 four chicks (502-75212, -13, -14, -15) on July 5; at Nest 20 three chicks (502-75239, -40, -42) on July 4 and one chick (502-75243) on July 5.

During the hatching period some parent turnstones became bold and defiant. Males were especially aggressive. One puffed up its plumage as it ran up to within a few feet. Another flew at me several times, striking at me with its bill. The female did not come close. So aggressive were the birds at one nest that MacDonald caught them by hand. These he banded (male 502-75206, female 502-75207, July 4). At another nest he caught the male and banded it (502-75211, July 5).

Male turnstones were much stimulated by the peeping

of their young. One male was wary up to the time of hatching and would not approach its nest as long as MacDonald remained close by. The peeping of a newly-hatched chick beneath the female immediately triggered a chain of responses. He "became broody, ran about with body feathers puffed out and attempted to brood bare patches of ground (similar to nest?) and large gray, fluffy willow catkins (similar to young?)... A young wriggled out from beneath the female. The male saw it, and without hesitating, ran and tried to get on the nest" (MacDonald field-notes).

Fledging Period. In 1951 Tener (Godfrey, 1953:91) saw young turnstones "flying short distances" near Slidre Fiord July 24-25. In 1955, most of the young turnstones probably fledged during this same period. Trips to other regions prevented our witnessing the actual fledging on the Fosheim Peninsula. Young that we saw on July 24 on the northeast coast of Nansen Sound were flying. On July 27 we collected a fledged bird of known age near Slidre Fiord. The fledging period was about 20-21 days.

Except for a flightless chick caught and banded (502-75263) near Eastwind Lake on July 10, we failed to find young turnstones during the fledging period. This was due in part to the gathering of many turnstone and knot families in certain favored areas such as the broad ridge west of Black Top Creek, the ridge between Station and Ptarmigan creeks, and the tundra just south of Eastwind Lake. Sim and Marsden re-

ported having seen "literally dozens" of displaying turnstones and knots on a ridge nine miles east of the head of Slidre Fiord on July 12. Not all turnstones and knot families joined these aggregations of course, but many of them did. Both species probably benefited by the combining of forces, for the noise and movements of so many adult birds were extremely distracting.

The gathering of these family groups probably took place early in July. On July 7 we were puzzled by the absence of turnstones from certain familiar areas. By July 16 we were convinced that a general shifting of populations had taken place, for areas which had been alive with turnstones now had none.

Parent-Offspring Separation. Ideas differ as to which parent abandons the brood first. According to Manniche (in Bent, 1928:284-5) it is the male. Salomonsen (1951:208) states that it is the female, and that the male leaves as soon as the young can care for themselves. In 1955 all adult birds had departed by the time the young had moved out to the coasts. According to my observations the females left first. The males remained a few days longer and whether they left the broods or the broods left them is a moot matter.

Both young and old turnstones left the ridge west of Black Top Creek on July 27. That day I saw two young birds standing side by side, one with a band, one without. I shot the banded one, but it fell 80 yards away. A bright adult,

probably the male parent, flew to it immediately and remained by it until frightened off. The specimen wore band no. 502-75248; it was the second chick I had banded at Nest 1 on July 5, approximately 22 days, 6 hours earlier. It was fully fledged. The nest in which it had hatched was about 350 yards away. Other turnstones on the ridge were wary. Some young birds flew in flocks directly to the fiord. Adults were the last seen that day. We saw no turnstones on the ridge thereafter.

By July 30 only a few scattered turnstones remained inland. At Eastwind Lake MacDonald saw a flock of 11 juveniles and one separate adult on that date, and on a ridge between Station and Ptarmigan creeks I saw a pair with at least two unfledged young. One chick I ran down after it had made several short flights, each of about 10 feet. I collected the male parent. This pair had nested late. Farther up-slope three young birds flew strongly to the fiord. Still farther up-slope, two knots and a turnstone displayed. I collected the turnstone, a male, near its three fully fledged young. These soon left, flying straight to the fiord. They were the last young that we saw inland.

Arrival of Young at Coast. In 1955 we first recorded juvenile turnstones along the fiord shore on July 29 (four in the morning, four in the afternoon). No adults were with them. From July 29 to September 1, they frequented the beach and the stony river deltas and nearly dry stream beds, asso-

ciating with young knots and sanderlings (Crocethia alba). Occasionally they fed on kitchen refuse, but they were not attracted by oats as the newly arrived adults had been. We often heard them splashing as they bathed in the shallow creek water. None of us saw them "alight upon the water," however, as MacMillan (1918:409) had. During the first ten days of August young turnstones were common. The largest flocks (27 birds, 36 birds) we saw on August 10, at Station Creek delta.

Departure of Adults. The adults simply disappeared. We saw no flocks anywhere. We saw no adults north of Slidre Fiord after July 30. MacDonald (1953:8) last saw adult turnstones at Alert on August 3 in 1951.

On August 21 we collected a lone adult miles inland on high ground south of Slidre Fiord. The bird ran and flew well and was exceedingly wary. Although there was no outward sign of injury, a lesion that existed in its lower viscera may have in some way prevented this bird from migrating. Upon further examination, the lesion was regarded as mycosis rather than neoplasm by the Animal Disease Institute at Ottawa.

Departure of Young. In Greenland the young turnstones start to migrate south from mid-August to mid-September, the majority of them before the end of August (Salomonsen, 1951:208). Turnstones were seen at 82°30'N. on the north coast of Ellesmere Island on September 5 in 1875 (Feilden,

1877:405). In 1951 MacDonald (1953:8) last saw the species at Alert on September 1 (one bird). That same year Tener (Godfrey, 1953:91) last saw the species at Slidre Fiord on August 20. Bruggemann (1953, 1954) last saw it at Slidre Fiord on September 3 (two birds) in 1953; in 1954 he did not see it after August 14. According to Bruggemann (1954), the turnstone, knot, long-tailed jaeger, and arctic tern left the Slidre Fiord area more than two weeks earlier in 1954 than in 1953, in spite of the fact that August temperatures were higher in 1954.

In 1955, migration was underway by mid-August. We saw young birds repeatedly in late August, but never more than four at any one time. On August 28 we saw four birds, on August 30, two birds, on August 31, two birds, on September 1, two birds. Air temperatures at Eureka ranged from a high of 32.9°F. to a low of 30.8°F. on September 1, and fresh water ponds were freezing.

Old World Winter Grounds. Some European turnstones winter on the coasts of Iceland, the British Isles, and Europe. It is rare inland except during migration, being confined mostly to the rocky and pebbly shores from Iceland to southern Norway and the British Isles, south to Spain, etc. (Witherby, 1948, 4:225; Peterson et al., 1954:115). Greenland turnstones migrate across the Atlantic and winter in the temperate and tropical zones of the Old World (Salomonsen, 1951:209). Salomonsen substantiates this belief by the fol-

lowing: (1) Kolthoff observed migrating flocks between Greenland and Iceland in September 1883; (2) a turnstone banded January 1, 1942, at Bushmills, Ireland, was recovered on the northward migration at Prøven, Upernavik District, Greenland, on May 30, 1945. A British-banded turnstone (No. T 3533), collected by us at Nest 6 on June 14, 1955, definitely establishes the fact that birds which nest on Ellesmere Island winter in the Old World. Robert Spencer, Secretary of the Bird-Ringing Committee of the British Trust For Ornithology, informs me that turnstone T 3533 (DFP 97) had been banded by H. G. Hurrell at Wembury, South Devon, England, on January 13, 1951. On September 11, 1955, turnstone 502-75249, banded at Nest 1 on July 5, was recovered at the mouth of the Cavado River between the villages of Fao and Esponzende, Portugal. William Tait of Oporto, Portugal, reported its recovery. One of its three siblings, 502-75248, was the juvenile collected on the nesting grounds July 27 when it was still attended by an adult. Thus, 502-75249 must have flown from western Ellesmere Island to Portugal within a 48-day-period. Adults and young of the year both return to the old world wintering grounds, but many young birds migrate later than the adults.

Feeding Behavior. To ascertain what food the turnstones ate on arrival, we collected several specimens. One male taken May 30 had eaten grass seed; the stomach of another was empty. A female taken that evening had eaten grass seed. A male taken May 31 and a female taken June 1 had

eaten grass seed. All five of these specimens were very fat. Manniche (in Bent, 1929:287) states that "just after their arrival in Greenland the turnstones feed mainly on vegetable food; the stomach of a bird taken on May 22 contained only remains of plants."

The newly arrived Slidre Fiord turnstones fed primarily on vegetable matter. Animal foods were, nevertheless, available. As early as May 21 we saw a small fly on a talus slope nearly 2,000 feet above sea level. On May 24 MacDonald found a geometrid moth larva on a sunny slope near Eureka, and Sim and Marsden found several larvae of the moth Byrdia under loose rocks. By May 27 we often saw the latter on tufts of grass or on muskox dung, basking in the sun. Occasionally they crossed snow. Wondering whether the turnstones preyed on them, I placed some of them among scattered oatmeal. The turnstones ate the oats, but not the larvae.

On the evening of May 30 I watched eight turnstones feeding in snowless places on the slopes of a creekbed. The birds were upturning angular pieces of hard clay half an inch thick and the size of a man's fist. Areas of encrusted earth were common in the poorly vegetated, stoneless lowlands. Immediately beneath the broken crust the earth was fine-grained and soft. The angular pieces flipped over easily, presenting no problem to a turnstone. I flipped two dozen or so myself, finding a small white cocoon under one, a moth larva under another. Watching the birds, I concluded that they did not

flip the clods at random. In some places they turned many, in others, few.

We had stormy weather May 31. The temperature dropped, the high at Eureka being 27.6°F., the low, 18.1°F. Wind from the south and southeast reached a velocity of 22 mph. Returning from Geum Creek, MacDonald came upon five scattered turnstones all busily flipping clods despite the blowing snow which part of the time hid them from sight. When flushed, they flew in a flock.

As late as June 6, turnstones fed about the station area. They were not by any means the scavengers the long-tailed jaegers were, but the two species often fed side by side. Once we saw five turnstones and eight jaegers feeding together on kitchen scraps. A wolf carcass put out to attract gulls was a favorite feeding spot. Here both jaegers and turnstones picked at the flesh.

We collected 13 adult turnstones on the nesting grounds. The stomachs of six of these were empty. One stomach contained four moth larvae and two spiders (June 14); five contained moth larvae only (June 17-25); one contained the remains of adult insects (July 30). The largest number of moth larvae found in a single stomach was 12. The stomachs of two young taken July 30 contained the remains of adult insects. The stomach of an adult taken August 21 contained one caterpillar and remains of craneflies.

Roosting Behavior. We first saw roosting turnstones

at 9:30 p.m. on May 31. Eight of the birds, standing within a foot of one another, were strung out on a gentle rise near the bed of a small creek about a mile from the fiord. All had faced eastward, upslope, before going to sleep. A ninth bird, several feet away from the rest, stood watch on a prominence, facing westward. All the birds were in direct sunlight. I heard no warning note from the sentry; but when I walked to within about forty yards, the whole flock flew off.

During the next few days we often saw two or more turnstones roosting or resting, sometimes with knots, when the sun was close to the horizon. The largest roosting flock (48 turnstones, two knots) we saw on June 3 (Eureka dump, 11:00 p.m.). Most of these birds were asleep, but four or five turnstones, with an occasional change of individuals, fed constantly. We saw no group-roosting of adults after nesting had started, but young birds roosted together in the dusk on the lee side of gravel banks near the delta of Station Creek in August. All of the turnstones were gone by the time we experienced our first true night at Eureka. Turnstones are among the birds that never see the sun set at Slidre Fiord.

Predation. In 1955 the fox was a common predator. These animals ranged the tundra finding what they could. They paid little attention to attacking turnstones. The long-tailed jaeger was another common predator. The knots and turnstones combined forces against the jaegers but when sev-

eral jaegers attacked an isolated pair of shorebirds the latter were likely to suffer. Both male and female turnstones were given to chasing the jaegers a long way, and sometimes they were gone long enough to permit one or more other jaegers to drop in and snatch an egg or chick. Parent turnstones often stopped scolding us and gave chase to jaegers. We never saw a turnstone attack a jaeger that was standing on the ground; but the instant the jaeger flew the turnstone went after it, striking it with its bill. We never saw a jaeger strike back.

Two of 11 turnstone nests under observation were destroyed by predators. One of these nests we had marked with a pile of rocks. On June 10 MacDonald found the scattered remains of an adult turnstone.

Description of Specimens. Godfrey (1953:90-1), who refers adult specimens from Alert and Slidre Fiord to the nominate race, says that the "only considerable tendency of the Ellesmere Island series toward morinella is in size." The average wing-length of five Alert males measured by him is 147.0 mm., of seven Slidre Fiord males, 147.0, of four females from both areas, 150.9. My Slidre Fiord specimens average considerably larger than this--abundant evidence that they represent A. i. interpres, a form which, according to Ridgway (1919:44) and Salomonsen (1951:202), averages more than 150 mm. in wing length and more than 62.0 mm. in tail length. The measurements of my ten adults are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
89	May 31	male	149.0	66.5	22.0	24.0
99*	June 17	male	155.0	65.5	20.5	26.0
102*	June 19	male	152.5	67.0	20.5	24.0
127	July 30	male	150.0	65.0	21.5	25.0
148	Aug. 21	male	150.5	65.0	23.0	24.0
88	May 30	female	157.0	66.5	20.5	25.0
97*	June 14	female	151.5	64.0	22.0	26.0
98*	June 14	female	151.5	61.5	22.0	24.5
100*	June 17	female	155.5	65.0	21.5	25.0
101*	June 17	female	151.0	63.5	20.5	25.5

* collected at nest

The five males average: wing, 151.4, tail, 65.8, culmen, 21.5, tarsus, 24.6; the five females: wing, 153.3, tail, 64.1, culmen, 21.3, tarsus, 25.2.

Eight adult A. i. morinella from Southampton Island (1930) and Churchill, Manitoba (1931) measure:

Carnegie Mus. No.	Date	Sex	Wing	Tail	Culmen	Tarsus
110136	June 12, 1930	male	141.5	58.5	21.0	24.5
110241	June 29, 1930	male	147.0	59.5	21.0	25.0
110494	June 6, 1931	male	144.5	59.5	19.5	23.0
110728	June 6, 1931	male	137.0	58.5	21.5	23.0
110138	June 12, 1930	female	147.0	59.5	24.5	25.5
110283	July 9, 1930	female	145.5	59.0	21.0	24.0
110720	June 5, 1931	female	145.0	58.0	23.0	25.0
110727	June 6, 1931	female	145.0	57.0	23.0	25.0

The four males average: wing, 142.5, tail, 59.0, culmen, 20.6, tarsus, 23.8; the four females: wing, 145.6, tail, 58.3, culmen, 22.8, tarsus, 24.8.

The Ellesmere Island specimens are considerably the longer-winged and -tailed, but the longest-billed birds are the morinella females, and the shortest-billed ones are the

morinella males. Although the amount of cinnamon-rufous and black of the upper parts varies considerably in each series, when compared with the Southampton-Churchill birds the Ellesmere Island birds are the duller, i.e., the cinnamon-rufous of their upper parts is less extensive, the white of their heads is not as clear, and the brown of their heads is less streaked.

In general my Ellesmere Island males are more cinnamon-rufous above than the females. Two females, DFP 98 and 101, approach the males in brightness of back color and whiteness of head. Noticeable in six freshly-killed specimens (both sexes) were dark markings on the tarsi and toe-joints. The average weight of 10 males (including specimens taken by MacDonald) was 110.2 grams; of eight females, 117.4 grams. Brood patches were present in both sexes.

A newly-hatched female chick (DFP 109) taken on July 7 weighed 10.5 grams. Its culmen measures 10.5 mm., its tarsus 19.0. The underside is white except for the chest which is covered with dark down tipped with white, appearing as diffused gray. Thus, the chest band is already present in the nestling. Bent (1929:285) states that the "entire under parts" of the downy turnstone are "pure white." The specimen above referred to is like the chick described in Witherby (1948, 4:226) except that an additional black line leads from the upper mandible to below the eye. It does not differ greatly from two Southampton Island birds (Carnegie

Museum nos. 110298 and 110300) but it is less buffy above. The legs of the newly-hatched chick are brown but they become orange long before fledging.

The unfledged chick (DFP 128) captured July 30 weighed 86.0 grams. It measures: wing, 105.0 mm., tail, 28.5, culmen, 19.0, tarsus, 24.5. Much natal down remained in the region of the forehead, nape, throat, mid-chest, lower belly, and thighs. The fledged chick (502-75248 or DFP 126) of known age weighed 98.0 grams and measures: wing, 132.0, tail, 50.5, culmen, 20.0, tarsus, 24.0. There was considerable natal down on the head, but most of this came off during preparation as a skin. Both specimens show a conspicuous dark chest band.

Of 17 eggs collected, 16 measure (in millimeters):

Set 55-1 (Nest 6)	Set 55-2 (Nest 9)
40.5 x 30.5	43.0 x 30.5
41.0 x 30.0	42.0 x 30.0
42.0 x 30.5	43.0 x 30.0
41.0 x 29.5	44.0 x 30.5
Set 55-3 (Nest 10)	**Set 55-4 (Nest 11)**
41.5 x 29.0	41.5 x 28.5
41.5 x 29.0	39.5 x 29.0
40.0 x 29.0	41.5 x 29.0
40.5 x 29.0	40.5 x 28.5

Set a/4 (Nest 19) contains one egg only since the rest of the clutch hatched. This egg measures 43.0 x 28.0 mm. The average of the 17 eggs is 41.5 x 29.4. One hundred eggs collected in Europe and measured by Jourdain (in Bent, 1929: 284) aver-

age 40.5 x 29.2. The extremes of the Slidre Fiord eggs fall within those given by Jourdain, but in any event the 17 Slidre Fiord eggs average large even for interpres. Brandt's 44 Alaskan eggs averaged only 39.0 x 28.0 (Bent, 1929:284).

Pleske (1928:229) states that turnstone eggs are colored in two ways. In the common type the "olive-buff" or "nut brown" ground color is almost hidden by thick superficial spots which in the lighter areas are of a buffy brown and in the darker portions of an olive brown. In the uncommon type there is much less spotting and the olive-buff ground color predominates. Slidre Fiord eggs were of two sorts. Set 55-2 is of the first type while Set 55-3 is of the second type. In each of sets 55-1 and 55-4, three of the eggs are of the second type and one is of the first type.

Distribution of the European Turnstone in Canada. Salomonsen (1951:210), who mentions the likelihood that the turnstones of Ellesmere Island are A. i. interpres, calls attention to the "gap between the breeding-area of this subspecies and of A. i. morinella." Apparently the European turnstone was not known to breed in Canada before Godfrey (1953:90-1) identified Tener's and MacDonald's Ellesmere Island birds. My specimens confirm Godfrey's identifications, while the banding returns provide evidence that Ellesmere Island birds are, in a very real sense, old world turnstones. The "gap" that Salomonsen mentions may be a gap in human knowledge rather than a true gap or geographical barrier.

The turnstones of Axel Heiberg Island probably are A. i. interpres, but breeding specimens have not been collected there so far as I know. A. i. morinella may have a more restricted range than has heretofore been believed.

Annual Breeding Cycle. In late May, before the spring thaw sets in, a few turnstones appear on the Fosheim Peninsula. About June 1, many turnstones of both sexes arrive. They appear not to be paired. Pursuit flights and ground displays of males are frequent and pairs soon form. The flocks disperse about June 6, and the pairs go inland to the breeding grounds. The first egg is laid about June 10. The pairs tolerate one another, and also the knots, during and after egg-laying. An egg is laid each day, four being the clutch. The female incubates regularly, the male sporadically. The incubation period is about 21½ days. Pursuit flights and chases cease by hatching time in early July. The hatching period of the whole brood is rapid, being much less than a day. Young leave the nest within a day of hatching. After hatching, many turnstones abandon their nest areas, and join forces with knots in certain favored areas. Fledging requires about 20-21 days. Both parents remain with the young during fledging, but females leave the nesting areas before the males and fledged young. At one nest, 48 days elapsed from the laying of the first egg to the departure of the brood for the coast. The flying young go to the seashore about August 1. The last adults leave the peninsula

at this time. The young are numerous at the river mouths and along the fiord shore during the first 10 days of August, but they become increasingly scarce thereafter. By early September the last of them have left for the old world wintering grounds.

The annual routine of A. i. interpres on Ellesmere Island is the more interesting when compared with that of A. i. morinella on Southampton Island. That form arrives on its breeding grounds later than A. i. interpres does at Slidre Fiord. The chicks hatch about July 15 (9-11 days later than at Slidre Fiord) and in late July the adults begin their post-nuptial molt "which is apparently completed before they migrate" (Sutton, 1932:118). We carefully looked for the post-nuptial molt at 80°N. We thought we had some evidence when MacDonald's turnstone specimens (SDM 137-8) of June 22 showed traces of molt on the head and neck. But no adults collected or observed thereafter showed any real molt. One of two males collected July 30 had a few pinfeathers among the body plumage. The diseased adult collected August 21 was not molting.

CHAPTER XIII

OLD WORLD KNOT

The knot (Calidris canutus) breeds principally in the high arctic. In Greenland it appears to breed "along the entire North-coast...southwards right to the boundary of the low-arctic region on both East- and West-coast" (Salomonsen, 1951:225). In Eurasia it nests in the western part of the Taimyr Peninsula and in the New Siberian Archipelago (Pleske, 1928:442-3), in Spitzbergen (Dalgety et al., 1931:250-1), on Wrangel Island (Portenko, 1937:129), and in Iceland (Salomonsen, 1951:229). It occasionally breeds at Point Barrow, Alaska (Bailey, 1948:211-3). Sabine found it "nesting in great numbers" on Melville Island in 1820 (Feilden, 1877:407). Eggs (Bent, 1927:136, 145) and downy young (Godfrey, 1953:91) have been found on Victoria Island. MacDonald (1954:227) found it nesting on Prince Patrick Island in 1949 but not in 1952.

Ellesmere Island. Feilden (1877:407-8) stated that the knot bred in "some numbers" along the shore of Smith Sound and the north coast of Grinnell Land. On July 30, 1876, he secured newly-hatched young at Cape Sheridan where Peary

(Bent, 1927:135, 145) later found two nests--the first recorded in the New World--on June 26 and 27, 1909. Greely (1886, 2:377) found it breeding "in small numbers" in the vicinity of Discovery Harbor on the east coast. According to Bay (in Sverdrup, 1904, 2:481) it bred at the head of "Gaasefjord" in King Oscar Land. Schaanning (1933:155) reported four nestlings taken with a parent at Winter Harbour, King Oscar Land, on July 21, 1901. In the summer of 1951 MacDonald (1953:8-9) found the knot common at Alert. Bruggemann captured two of three small young on July 26, 1951, in the same area.

In 1955, the knot was common on the Fosheim Peninsula, but less so than the turnstone and snow bunting. We found it almost everywhere. In certain areas it was the most abundant and conspicuous bird. We observed an adult knot and three fledged chicks at 80°46'N. 88°23'40"W. on the northeast coast of Nansen Sound on July 24. Sim and Marsden saw 14 juveniles and two adults in the Caledonian Bay area of Canyon Fiord on July 26.

Axel Heiberg Island. We saw one adult knot at 80°12' N. 87°54'W. on the Schei Peninsula July 25.

Arrival. In northern Greenland the knot arrives in late May and early June (Salomonsen, 1951:226). In 1876 Feilden (1877:407) first noted the species at Knot Harbour, Grinnell Land, on June 5 (flock of 14). Greely (1886, 2:377) reported its arrival at Discovery Harbor on June 3, 1883. In

1951 MacDonald (1953:9) first observed it at Alert on May 31 (one bird). That year Tener (Godfrey, 1953:91) first noted it at Slidre Fiord on May 27 (one bird); he saw more than 75 on June 3. Bruggemann (1953, 1954) first noted it at Slidre Fiord on May 27 (flock of 12); in 1954, June 1 (three birds).

In 1955 we first saw the knot on May 30. The birds were not paired. They were going about in flocks as well as separately. Some flocks were composed of knots and turnstones, but the two species had arrived separately. Everywhere the clear mating calls of the knot sounded. From slopes still covered with snow, the earliest arrivals rose to great heights in giving their display flights, singing as they circled, then plunging to earth and remaining silent and hidden. The mating call has been described by many who have heard it. To us it was merely "poor-me," the emphasis being either on the "poor" or "me." To those who have not heard the call, words cannot adequately describe it.

On May 31 we saw many knots--several small flocks flying over the fiord, a flock of 31 flying northward, a company of five knots and 10 turnstones a mile and a half inland on the ground near a creekbed, and two birds (also inland) that may have been paired. The two sexes arrived together. On June 1 we fired into a flock of about 80 birds that rose, obtaining five males and eight females. The gonads of all the specimens were enlarged. The largest testis measured 13.0 x 8.5 mm., the largest ovum, 6.0 mm.

On June 2 we saw a flock of about 60 birds flying up-fiord over the delta of Station Creek. We saw no migrating adults thereafter. Knots and turnstones mingled from the time of arrival to departure. The adult knots did not frequent the fiord beach as did the turnstones, however; and, unlike the turnstones, they did not visit the station grounds. Only once did we see them there: on June 3, at 11:00 p.m., we saw two of them roosting with 48 turnstones near oatmeal we had scattered near the dump. The turnstones fed voraciously on oats and refuse, but knots did not seem to be interested in such food.

On several occasions we observed roosting knots when the sun was low. Like the turnstones, they slept in snowless places, usually slopes, along streams. Several active birds always kept watch for the flock. We never saw them with their heads turned back while sleeping. They faced straight ahead with necks drawn in, assuming a plump, rather dumpy appearance. On the nesting grounds they did not roost in flocks nor did they seem to have a specific roosting period.

Nesting. In 1951 Tener (Godfrey, 1953:91) observed two knot nests near Slidre Fiord--one with four eggs "on top of an 800-foot sandstone ridge" (June 23), another with newly-hatched young (July 12). In 1953 a nest was found a few yards from the airstrip about June 12 (Bruggemann, 1953).

In 1955, the knots returned directly to their breed-

ing grounds. They probably were paired shortly after arrival. They did not defend nest-areas, so far as we could see, in this respect being very different from the turnstones. When flushed they flew long distances, often disappearing altogether. When watched from afar they fed and walked about aimlessly, eventually flying out of sight. We covered all likely nesting places--sandstone ridges and gravelly slopes, low barren hills, even remote slopes of scree--but never found ourselves in a "defended" area. Near the fiord we heard flight songs repeatedly and watched nuptial chases, but we never witnessed copulation, and the fact that the birds continued to go about in flocks after June 15 was disquieting. So strikingly different was their behavior from that of the turnstones that we were nearly convinced that they were not nesting.

On June 19 MacDonald collected one of a pair that flew by him near Station Creek. The specimen was a female with brood patches. We had by this time covered miles of terrain and had nowhere found a nest.

On the evening of June 20 I visited the low, highly eroded tundra northeast of Eureka. The few knots that I saw showed no interest in any particular area. Shortly after midnight I was attracted to a large number of them on the hummocky ridge just west of Black Top Creek. On the top of the ridge knots were everywhere. I counted upwards of a dozen at once in the air overhead. They flew by singly, in

pairs, or in flocks. Some of them made long circling flights; others disappeared flying towards the barren slopes of Black Top Ridge where we supposed they nested. Always aware of my presence, they kept their distance. Finally, however, two alighted close by, rose, circled, alighted again. I shot, killing one. Near the fallen knot was its nest and four eggs--not on stony or gravelly ground as described by Salomonsen (1951:227), but in wet tundra (Fig. 15). While I looked at the eggs I sank in water and mud half way to my knees. The nest, two or three inches above water, was a slight hollow lined with grasses, bits of moss, dry willow twigs and leaves, among low willows on a hummock. The eggs were not in the least concealed. My specimen was a male with brood patches (testes 10.0 x 7.5 and 7.5 x 7.5 mm.).

Having learned that the knots were nesting, not merely feeding, in areas obviously favored by them, we found several nests--nine in all.

In 1951 Tener (Godfrey, 1953:91) believed that the nesting-habitat of the knot on the Fosheim Peninsula was weathered sandstone ridges and elevations with scattered clumps of willow, dryas, and poppy. In 1955, the species nested in many sorts of places. Most pairs nested inland below 600 feet elevation. Nests were often among willow, dryas, or heather. No nest was on barren ground; nor were any of them in scree as was that photographed by Peary at Cape Sheridan (see Bent, 1927: plate 24, 25).

The elevation of six nests was recorded (lowest, 281 feet; highest 757 feet; average, 463 feet). Elevation of the other three nests was estimated at 400, 425, and 1100 feet. Except for one brood at 870 feet, recently-hatched chicks were observed only at elevations below 600 feet. One nest was only a half mile, others from one to eight miles, from the coast. Two nests were within a half mile of each other; others were from one to 10 miles apart.

Very few knots inhabited the dry, easily-traversed slopes and ridges. The favored Fosheim Peninsula nesting ground is wet while eggs are in the nest. The wet areas gradually dry as the season advances.

All nine nests were slight hollows lined with dry grasses, moss, and leaves. Nest 3 was unusual in that it bridged a deep fissure between two hummocks. One or more eggs could easily have dropped through the flimsy structure. Data concerning the nests are:

Nest No.	Date found	Contents when found	Clutch-size	No. young hatched	Date of hatching
1	June 21	4 eggs	4	collected June 21	
2	June 22	4 eggs	4	3	July 3-5
3	June 24	4 eggs	4	collected June 26	
4	June 25	4 eggs	4	collected June 26	
5	June 27	1 egg	?	0 (destroyed)	
6	July 3	4 eggs	4	3*	July 5-6
7	July 3	4 eggs	4	?	
8	July 10	3 young, 1 egg	4	3, possibly 4	July 10
9	July 12	4 eggs	4	4**	July 12-13

* one banded (502-75216) on July 6
** two banded (502-75264, -65) on July 13

The eggs of Nest 1 contained small embryos. One egg of Nest 2 did not contain an embryo; this egg was abandoned when the young left. Three eggs of Nest 3 contained large equally developed embryos, but one egg had no embryo. The eggs of Nest 4 contained very small embryos. One young at Nest 6 died during hatching while still in the shell.

At Nest 3 the incubating adult was captured by hand and banded (502-75204). We failed to see it again. The incubating adult collected at Nest 4 by MacDonald proved to be a male (testes 13.0 x 9.0 and 9.0 x 7.0 mm.).

Incubation Period. We did not determine the period of incubation. Eggs found near Eureka about June 12, 1953, hatched "around July 8" (Bruggemann, 1953). According to Bird (in Salomonsen, 1951:227) the period "lasts for 21-22 days."

The knot incubated closely (Fig. 16). When flushed, it uttered low peeping and squeaking cries and flounced and flopped about on the ground a few feet in front of us. Half running, with tail spread and dragging, and with rump plumage, scapulars, and body feathers stuck up in such a way as to make it appear twice its actual size, it propelled itself to some extent with downward thrusts of its wings. Returning to normal, it flew off, only to return a moment later and go through the whole procedure again. If we stepped to one side, it changed its course and kept in front of us. One led us thus a full mile; another discontinued its injury feigning

when about a hundred yards from the nest.

When flushed from its eggs, the knot often remained away from them as long as we were in the area. Even during the near-freezing weather of July 6, the pair at Nest 6 did not return to their four pipped eggs for several hours. Three of this brood survived, one perished (while hatching). Only once did we actually see a knot return to its eggs. After the pair had run and flown about at great length, one of the birds hesitatingly went to its nest, but it sat with neck extended and head high, watching our every move.

The mating "poor-me" calls were given less frequently as the season advanced. Pairs of knots often flew about together during the incubation period, and we often saw a bird rise and join its mate in circling flight. A common call at this time was a rapidly repeated whip-poo-me.

Companies of up to 30 knots frequently engaged in aerial maneuvers over the nesting grounds. Turnstones often joined in these maneuvers and mixed parties were common. The performers circled widely, disappearing and reappearing, usually staying about 100 feet above the ground. The circling was most noticeable in late June and early July. It went on at all hours even during stormy weather. We first thought the flying flocks were composed of non-breeding birds, but we discovered that certain individuals continued to leave the group while others joined it. We became aware of this partly through watching the turnstones which, unlike the knots,

usually returned directly to their nesting spots. On July 3, while watching the circling of six knots, we saw the company suddenly break up into three pairs. Each pair flew off in a different direction.

Fledging Period. We first saw chicks out of the nest on July 6. That day I banded three very recently-hatched downies (502-75255, -56, -57) on the ridge west of Black Top Creek. The same day Sim and Marsden found three chicks near the airstrip and MacDonald found three more at 870 feet elevation on Black Top Ridge. He banded two of these (502-75217, -18) and collected the third. All of these chicks were very small.

On July 9 we banded five more chicks, three of them (502-75258, -59, -60) on the ridge west of Black Top Creek, two (502-75261, -62) on lower ground east of Black Top Creek. The chicks, though downy, were obviously larger than those found on July 6. On July 11, in a marshy area several miles southeast of Iceberg Point, we found a very small chick dead. On July 15 we found and banded (502-75251, -66, -67) three fairly large chicks. They were attended by three adults and probably belonged to more than one brood. On July 18 we observed a knot and sanderling defending the same area on a barren ridge a mile north of the head of Slidre Fiord. In searching for the young sanderlings we found a well-developed knot which we ran down and banded (502-75268). On July 20 a knot feigned injury near the airstrip. We saw two young,

neither of them fledged, and succeeded in catching one (band no. 523-50282).

Chicks were nearly able to fly by July 22. The remiges of three chicks (probably not siblings) captured on a ridge that day (band nos. 502-75277, -78, -79) appeared to be fully developed, but when I let the chicks go they ran off instead of flying. We did not ascertain the period of fledging (from hatching to strong flight), but it was probably close to 21-22 days. Young knots that I saw on the northeast coast of Nansen Sound on July 24 were flying strongly. In 1951 Tener (Godfrey, 1953:91) saw young knots flying "short distances" near Slidre Fiord on July 23. Fully-fledged young were seen at Alert on August 1, 1951 (MacDonald, 1953:8).

The warning calls of the parent knot were effective throughout the entire period of fledging. Calls that I wrote down were: whit-whit; whit-whit-whit; wit-wit; wheat-wheat. These were given by the parents in flight or on the ground. The calls stopped a chick in its tracks. There was no scampering, not the slightest movement, even when we reached down to pick it up. The instinct to remain still was broken, however, the instant we touched the chick; now it ran hard, peeping loudly, until out of sight.

The two parents cared for the young, but it was difficult to be sure which one was more attentive when the chicks were small. Not only were the sexes similar, but more often than not one of the pair was away while the other at-

tended the brood. This problem was the more complicated when many knot and turnstone families gathered in certain favored areas (see Chapter XII, pp. 103-4). These mixed flocks gathered chiefly in early July. They were very noticeable on July 12 and lasted until the families broke up and left the nesting areas. Injury feigning was common during both incubation and fledging periods. The knots were often so concentrated during the fledging period, however, that several of them customarily feigned injury at once.

Parent-Offspring Relationships. Ideas differ as to which parent abandons the brood first. Manniche (1910:134-6) thought that care of the young was "entrusted to the female alone." According to our experience males are more attentive than females during the latter part of fledging. On July 23 I collected a male from the many parent knots on the ridge west of Black Top Creek. By July 30 most of the adult knots had left the nesting grounds, but a few remained. That day I collected two males that feigned injury on the ridge between Station and Ptarmigan creeks and MacDonald collected a male that feigned injury near Eastwind Lake. We last saw a parent bird and young together on August 5. The parent was a male (testes 4.5 x 3.0 and 4.0 x 2.5 mm.).

Departure of parent birds appeared to be much like that of the turnstones. Female knots departed first. The males attended the young up to the time the broods flocked and went to the coast. We did not see the young knots sud-

denly leave the interior and fly to the coast as we had the turnstones. The young knots were prone to gathering in flocks before going to the coast. On July 30 MacDonald saw a flock of 28 juveniles near Eastwind Lake, and I collected a male from a flock of six juveniles a mile north of Slidre Fiord. We saw no small chicks anywhere by this time. Downy chicks have been found in Greenland throughout most of July (Salomonsen, 1951:227) and on the north coast of Ellesmere Island as late as July 30 (Feilden, 1877:407-8) and July 26 (MacDonald, 1953:8).

Arrival of Young at Coast. In 1955 the young knots made their way from the nesting areas to the fiord shore in late July and early August. We first saw them at the fiord on July 29 (flock of five flying near Eureka). We saw no young inland after August 5. At the coast they associated with other young shorebirds.

Departure of Adults. We last saw an adult knot inland on August 5 (one bird) but Handley (unpubl. ms.) saw one north of Slidre Fiord as late as August 9 in 1947. MacDonald (1953:9) last saw adults at Alert in 1951 on August 5. The latest record for an adult knot on the Greenland breeding grounds is August 8 (Salomonsen, 1951:228).

Departure of Young. In Greenland most young knots migrate south in mid-August, but some remain into early September (Salomonsen, 1951:228). In 1875 Feilden (1877:407) noted "several" knots at Discovery Bay on the east coast of

Ellesmere Island on August 25. In 1951 MacDonald (1953:9) last saw juveniles at Alert on August 25 (seven birds). In 1953 Bruggemann (1953) twice saw the species at Slidre Fiord in September--nine on September 3 and one on September 8. In 1954 Bruggemann (1954) did not record the species at all after July 24.

In 1955 most juvenile knots had left Slidre Fiord by mid-August, but a few remained to the end of the month. On August 17 we took one male knot from a flock of nine young sanderlings at Station Creek delta. On August 20 we saw three knots with two young turnstones and a young sanderling on the south shore of the fiord. On August 22 we saw three knots at Eureka. On August 31 we saw one knot with a young turnstone at Station Creek delta.

Food. It is well known that the knot can subsist on vegetable foods, especially in spring on the breeding ground (Feilden, 1877:407; Manniche, 1910:131; Salomonsen, 1951:229). At Eureka, in the spring of 1955, the knots found an ample supply of grass shoots, seeds, and other plant items, for the cover of snow was thin. Of the 13 specimens collected on June 1, 12 had eaten plant foods, none of them, animal foods. A male collected June 10 had also eaten vegetable matter only. The diet changed as the season advanced. A female collected June 19 had eated 51 caterpillars and no plant food. A male collected June 21 had eaten three caterpillars (only). A male collected July 23 had eaten adult insects (only). Three

males collected July 30 had eaten adult insects (only). A young male and young female collected July 30 had eaten adult insects, including craneflies. An adult male collected August 5 had eaten both seeds and adult insects. The stomach of a young male collected on the shore of the fiord on August 17 had eaten insects and marine invertebrates.

Predation and Survival. Problems of predation and survival were much the same for the knot and turnstone. The two species occupied the same habitat, nested in similar places, and raised their young together. Their abundance and wide distribution were proof of their ability to endure the elements and escape the predators.

The knot was most vulnerable between hatching-time and fledging-time, for during this period long-tailed jaegers were quartering the tundra almost constantly, looking for prey. These robber gulls were attracted by the peeping whenever we captured young knots; they glided back and forth, dodging the parent knots, ready to dart in and snatch a chick. When several jaegers converged on a family of knots, some of the chicks were likely to be caught. The knots, like the turnstones, drove off jaegers, but in doing so they exposed their eggs or chicks to other jaegers. Such was the case when I banded three downy knots on July 6. Only the two parent knots were there to drive off the half dozen jaegers which had gathered. Although I had their young in my hand, the knots paid far more attention to the jaegers than they

did to me. I shot at the jaegers myself, to drive them away. We did not often encounter separate families of knots or turnstones. The two species joined forces, thereby protecting themselves, as discussed above.

MacDonald and I witnessed a dramatic bit of predation when returning to Eureka from Eastwind Lake on the evening of July 15. Four knots suddenly feigned injury near us and a large chick raced away over the tundra. We ran it down and found two more chicks. Several jaegers appeared overhead, but we drove them off with gunfire. Kneeling, we banded the first chick (502-75267). When released it ran off swiftly; but it was hardly six feet away when a jaeger swept in and snatched it off without touching the ground. The jaeger was instantly beset by three knots, which pounded it so fiercely that we heard the slapping of their wings against the body of the jaeger. The jaeger dropped its quarry but circled quickly, picked the dead chick from the ground, and flew off again, finally alighting a hundred yards away where it was joined by another jaeger. Running hard, we approached and killed the jaeger and retrieved the chick. The young knot (DFP 113) weighed 50.2 grams; its remiges were still sheathed. One of its legs had been badly torn, but a pinch on the back had killed it.

Knots sit so closely while incubating that the jaegers probably do not steal many eggs, but the foxes, which wander far and wide in their search for food, probably de-

stroy some of their nests. Of nine knot nests found by us, one (Nest 5) was destroyed by some predator.

One of three downy chicks found by Sim and Marsden on July 6 slipped into a deep fissure. Such ground "traps" were numerous and widespread on the peninsula, but it is difficult to say whether downy knots ever perish in them. The cracked earth and some of the fissures provide refuge from predators and from raw winds.

Annual Molt. The nuptial plumage is acquired by an incomplete molt, involving most (not all) of the body feathers and the innermost secondaries and coverts from February to June, and the winter plumage is acquired by a complete molt from July to October (Witherby, 1948, 4:230-1). Both sexes arrived on the Fosheim Peninsula breeding grounds in nuptial plumage, although some winter feathers, excluding those normally retained, were found on all of the birds handled. Gray winter feathers were particularly noticeable on the breasts. We looked carefully for a post-nuptial molt but concluded that this was not nearly completed on the nesting-grounds. Knots in full nuptial plumage have been noted as late as September 6 (Bent, 1927:138-9). DFP 116 (male, July 23) had pinfeathers on the neck and lower back. DFP 129 (male, July 30) had pinfeathers on the neck, body, and legs. DFP 130 (male, July 30) had a thin scattering of pinfeathers over the body and neck. DFP 132 (male, July 30) had a few pinfeathers on the body. A male (DFP 138) collected August

5, had pinfeathers on the belly and neck. It was noticeably grayer about the head and neck than the other specimens.

Some adults, believed to be females, appeared to be molting heavily as early as July 20 while still attending young; but we failed to collect such birds at the time.

Description of Specimens. Measurements (in millimeters) of 10 knots collected on the Fosheim Peninsula in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
91	June 1	female	171.0	65.0	33.0	33.0
90	June 1	male	168.0	65.0	33.0	30.0
103	June 21	male	154.0	61.0	31.0	29.0
116	July 23	male	158.0	62.5	33.0	29.5
129	July 30	male	164.0	64.0	32.0	31.0
130	July 30	male	162.0	64.0	30.0	28.0
132	July 30	male	163.0	61.0	32.5	30.0
138	Aug. 5	male	157.0	63.5	32.5	30.0
131	July 30	male*	150.0	57.0	27.0	30.0
139	Aug. 6	male*	147.0	56.5	24.0	27.5

* juvenile

The immature male taken August 6 (DFP 139) is downy about the base of the bill while the young bird taken a week earlier (DFP 131) is comparatively free of down. The two specimens differ too, in color of the under parts, those of DFP 139 being much the lighter. The downy chick (DFP 107) is like that described in Witherby (1948, 4:231). The large chick (DFP 113) collected July 15 was well covered with down. First winter feathers were appearing on the wings, back (not rump), and sides.

The American knot (C. c. rufa) of the Canadian Arctic

Archipelago is characterized by lightness of upper parts in both breeding and immature plumages. Salomonsen (1951:222) refers Ellesmere Island (Floeberg Beach and Discovery Bay) birds and Greenland birds to the dark old world race, C. c. canutus. Godfrey (1953:91) likewise refers Ellesmere Island (Alert and Slidre Fiord) birds to the nominate race. All of my adult birds fit the description of canutus as given by Conover (1943:226-8), Salomonsen (1951:222-5), and Godfrey (1953:91). They are very dark above and below, and the rufous of the under parts, especially of the males, extends far down on the abdomen. In this respect they differ from two adult males, probably rufa, in the Sutton collection taken by R. R. Graber (RRG 2460, 2477) on the coast of Tamaulipas, Mexico, August 10 and 13, 1953.

Knot eggs observed in 1955 on the Fosheim Peninsula varied considerably in size, shape, and marking, but the ground color of all was light green. Four (DFP 55-7) that were collected are boldly marked with light to very dark brown splashings and dabs of lavender. The markings, which are somewhat whorled, are heaviest at the larger end. Four (DFP 55-8) are much less boldly marked and lack very dark brown spots. The eight eggs average 42.3 x 30.8 mm. Individually they measure:

Set 55-7 (Nest 1)	Set 55-8 (Nest 3)
43.0 x 32.0	43.0 x 29.5
41.5 x 32.0	43.0 x 29.5
41.0 x 32.0	41.5 x 30.5
43.0 x 31.5	43.0 x 30.0

The "greenish tinge" of fresh knot eggs tends to fade (Witherby, 1948, 4:229). Within four months the green ground color of the Fosheim Peninsula eggs faded to a very pale grayish green or buffy green, but there has been no pronounced fading since.

Annual Breeding Cycle. Flocks of knots arrive at Fosheim Peninsula in late May or early June. The sexes arrive together and immediately scatter widely on the inland nesting areas. A favored habitat is well-vegetated hummocky tundra. Courtship flights are continuous and pairs form. Eggs are laid from June 10 to about June 25. Both sexes incubate. Hatching takes place from early July to mid-July. Knots and turnstones, both old and young, band together on broad ridge-tops or flat stretches of tundra during the fledging period. Both sexes attend the young. Females leave the broods first. Males remain until the young form flocks and abandon the nesting areas for the coast. The chicks start to fly about July 24. The post-nuptial molt may start while adults are on the nesting ground but it is not finished there. Most adults leave the peninsula by August 1. Most of the young leave by mid-August, but a few remain at the coast until early September.

CHAPTER XIV

SANDERLING

In the old world arctic the sanderling (Crocethia alba) breeds on Spitzbergen, the Taimyr Peninsula, and the New Siberian Islands (Witherby, 1948, 4:279), but not on the mainland coast between the mouth of the Lena and Cape Deshneff (Pleske, 1928:243). In Arctic America very few nests have been found. In 1864 MacFarlane (Mair and MacFarlane, 1908:332-3) found a nest with four eggs on the barren grounds east of Fort Anderson, considerably south of its main new world breeding area. The species is not known to breed in Arctic Alaska (Bailey, 1948:228) or in "Baffin Island and adjacent parts of Canada's Eastern Arctic" (Salomonsen, 1951: 221). MacDonald (1954:227) found it breeding on Prince Patrick Island (common in 1949, very rare in 1952). It breeds commonly in most of high-arctic Greenland (Salomonsen, 1951:215).

Ellesmere Island. Feilden (1877:406) found a nest with two eggs in Grinnell Land (82°33'N.) on June 24, 1876. Greely (1886, 2:378) did not with certainty record the species on the east coast, and Bay (in Sverdrup, 1904, 2:477-82)

did not record it at all for southern Ellesmere Island. MacDonald (1953:9) thought that it nested at Alert in 1951. It nests in small numbers on the Fosheim Peninsula. Probably it breeds also on Axel Heiberg Island, but we did not see it at any of the places we visited there in late July.

Arrival. Knowing that in northeast Greenland sanderlings arrive in company with other waders and large flocks of snow buntings (Manniche, 1910:140), we looked carefully for sanderlings among the early flocks of knots and turnstones, but failed to find them. The spring migration of the species in high-arctic Greenland is extremely rapid, flocks of 8-12 individuals arriving in late May or early June and frequenting the seashore and snow-free spots (Salomonsen, 1951:217). In 1949 Hatfield (in Handley, unpubl. ms.) saw flocks "of ten to fifteen small birds with reddish breasts and backs...beside small ponds in the hills. They were waders, not swimmers." He recorded no dates. Neither Tener (Godfrey, 1953: 91) in 1951, nor Bruggemann (1953, 1954) in 1953-54, recorded the arrival date of the sanderling on the Fosheim Peninsula.

Nesting. On July 12, 1951, in the Slidre Fiord area, Tener saw an adult sanderling with three young which he thought to be not more than 12 hours old (Godfrey, 1953:91). Near Eastwind Lake on July 23, 1953, Bruggemann (1953) saw an adult sanderling behave as if a nest or young were close by. He did not record the species at all in 1954.

In 1955, we first saw the sanderling on June 29--a

single bird flying with a flock of knots low over hummocky tundra just northeast of Eastwind Lake. MacDonald saw four sanderlings and two turnstones flying together over a marshy area south of the lake on June 30 and a flock of three sanderlings flying over hummocky tundra four miles northeast of the lake on July 2. None of these sanderlings showed attachment to any particular area.

The only sanderling nest found in 1955 was discovered July 12 by MacDonald on high, dry, stony ground between Eastwind Lake and Pterophorid Hill to the west. The nest, a slight hollow lined with dry willow leaves, was in a patch of Dryas; it held four eggs. The site was at 740 feet elevation, above the wet, well-vegetated marsh and hummocky areas throughout which knots and turnstones were conspicuous. This habitat was decidedly different from the "hummocky tundra" in which we had previously seen the species near Eastwind Lake. Eleven Greenland nests found by Manniche (1910:142-3) were at the edge of or in a tuft of Dryas on a dry, clay-mixed, stony plain sparsely covered with Salix, Dryas and Saxifraga.

Many of our observations at the Ellesmere Island nest closely parallel those of Manniche (1910:145-6). Once the nest had been discovered, the incubating bird became "incredibly fearless." We approached to within a few feet and photographed it at will (Fig. 18), nearly touching it with our fingers. Now, instead of running from its eggs, it fluttered straight upward a foot or so, alighted close by, ran about

uttering low "growling" noises, and within a minute or two returned to its eggs and settled down. The normal incubating position was high, the body only lightly pressed against the eggs, the neck and head erect (cf. Manniche, 1910:146).

When discovered (7:15 p.m.), two of the eggs were pipped. All four were pipped by 7:30 the following morning (July 13). We visited the nest several times the following two days. On our last visit (8:15 a.m., July 15) the bills of the young were not yet protruding from the eggs. The adult was not at the nest when we first arrived, but it soon ran in to the eggs. Apparently only one adult was in attendance. We knew it was the same individual, visit after visit, not only by the very pale breast and upper-parts--strongly suggesting a female (see Witherby, 1948, 4:280)--but also by a recently injured toe-nail on the right foot. On July 15 we caught the bird and banded it (502-75254). On checking the empty nest September 5, we found no scattered feathers, egg-shell, etc.

If we allow 23-24 days for incubation (Manniche, 1910:146), egg-laying must have been completed by about June 20 at one Fosheim Peninsula nest in 1951, since Tener (see above) found newly-hatched young on July 12 of that year. Egg-laying probably was completed by about June 22 at the Eastwind Lake nest in 1955.

On July 18, on a high stony ridge near the head of Slidre Fiord, a knot and a sanderling behaved as if both had

young close by. We hunted for the sanderling chicks but found only one large knot chick. The skittish sanderling circled erratically, occasionally flying out of sight entirely, but always returning a few minutes later from a different direction. MacDonald collected it. Though molting, it was not pale like the Eastwind Lake bird but bright, with pinkish cinnamon upper breast. It had well-defined brood-patches.

This specimen proved to be a male. The larger testis measured 4.0 x 3.0 mm. In the stomach was an adult cranefly. According to Jourdain (Witherby, 1948, 4:278) there is "no incubation-patch in male" sanderlings. Manniche (1910:144), inferring that females do all the incubating, states that the males join in smaller flocks when brooding begins, wander around the table-lands and fresh water beaches with other waders, and usually leave the country before the middle of July. Feilden (1877:406) killed a male bird at the nest.

Sim and Marsden saw an adult sanderling in the lake area near Iceberg Point on July 2. We did not see the species there on July 11.

August Records. We occasionally saw juvenile sanderlings, not adults, about Slidre Fiord in August. They associated with knots and turnstones, all of which were also juvenile.

August 3: of five birds scattered along the gravel bars of Station Creek near Eureka, we collected two. August 12: flock of five knots, nine turnstones, and one sanderling

flew past Eureka. August 17: from a flock of nine sanderlings and one knot at Eureka, we collected one sanderling. August 20: from a flock of three knots, two turnstones, and one sanderling on the south shore of the fiord, we collected the sanderling. August 22: a wary flock of seven sanderlings flew by Eureka. August 25: one sanderling at Eureka. August 26: we collected one of two sanderlings which were running along the beach together on the south shore of the fiord. August 31: we collected a sanderling near a turnstone on the fiord beach just west of Eureka.

Departure. In Greenland, fall migration of adult sanderlings takes place from late July to mid-August; of young sanderlings, from the latter half of August to mid-September; juveniles have been observed as late as September 18 in Scoresby Sound (Salomonsen, 1951:218). On the north coast of Ellesmere Island, in 1951, MacDonald (1953:9) last saw juvenile sanderlings on September 3 (two birds). In 1953 Bruggemann (1953) recorded the sanderling from September 13 to 16--two juveniles with some snow buntings at Slidre Fiord. The observation is noteworthy. The ground was snow covered and the air temperature below freezing. The sanderlings fed half-heartedly on kitchen refuse, cornmeal and cracker crumbs while hopping about on one leg, the other tucked up among the feathers. In 1955, we did not record the species after August 31.

Description of Specimens. Measurements (in milli-

meters) of four juvenile specimens taken at Slidre Fiord in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
133	August 3	female	115.0	43.5	23.0	23.0
145	August 20	?	116.0	43.5	?	25.0
156	August 26	female	120.0	51.0	25.0	25.0
160	August 31	female	124.0	49.0	25.0	25.0

Annual Breeding Cycle. Sanderlings probably arrive at the Fosheim Peninsula in late May or early June, about the time the turnstones and knots arrive. Egg-laying starts about mid-June, hatching about mid-July. The fledging period of 12-14 days (Manniche, 1910:148) probably is finished before the end of July. No adults whatever have been seen on the beach at Slidre Fiord, but juveniles appear there in August. Most juveniles leave the fiord shores by early September.

CHAPTER XV

BAIRD'S SANDPIPER

Baird's sandpiper (Erolia bairdii) breeds from eastern Siberia across Alaska and Canada to northwest Greenland. In the Canadian Arctic Archipelago it breeds well northward, but its distribution at high latitudes is not well known. On Prince Patrick Island it was rare in 1949 but common in 1952 (MacDonald, 1954:227). In Greenland it is known to breed locally in the Thule District, and probably northwards from there to Washington Land (Salomonsen, 1951:243).

Ellesmere Island. Specimens (adult, Hayes Sound, July, 1899; clutch of four eggs, "Stordalen," June 20, 1900) collected in Ellesmere Land by the Second Fram Expedition have been reported by Schaanning (1933:154-5). Neither Feilden (1877:401-12) nor MacDonald (1953:7-11) found the species on the north coast, nor did Greely (1886, 2:384-5) find it on the east coast. Heretofore it has not been reported from the Fosheim Peninsula. In 1955 we saw it there on two occasions only.

Axel Heiberg Island. At 80°42'40"N. 90°59'W. (18 miles northwest of the mouth of Stang Bay and three miles

from the coast), in high, well-vegetated country, MacDonald collected an adult molting male Baird's sandpiper (brood-patches distinct) on July 23. The bird behaved as if young were close by, but no chicks were seen. An adult male collected on the east coast of Baffin Island on July 10, 1950, had brood-patches and was beginning to molt (Wynne-Edwards, 1952:369).

Nesting. At least one pair nested on the Fosheim Peninsula in 1955. As we were crossing well-vegetated hummocky tundra just south of Eastwind Lake on July 15, we saw two adult birds running and flying about excitedly. One of these was accompanied by three well-developed but flightless chicks. After shooting this parent, a molting female with well-defined brood-patches, MacDonald ran down one of the chicks. The loud peeping made possible the capture of another. The second adult, which was extremely shy, finally flew off, calling loudly.

Baird's sandpiper may breed abundantly at one particular place and be entirely absent at "equally suitable" places close by (Dixon, 1917:79). This species may have been largely overlooked on the Fosheim Peninsula, but granting that, it was certainly the rarest scolopacid encountered by us in 1955.

Departure. We failed to find this sandpiper among the various young shorebirds along the fiord coast in August. We did, however, collect two young birds on a gravel bar just

upstream from the delta of Station Creek on August 27.

Description of Specimens. Measurements (in millimeters) of these two young birds are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
157	August 27	female	121.5	47.5	21.5	21.0
158	August 27	male	119.5	49.5	21.0	22.0

DFP 157 weighed 36.1 grams, its ovary measured 5.0 x 1.5.
DFP 158 weighed 36.2 grams, its testes measured 1.0 x 0.5.

One of the chicks (DFP 112) collected near Eastwind Lake on July 15 was a female (weight, 21.9 grams; culmen, 14.0 mm.; tarsus, 21.0 mm.). Although mostly covered with down, its remiges were starting to burst from their sheaths as were feathers on the back, scapulars, sides, and flanks.

Annual Breeding Cycle. There is no spring record for Baird's sandpiper on the Fosheim Peninsula. Nothing is known of its nest-site, egg-laying, incubation, and fledging there. Large chicks found July 15 indicate fairly early egg-laying, conceivably as early as mid-June. Both sexes have brood-patches, and apparently both sexes attend young. Post-nuptial molt is well under way by mid-July, but this molt may or may not be completed on the nesting grounds. Young birds have been seen as late as August 27.

CHAPTER XVI

RED PHALAROPE

The red phalarope (Phalaropus fulicarius) breeds somewhat locally on the arctic coasts and islands of the Holarctic Region (Peters, 1934:292). It is common on the Eurasian tundra, breeding northward to high latitudes on Spitzbergen and the Franz Josef Archipelago (Pleske, 1928: 280-1). In Canada it breeds northward to Melville Island and northern Ellesmere Island (Hellmayr and Conover, 1948: 218). MacDonald (1954:227) saw it on Prince Patrick Island in 1949 and 1952, but found no evidence of breeding. It breeds only in the high arctic in East Greenland and only in the northern part of the low arctic in West Greenland (Salomonsen, 1951:254).

Ellesmere Island. In 1876 Feilden (1877:406) collected a female on the north coast on June 30 and in July he saw there a pair that were "apparently breeding." Only a few red phalaropes were seen by Greely's party on the east coast. One specimen was taken at Distant Cape, June 26, 1883, another at Cape Baird, July 2, 1883 (Greely, 1886, 2:377). In 1951 MacDonald (1953:9) collected three adult males and six

adult females from a flock of 10 birds on the north coast (Cape Belknap) on June 23. Heretofore it has not been reported from the Fosheim Peninsula. In 1955 we saw it there on three occasions.

In Greenland this species arrives June 9-13, later than any other bird (Salomonsen, 1951:258). In 1955 we first recorded it on June 18 (one bird seen by Sim and Marsden at a lake 18 miles northeast of the head of Slidre Fiord). On July 2 six birds were seen at a lake near Iceberg Point (Sim and Marsden). MacDonald and I visited this same area on July 11, finding a single male bird on one of the sedgy ponds. It flew about erratically, as if perturbed by our presence near its nest. Failing to find either eggs or young, we finally shot it, finding that it had well-defined brood-patches. We did not see the species thereafter.

We failed to find the red phalarope in any of many marshy areas we visited in 1955 in the Fosheim Peninsula interior. Had it been at all common in 1953-54, Bruggemann would have surely noted it.

CHAPTER XVII

LONG-TAILED JAEGER

The long-tailed jaeger (Stercorarius longicaudus), a holarctic species, breeds extensively in the new world high arctic. Bailey (1948:235) considers it the "common form" of jaeger on the Alaskan coast from Cape Prince of Wales to Point Barrow. MacDonald (1954:228) found it "common" in 1949 and 1952 at 76°N. on Prince Patrick Island. In Greenland it is a "true high-arctic bird," breeding rather commonly even on the north coast (Salomonsen, 1951:278).

Ellesmere Island. In the summer of 1876 the long-tailed jaeger bred commonly on the north coast (Feilden, 1877:409-10) where MacDonald (1953:9) found it "amazingly abundant" in June of 1951. In 1881-83 it was the "most common bird" in the vicinity of Discovery Harbor on the east coast and common in the interior of Grinnell Land in July, 1882 (Greely, 1886, 2:374). It also was common and bred in southern Ellesmere Island (King Oscar Land) in 1901-02 (Bay, in Sverdrup, 1904, 2:480). It has been common on the Fosheim Peninsula, all observers since 1947 having seen much of it. In 1955 it was very common there, only the turnstone, knot,

and snow bunting being commoner. It was widely dispersed, being conspicuous along the coast and in well-vegetated areas inland.

Sim and Marsden reported seeing "several" long-tailed jaegers in the Caledonian Bay area of Canyon Fiord east of the Fosheim Peninsula during July 23-27, 1955. On July 24, 1955, at 80°46'N. 88°23'40"W., on the northeast coast of Nansen Sound, we saw a pair behave as if small young were close by.

Axel Heiberg Island. A pair of long-tailed jaegers that we saw at 80°12'N. 87°54'W., on the Schei Peninsula, July 25, 1955, behaved as if they had small young close by.

Arrival. The long-tailed jaeger arrives in high-arctic Greenland in late May and early June (Salomonsen, 1951: 282). In Ellesmere Island, both Feilden (1877:409) and MacDonald (1953:9) recorded its arrival on the north coast during the first week of June in 1876 and 1951 respectively. On the east coast, in 1882, 1883, and 1884, Greely (1886, 2: 374) noted its arrival on June 3, June 4, and May 23, respectively.

In 1951 Tener (Godfrey, 1953:92) first saw the species at Slidre Fiord on June 7 (one bird). In 1953 and 1954 Bruggemann (1953, 1954) first observed it at the fiord on June 2 (two birds) and June 1 (one bird) respectively. In 1955 Sim and Marsden saw many long-tailed jaegers near the head of the fiord as early as May 31.

On June 4 two jaegers, the first MacDonald and I had seen, flew low over Eureka. We collected one of them, a female with an ovum 12 mm. in diameter. Both sexes probably arrived at the same time, although we did not collect a male specimen until June 10. We observed copulation on June 8. The birds chased each other playfully above the shore and fiord ice from June 4 to 11. So far as we could tell there were no special courtship displays.

On June 5 and 6 we saw as many as 33 jaegers at one time at Eureka. Flocks of migrating birds continued to arrive until mid-June. Migration reached a sort of peak at 1:30 a.m., on June 14, when 200 or more jaegers gathered over Station Creek delta and flew northwestward en masse.

We saw only two long-tailed jaegers in sub-adult plumage (June 20, July 22). This is surprising in view of the fact that a "good number" of immature birds follow the adults to the breeding-places in high-arctic Greenland (Salomonsen, 1951:282-3). If Bent (1921:24) is correct in stating that the long central rectrices are not assumed until the second post-nuptial molt, the birds we saw were probably in the "first summer plumage" as illustrated in Witherby (1948, 5:plate 139).

Behavior at Eureka. The long-tailed jaeger was the most conspicuous and vociferous bird at Eureka. Whenever we stepped outside we saw half a dozen jaegers eating scraps near the chained dogs and another half dozen circling and

gliding back and forth. Their incessant mewings never let up, and the men looked upon them as pests.

Unlike the glaucous and Thayer's gulls (Larus argentatus thayeri), which were wary, the long-tailed jaegers alighted boldly anywhere about the weather station. We could walk to within a few feet of them and call several of them in by tossing scraps of food into the air. They greedily ate almost anything but were especially fond of spaghetti. Large items they carried to the fiord ice or to gravel bars of the delta. Snatching and flying off with a scrap triggered a response in the other jaegers to pursue and harass. If the pursued was lucky enough to outfly the jaegers and get past the Thayer's gulls, it almost always lost its prize to a glaucous gull waiting on the outside ring. Several times we saw food pass from jaeger to Thayer's gull to glaucous gull, ending up in the last.

Jaegers were especially abundant during the second and third weeks of June. Large numbers of them congregated on the beach and offshore ice. As the snow receded they found food left by the dogs and buried by snow. They swam on the inundated sea ice following the spring thaw. When shore leads formed, they occasionally fed on marine animals.

A favorite roosting spot in summer was a gravel slope near the beach and just east of the station. Here the birds roosted or slept at all hours. The largest number we saw there at any one time was 69 (12:45 a.m., June 12). A few of

them roosted on the sea ice, the gravel bars of the delta, or the roofs of the station buildings. The only roosting flocks we saw were at Eureka. Inland we often saw a single bird roosting on a rock or knoll. Here there seemed to be definite roosting hours--when the sun was low.

The jaegers were easily trapped. Captured birds bit viciously. Failing to win freedom through biting, they shook their heads violently and regurgitated food. Many birds we caught a second time. The flapping and screaming of a captured jaeger held by its legs did not frighten the others off.

Banding at Eureka. On June 6 we live-trapped our first jaegers. We caught the birds in padded fox traps set on the ground near food scraps. On June 6, 7, and 8 we banded 25 birds (494-14101-25), on June 9 and 10, 25 more (495-59426-50), from June 15 through 18, 53 more (523-50219-71). We did not trap more until August 7. From August 7 through 14 we banded 24 birds (523-50275, -278, -281, -284-300, and 35-312792-95). Thus we banded 127 birds at Eureka weather station.

We had 19 repeats at Eureka, not including those made on the day of banding. The more significant ones were: 494-14102, banded June 6, repeated June 8, July 21, and August 10; 494-59429, banded June 9, repeated August 7; 523-50246, banded June 16, repeated August 7 and 8; 523-50264, banded June 16, repeated August 14.

Through banding and marking two significant facts

were brought to light. 1. New birds visited Eureka throughout the summer. 2. About one jaeger in 20 observed away from Eureka had a band. We observed one banded jaeger near Eastwind Lake, about eight flight miles northeast of Eureka.

Nesting. On the Fosheim Peninsula, in 1951, the behavior of adult long-tailed jaegers "strongly suggested breeding," but diligent search by Tener failed to reveal any nests (Godfrey, 1953:92). In 1953 Bruggemann (1953) found a nest with an egg and downy chick near Slidre Fiord on July 15. In 1954 Bruggemann (1954) found a young bird, presumably out of the nest, on July 24.

In 1955 the species nested on the barren fiord slopes as well as inland. Well-vegetated hummocky tundra in the vicinity of lakes and ponds was a favorite habitat. Water was not requisite, however. Of 18 nests found, the lowest was 173 feet, the highest 740 feet, above sea level. Sim noted a jaeger that appeared to be "nesting" at 1700 feet elevation on Northwest Ridge (June 30). In Greenland the species sometimes frequents areas of 800 meters elevation (Salomonsen, 1951:282).

All nests seen by us were unlined natural cups or shallow hollows in the ground. Most of our 18 nests were among low spreading willows. One was on the top of a hummock, another on bare ground in the hoof print of a muskox (Fig. 11). Data concerning 18 Fosheim Peninsula nests are:

Nest No.	Date found	Contents when found	Clutch-size	No. young hatched	Approximate hatching date
1	June 17	2 eggs	2	collected June 19	
2	June 17	2 eggs	2		
3	June 20	1 egg	1	0 (destroyed)	
4	June 22	1 egg	1	1	July 15
5	June 23	2 eggs	2		
6	June 27	2 eggs	2	2	July 9*
7	June 28	1 egg	1	1	July 13
8	June 29	1 egg	1	0 (destroyed)	
9	June 29	2 eggs	2	2	July 11*
10	July 2	2 eggs	2		
11	July 3	1 egg	1		
12	July 3	2 eggs	2		
13	July 4	2 eggs	2		
14	July 10	1 young		1	July 10
15	July 11	1 egg	1	1	July 12
16	July 12	1 egg	1		
17	July 12	1 young		1	July 12
18	July 16	1 young		1	July 16

* first egg

In Greenland the long-tailed jaeger regularly lays two eggs (Salomonsen, 1951:283). On the Fosheim Peninsula in 1955 one-egg clutches were as common as two-egg clutches.

Copulation. On June 8 we witnessed copulation on the fiord ice near Eureka. The female squatted and the male, with wings fluttering, mounted from behind. The act was brief. Twice we witnessed copulation inland--on June 12 at a place not later defended by jaegers, and on June 20 at a nest-site. There the females remained standing while the males, with wings fluttering and tails switching back and forth, mounted from behind. In each case the male mounted three times in about as many minutes.

Incubation Period. The egg found June 22 (Nest 4)

was probably fresh, for I had watched the pair on their territory regularly since June 20. The incubation period of this egg was probably 22-23 days. Manniche ascertained that the incubation period in Greenland is 23 days (Salomonsen, 1951:283).

According to Jourdain, incubation probably starts with the first egg (Witherby, 1948, 5:139); according to Manniche, the second egg is laid 36 to 50 hours after the first (Witherby, op. cit.).

Both sexes incubate. At Nest 1 (one and a half miles northwest of Eureka) on June 19, we snared each parent bird as it settled to incubate. One of them already had been banded (523-50243) on June 16. We banded (523-50272) its mate, then marked each bird with a red band. We then collected the eggs. They deserted the territory, and we did not see either of them again. At Nest 4 (two miles northeast of Eureka), the female (sex determined by position in copulation) was already banded (494-14102 on right leg, gold band on left, June 6), but the male we never captured. According to our observations the male spent more time than the female on the nest.

Hatching. A chick that hatched July 9 was two days ahead of its sibling, which had barely pipped its shell at that time. According to Pedersen (in Witherby, 1948, 5:139) young leave the nest when "2 days old." A chick at Nest 18 had left the nest within 18.5 hours of hatching.

Fledging Period. In Greenland the young are fledged by early August, sometimes by late July (Salomonsen, 1951: 283). On the Fosheim Peninsula, in 1953, Bruggemann (1953) saw one young bird, presumably flying, with two adults on August 19 and 28 and a single young bird flying on August 29.

In 1955 we first recorded young birds flying on August 9; that day Sim and Marsden saw three 12 miles southeast of the head of Slidre Fiord. On August 17 we shot two flying young birds--a male (weight, 248.5 grams) that was by itself and a very fat female (410.9 grams) that was attended by both parents. When flushed this bird flew a half mile before alighting again. The adults followed it and took commanding positions on prominences where they crouched and screamed incessantly. Not once did they boldly fly at us as they would have surely done at the nest; nor did they disclose the exact whereabouts of the young, which was exceedingly difficult to see. After several long chases we collected it. It was much heavier than the average adult. It had recently eaten adult insects and a piece of beef (from Eureka). One of its parents was banded.

According to Pedersen (in Witherby, 1948, 5:139) the fledging period of the species is "about 3 weeks," and the young are fed by both parents "till 10 days after they can fly." A chick that we banded (523-50273 on right leg, yellow band on left leg) at Nest 18 on July 16, appeared at Eureka on August 19, almost exactly 34 days after hatching. It flew

strongly and held its own among other jaegers and gulls which it sometimes chased. But as late as August 27, within a few days of the last jaeger departures, a parent still attended and fed this chick. Allowing "three weeks" for the fledging-period, the chick must have fledged about August 6. Thus it was fed 21 days after its supposed fledging, 42 days after its known hatching.

Departure. The long-tailed jaeger leaves high-arctic Greenland in August as a rule, but one bird was observed as late as October 2 in Scoresby Sound (Salomonsen, 1951:283). On the east coast of Ellesmere Island, in 1882, the species was seen as late as August 30 (Greely, 1886, 2:384). In 1951 MacDonald (1953:9) last noted it at Alert on August 5 (one bird).

Bruggemann (1953, 1954) noted flocks of jaegers (up to 25 birds) daily at Eureka until mid-July in 1953, but their numbers declined steadily thereafter (latest record: one bird, August 30); in 1954 he noted large flocks (up to 30 birds) daily at Eureka from the second week in June to the end of July (latest record, one bird, August 13). Bruggemann (1954) noted that the long-tailed jaeger as well as the turnstone, knot, and arctic tern, left Slidre Fiord two weeks earlier than in 1953, in spite of the fact that August temperatures were considerably higher in 1954.

In 1955 the migratory pattern of the long-tailed jaeger was anything but regular. Non-nesting birds probably

started to leave the peninsula as early as mid-July. The numbers of jaegers fluctuated at Eureka from time to time. In early July we saw surprisingly few--a fact appreciated even by the station personnel. During a six-day period we recorded no more than 11 at any one time. During a sudden cold snap on July 7 the jaeger count jumped to 38 and from this time on the species was again common until August. On July 29 a flock of 79 jaegers, almost certainly transients, appeared. Thereafter their numbers declined rapidly, the largest counts for July 30 and 31 being 13 and 9 respectively. On August 1 only a few were about. In August the jaegers were never as abundant as during June and July, the largest single counts often being less than 10 birds. On August 14 we banded 11 birds from a newly arrived group. Another migratory flock of 24 paused briefly on August 16.

By mid-August many inland areas had few or no jaegers. Even the places which had been inhabited by many of them were void. On August 27 jaegers were scarce everywhere, and for the first time we failed to note at least a few about the station. On August 31 we saw one at 7:30 a.m., two at 9:30 a.m., one at 11:00 a.m., two at 1:45 p.m. One was still about until 4:30 p.m. We last recorded the species September 1. A lone individual came to Eureka at 9:50 a.m. It flew about the area, frequently alighting on the buildings and circling out over the fiord.

Annual Food Cycle. In northeast Greenland nesting of

the long-tailed jaeger is subject to fluctuations which "appear" to be correlated with the size of the lemming population (Salomonsen, 1951:284). The dependence of this jaeger on lemmings may explain its rarity in west Greenland where the lemming is absent (Salomonsen, loc. cit.). Bruggemann (1953, 1954) found little lemming sign anywhere in 1953; in 1954 he did not see a single lemming. In 1955 lemmings were rare wherever we travelled. The long-tailed jaeger was, however, very abundant from 1953 to 1955, inclusive.

The weather station at Eureka furnished the jaegers an artificial food supply but this food could hardly have had much effect on the peninsular population as a whole. Many jaegers that fed at Eureka were non-breeding birds. Inland the jaegers fed principally on insects and their larvae. A female specimen collected near Slidre Fiord on June 7, 1951, by Tener (Godfrey, 1953:92) had eaten a small bird, probably a snow bunting; a female specimen collected by him June 13 had eaten three caterpillars. Of the specimens taken near Slidre Fiord in 1955, one had eaten three caterpillars (June 10); another, 28 caterpillars and one spider (July 6); another, 11 grubs (August 16). A few fish bones were found in the stomach of another (August 17). Following its capture on August 29, one individual regurgitated six polar tomcods (Boreogadus saida).

A less-than-three-day-old chick regurgitated the remains of craneflies and a snow bunting fledgling on July 15.

In Greenland young long-tailed jaegers are "fed with insects for the first 10-12 days" and then lemmings (Salomonsen, 1951:285).

An insect of wide-spread distribution on the peninsula was the moth Byrdia. In late May and early June the spiny caterpillars of this moth were very abundant in the lowlands. We confidently expected to find birds taking advantage of such a plentiful early food supply but apparently they did not do so. Once the pupae had formed, however, the jaegers ripped open the cocoons and ate the contents.

The cries of young knots and turnstones invariably called in the hunting jaegers. After we had banded and released an unfledged knot (weight 50.2 grams) on July 15, a jaeger glided in and carried it off without touching the ground. In escaping, the jaeger endured the determined pounding of three adult knots. We never saw a jaeger attack adult or fledged knots and turnstones; nor did we ever see one chase an adult snow bunting. MacDonald saw one fail repeatedly to catch a recently-fledged arctic tern on August 20.

Predation and Survival. On July 19 we found the remains of a recently-killed jaeger on a ridge near the head of Slidre Fiord. The attitude of the species toward the fox clearly showed that mammal to be a "much-hated" predator, for jaegers harassed foxes relentlessly. We never saw a jaeger actually strike a fox. Indeed, the foxes seemed to be only mildly annoyed by the birds. Near Eastwind Lake, in early

July, MacDonald saw a jaeger egg in the mouth of a fox which ran past him.

Recently-fledged jaegers were preyed upon by gyrfalcons. South of Slidre Fiord on August 22, I found the fresh remains of a young jaeger at the foot of a gyrfalcon cliff. Near by, on a pinnacle, two young gyrfalcons were feeding on the remains of another. Later, several miles from there, I found the scattered feathers of a third young jaeger.

Jaegers on the hunt were attracted to other jaegers defending eggs or young. The defenders attacked the intruders as they would have any other. A form of territorial defense existed after the young had hatched and were moving about the tundra. The adults of Nest 4 vigorously defended an area occupied by their small young some 300 yards from the nest itself. A third jaeger, attracted by the commotion, was driven swiftly off every time it came close. Our observations agree with those of Salomonsen (1951:282), who states that S. longicaudus "does not feign injury" (as does S. parasiticus) but has a "pronounced attacking instinct."

We crippled remarkably few jaegers during our live trappings at Eureka. While handling a captured bird on June 7, for some unaccountable reason, we injured it in such a way that it was unable to fly or even recover a standing position when turned over. We kept it until it regained its health some days later. Before releasing, we marked it with a band stamped 13. We last saw it at Eureka August 8. Un-

known to us at the time, jaeger 35-312793 was released with a broken femur after banding on August 14. The leg atrophied. It dangled loosely when the bird flew. On the ground the bird always crouched. This bird survived with one leg until MacDonald collected it August 22.

Jaeger 494-14113 had broken its tarsometatarsal bone previous to its capture on June 7. The break in this case had healed very well, and although the leg was somewhat deformed, it was perfectly functional.

When jaeger 495-59429 (banded June 9) repeated August 7, we discovered a large fish bone lodged sideways in its throat, pushing the sides of the throat far outward. This bird would have surely perished had we not removed the bone.

Description of Specimens. Measurements (in millimeters) of seven long-tailed jaegers taken at Slidre Fiord in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
94	June 10	male	298.0	292.0	29.0	42.0
140	August 16	male	301.0	303.0	31.0	40.5
159	August 29	male	308.0	308.0	28.0	43.0
108	July 6	female	311.0	293.0	28.0	43.0
144	August 17	female	299.0	254.0**	27.5	41.5
141	August 17	male*	267.0	130.0	25.0	41.0
143	August 17	female*	272.0	136.0	27.0	38.5

* juvenile
** rectrices worn short

The summer plumage of S. longicaudus is acquired by a complete molt "apparently" in early spring (Witherby, 1948, 5:140). All jaegers handled by us in June were in complete

summer plumage. DFP 94 (June 10) showed no molt, but some of the rectrices were still partially sheathed at the base. The species has an autumn molt (October and probably later) involving all body plumage, but it is not known when the wing and tail feathers are shed (Witherby, loc. cit.). DFP 108 (July 6) had numerous pinfeathers on the body, neck, and leg regions. DFP 140 (August 16) and 144 (August 17) had very few pinfeathers while DFP 159 (August 29) had none. We noted no regular molting of the remiges. Some of the jaegers seen in July and August appeared to have shed part of their rectrices. However, none of the above specimens show such a molt. DFP 144 alone is peculiar in having an abnormally long rectrix, but this single feather is still considerably shorter than the badly worn central pair.

The Fosheim Peninsula juveniles are strikingly paler, particularly on the head and under body regions, than two juveniles (Sutton Collection, nos. 11833, 11834) taken at Cape Dorchester, Baffin Island. The juvenal and first winter plumage of S. longicaudus is variable but not as variable as in S. parasiticus (Witherby, 1948, 5:140).

S. l. pallescens, a pale American form, breeds from Greenland west to Alaska and eastern Siberia (Salomonsen, 1951:285). Shortt (1951:219) states that Salomonsen's conclusion is borne out by material in the Royal Ontario Museum. Witherby (1948, 5:141) does not recognize pallescens. Until better understood, I refer the Ellesmere Island birds only to

S. longicaudus.

The set of eggs (DFP 55-5) collected near Slidre Fiord on June 19, 1955, are of the pale variety, being light greenish brown marked with lavender and brown. Each measures 51.0 x 39.0 mm.

Annual Breeding Cycle. The long-tailed jaeger arrives at the Fosheim Peninsula from late May to mid-June. Pairing takes place as early as June 8, probably earlier. The nesting habitat is varied. Egg-laying commences by mid-June. The clutch-size is one or two. Both sexes incubate. The incubation period is about 23 days. Eggs hatch as early as July 9, as late as July 16. Both sexes attend young during and after fledging. Fledged young occur as early as August 9, probably earlier. Some fledged young are attended by adults until departure in late August. The post-nuptial molt does not occur on the nesting grounds. Migration of non-breeding birds probably commences by mid-July. The last jaegers leave the peninsula by September 1.

CHAPTER XVIII

THAYER'S GULL

In June, 1901, several gulls, supposedly "Larus kumlieni," were collected by J. S. Warmbath at Buchanan Bay on the east coast of Ellesmere Island (Bent, 1921:120-1). These were described by W. S. Brooks (1915:373-5), in 1915, as a new species, Larus thayeri. Opinion has differed radically as to what "Larus thayeri" is. Many ornithologists have considered it the northernmost new world race of the herring gull (Larus argentatus). Salomonsen (1951:319) considers it a race of the Iceland gull (Larus glaucoides). It breeds from Banks Island to northwest Greenland. In Greenland it is found only in the Thule District (Salomonsen, op. cit.).

Ellesmere Island. Bay (in Sverdrup, 1904, 2:480) said that "L. argentatus" often bred at the same place with the glaucous gull in southern Ellesmere Island (King Oscar Land). Several sets of Thayer's gull eggs were collected by J. S. Warmbath at Buchanan Bay (Brooks, 1915:374). Neither Feilden (1877:401-12) nor MacDonald (1953:7-11) saw any gull of this sort on the north coast. At Slidre Fiord, Tener (Godfrey, 1953:92) saw two gulls, "probably thayeri," on June

12, 1951. Bruggemann (1953, 1954) recorded "Larus argentatus" at Slidre Fiord on June 9, 1953 (two birds), on July 25, 1953 (two birds), and several times in 1954 (July 12 and August 11, 12, 14, and 25, a single bird on each date). In 1955 Thayer's gull was uncommon at Slidre Fiord. We did not see it elsewhere on the peninsula.

Axel Heiberg Island. According to MacDonald (in litt.) members of the 1953 Axel Heiberg Expedition to Mökka Fiord saw as many as 15 Thayer's gulls nesting on cliffs near Lake Maersk. They saw the nests but did not climb up to them. MacDonald visited this area briefly on July 26, 1955. Two Thayer's gulls flew past him heading for the cliffs.

Arrival. Little is known about the migration of this bird. In Alaska it is seen in the fall, when it migrates along the coast, but not in spring, when it probably keeps well out to sea (Bailey, 1948:243). It winters along the Pacific Coast from British Columbia to California (Peters, 1934:316). Bay (in Sverdrup, 1904, 2:480) stated that the "herring gull" arrived at King Oscar Land in the "latter half" of May, about the same time as the glaucous gull. In 1955 we first saw Thayer's gull on June 10. That day a loose flock of six birds (probably three pairs) appeared at Eureka. Their cries were at once distinguishable from those of the glaucous gull which had arrived 16 days earlier. We collected five of the birds: two that were feeding on a wolf carcass and three that circled low overhead at Station Creek

delta. From that day until early August we regularly noted Thayer's gull (Fig. 17) at Eureka.

Slidre Fiord Population. At least 16 Thayer's gulls visited Slidre Fiord at one time or another in 1955. The largest number we saw at any one time was eight, on June 20. By this time we had already collected eight specimens. Thayer's gull and the glaucous gull visited Eureka daily, but they never fraternized. A Thayer's gull sometimes alighted on the ground between the buildings. A favorite perch was a high antenna mast. Unlike the glaucous gull, it did not often swim in the fiord.

Nesting. On June 18, 1955, we saw a pair copulating. The female slowly crouched while the male mounted from behind. The act continued for fully a minute. When the gulls nested is uncertain. We did not find scattered pairs nesting on tundra ponds as L. a. smithsonianus, the American herring gull, is reported to do. Birds which flew low overhead in July seemed to have brood-patches.

Departure. Bay (in Sverdrup, 1904, 2:480) stated that both herring and glaucous gulls remained in King Oscar Land as long as there was open water. Thayer's gulls are "regular" fall migrants along the Alaskan coast (Bailey, 1948:243). No dates are given for Greenland (Salomonsen, 1951:319-21).

At Slidre Fiord, in 1955, we saw four at Eureka on August 1, and a single bird on August 2, 3, 4, and 9. We

saw no young birds.

Description of Specimens. Measurements (in millimeters) of the two adults collected at Slidre Fiord in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
95	June 10	male	406.0	163.0	52.0	63.0
96	June 10	female	390.0	169.0	45.0	58.5

DFP 95 weighed 1028.0 grams; its testes measured 23.0 x 21.0 mm. and 13.5 x 11.0. DFP 96 weighed 846.0 grams; its ovary measured 27.5 x 16.0, the largest ovum, 10.0 x 8.5.

Although the mantle of thayeri is said to be lighter than that of L. a. smithsonianus (Ridgway, 1919:600), the Slidre Fiord birds are darker above than two smithsonianus specimens (Sutton Collection, nos. 11744, 11846) collected in southern Baffin Island. The wing-tip pattern of the Slidre Fiord birds differs slightly from that of the type specimen (Dwight, 1917:413-4).

Annual Breeding Cycle. Thayer's gull arrives at Slidre Fiord about June 10, considerably later than the glaucous gull. Nothing is known of its nesting on the Fosheim Peninsula. Very few birds have been seen in August, none after August 25.

CHAPTER XIX

GLAUCOUS GULL

The glaucous gull (Larus hyperboreus) breeds circumboreally northward to high latitudes. Pleske (1928:204) believes that it breeds across the whole of northern Eurasia, including even Spitzbergen and the Franz Josef Archipelago. It breeds well northward in America, but the northernmost breeding places in the new world are not well known. The most northern records for Greenland are not breeding records (Salomonsen, 1951:302-3).

Ellesmere Island. Feilden (1877:409) in 1876 and MacDonald (1953:10) in 1951 saw this species on the north coast but found no evidence of breeding. In the vicinity of Fort Conger, on the east coast, it was "not an uncommon" bird in 1881-83, but no breeding places were found (Greely, 1886, 2:374-5). Feilden (loc. cit.) mentioned its nesting at Cape Sabine. Most of the many gull nests found by the Second Fram Expedition were probably of this species. A single egg from Ellesmere Land (June 25, 1901) was preserved by that expedition (Schaanning, 1933:151). Bay (in Sverdrup, 1904, 2:480) stated that the glaucous gull was the "commonest"

breeding gull of King Oscar Land. A male was collected at Craig Harbour on August 26, 1938, and a "few" birds were seen there on August 22-24 in 1939 (Shortt and Peters, 1942:345). On the Fosheim Peninsula it is uncommon.

Arrival. The glaucous gull has been seen in Spitzbergen and the Franz Josef Archipelago as early as February 18 and March 5, respectively (Pleske, 1928:205-6). It arrives at its Greenland breeding places when the "ice is still unbroken"--in early June in Peary Land (Salomonsen, 1951:307). On the north coast of Ellesmere Island it arrived the "middle of June" in 1876 (Feilden, 1877:409) and on May 23 (one bird) in 1951 (MacDonald, 1953:10). At Fort Conger it was first seen on June 5 in 1883 (Greely, 1886, 2:374). In southern Ellesmere Island it arrives in the "latter half of May" (Bay, in Sverdrup, 1904, 2:480). At Slidre Fiord Tener (Godfrey, 1953:92) first noted the species on June 3 (two birds) in 1951. Bruggemann (1953, 1954) first noted it at Slidre Fiord on May 28, 1953 (one bird) and on May 25, 1954 (two birds).

In 1955 we first saw the species on May 26. A small, thin bird, probably a female, stood on the sea ice several hundred yards from shore that day, stealing in now and then to pick at a wolf carcass at the delta of Station Creek. It walked the entire distance each time. When flushed by fox or dog it flew low over the ice, alighting at a safe distance. We also saw three birds far out on the fiord that same day. On May 27 we saw eight birds in a loose flock offshore from

Eureka. Some of the birds went about in pairs. One pair copulated far out on the ice. Thereafter we saw the species at Slidre Fiord regularly, but it was never abundant.

Tener (Godfrey, 1953:92) noted as many as six glaucous gulls at Slidre Fiord in the summer of 1951, but it is not known whether the birds were paired. Bruggemann (1953, 1954) thought that only two pairs lived there in 1953-54. Probably four or more pairs lived there in 1955. By noting both marked and unmarked birds, we ascertained that at least nine birds visited Slidre Fiord at one time or another. We did not often observe the species far inland. Sim and Marsden saw it east of the head of Slidre Fiord in early June. On June 18 they saw a pair at a lake 18 miles northeast of the head of the fiord.

Banding at Eureka. By setting padded fox traps near food on the delta near Eureka we caught six glaucous gulls. Five of these we banded. We banded the first, a small female (527-65527 on right leg), on May 28. We also marked its right wing with bright red paint. This bird returned to Eureka with its larger mate on May 29 and 30. We last saw it there (by itself) on June 14.

The second bird, a large male banded (527-65528 on right) and marked (orange on right wing) on May 31, we saw regularly until September 12. It was known as "Orange-wing." It probably nested somewhere on the high rocks of Hare Cape. We never saw it fly from Eureka directly to the cape, however.

It followed the north shore of the fiord nearly to its mouth, then flew southward. It returned to Eureka by the same route.

The third bird, a huge male banded (527-65529 on left) and marked (yellow on right wing) on June 15, we did not see after June 16. Neither a female banded (527-65530 on left) and marked (green on left wing) on June 16 nor a male banded (527-65531 on left) and marked (red on left wing) on June 25 were seen by us again.

Behavior at Eureka. Hatfield (in Handley, unpubl. ms.) saw several pairs of these gulls around the station in the summer of 1949. Bruggemann (1953, 1954) also saw the species frequently in 1953-54. In 1955 it fed regularly at Eureka throughout the summer. One or more birds were about at almost any hour.

The species was always shy. It almost never alighted on the station grounds as did Thayer's gull and the long-tailed jaeger, preferring to watch from ice floes or gravel bars near by. A jaeger or Thayer's gull flying with a food scrap was immediately set upon by a glaucous gull and forced to surrender the food. When the ice broke on the fiord, the glaucous gulls commonly fished for sculpins.

Very few glaucous gulls fed at the wolf and seal carcasses about which we had set traps. For hours they eyed the carcasses with suspicion, sometimes hovering low above them, or, about to alight, suddenly dipping a wing and alight-

ing 10 feet away. Occasionally they walked up to the carcass and touched the flesh with their bills and jumped back suddenly as if shocked. They seemed to know that something was wrong. Peck order existed among them. One bird (527-65529) dominated every other gull at Eureka. On the day of its capture, this bird stood near the wolf carcass and repeatedly drove off all other birds though it did not once go to the carcass and feed. We finally captured it by placing the traps in a shallow pool of melt water containing strips of fresh meat. Another bird (Orange-wing), dominated all other gulls than the bird just discussed.

Nesting. Hatfield (in Handley, unpubl. ms.) mentions a nest on a steep bank near Eureka in 1948. Bruggemann (1953) found two nests in 1953. The first, at 1,750 feet elevation, was on a high "rock turret" far inland on the west front of Black Top Ridge. The second, at 800 feet elevation, was in a narrow gorge at Geum Creek, not far from the head of Slidre Fiord. Both nests were inaccessible. At one of the nests he saw a young bird on July 31, at the other nest, a young bird on September 5. He did not visit the sites in 1954. No gulls nested far inland along Black Top Ridge in 1955 so far as we know, but one pair nested at Geum Creek.

The 1955 nest-ledge, half way up the north wall of the gorge, was conspicuous. An unusual growth of flowers indicated that the spot had been used by birds for a long time. On July 18, the date of our first visit, both parent

gulls were there. The female incubated while the male, standing near the nest, called constantly. Finally the female stood up and both called, but they did not fly at us. A third gull watched from the other side of the gorge. None of these birds were banded. We looked down on the nest from above but looseness of the rocks prevented close investigation. The nest appeared to be a mere hollow. We could not see its contents. Snow buntings were common. Several times we saw them fly close to the gulls. Below the nest-ledge we found faded pieces of gull egg.

On July 19 the parent gulls were away when we first reached Geum Creek gorge. Within an hour they returned flying in from the east rather than from the fiord. The female went to the nest immediately, but the male flew above us, scolding. On August 9 the nest-ledge appeared to be deserted. There were no young, and we did not see a gull about the gorge again.

Hatfield (in Handley, unpubl. ms.) noted young flying at Slidre Fiord in late August and early September in 1949. In 1954 Bruggemann (1954) saw two young with an adult on an ice floe in Eureka Sound on September 8. The young, barely able to fly, almost hit the water when flushed.

As early as August 15, Orange-wing and his bandless mate dove at us repeatedly about a mile and a half west of Eureka. Their young were probably among the numerous ice floes that had drifted in that day, but we did not actually

see them until they visited Eureka on September 1. Both young were flying strongly on that date. They circled above a seal carcass, finally alighting on the water offshore where they swam with Orange-wing. Later the female joined them and all four flew off together. On September 3 Orange-wing flew about the station area and scolded several times.

Departure. Adult glaucous gulls leave their high-arctic breeding places in Greenland early in September, the young birds lingering until freeze-up (Salomonsen, 1951:308). In the fall of 1875 the species was last seen on the north coast of Ellesmere Island on September 1 (Feilden, 1877:409). The latest date for 1951 was August 17--one bird seen at Alert (MacDonald, 1953:10). In southern Ellesmere Island, the species remains as long as there is open water (Bay, in Sverdrup, 1904, 2:480). At Slidre Fiord, in 1954, Bruggemann (1954) observed it as late as September 28 (one adult). In 1955 we last saw an adult (Orange-wing) on September 12 and a young bird on September 17.

Molt. The primaries in this species are molted gradually throughout the summer. As early as June 25 we saw one drop from the wing of an unbanded individual circling above us. On September 12 Orange-wing still retained two orange primaries.

Food. The species is a predator of renown, but the only bird we saw it attack was a nearly-fledged greater snow goose (Slidre Fiord, August 26). At Eureka where we saw

glaucous gulls most often, they were mostly interested in the artificial food supply. Nesting arctic terns repeatedly drove them off.

Annual Breeding Cycle. The glaucous gull, conspicuous but uncommon, arrives at Slidre Fiord in late May before the spring thaw and the formation of shore leads. Either it is mated on arrival or pairs form soon after arrival. It breeds in widely scattered pairs, placing its nest on precipitous cliffs or steep banks. Egg-laying probably takes place throughout June, hatching throughout July. Young probably leave the nest from mid-August to early September. Both adults attend young until after fledging. Most adults leave by mid-September, the young somewhat later.

CHAPTER XX

ARCTIC TERN

The arctic tern (Sterna paradisaea), a holarctic species, has a wide but very uneven breeding distribution. In Eurasia it breeds northward to high latitudes in Spitzbergen and the Franz Josef Archipelago (Pleske, 1928:442-3). It breeds commonly, although not continuously, along all but the northernmost coasts of Greenland (Salomonsen, 1951:339). In the Canadian Arctic Archipelago it breeds northward to the very limits of land.

Ellesmere Island. Feilden (1877:408-9) in 1876, MacMillan (1918:406) in 1909, and MacDonald (1953:10) in 1951 observed small numbers of arctic terns nesting on the north coast. In 1881-83, the species was "not uncommon" near Fort Conger on the east coast (Greely, 1886, 2:375). In 1900-02, it was "very common" on the south coast where it "generally bred in colonies" (Bay, in Sverdrup, 1904, 2:480). On the Fosheim Peninsula it has been conspicuous but not abundant in summer since 1947. At Slidre Fiord it nests in isolated pairs or in small colonies on gravelly deltas. It probably nests near Iceberg Point and elsewhere along the south shore

of Greely Fiord, where it was seen in 1953 by Bruggemann (1953) and in 1955 by Sim and Marsden. On July 24, 1955, Roots saw a single bird at 80°46'N. 88°23'40"W. on the northeast coast of Nansen Sound.

Arrival. In the Franz Josef Archipelago the arctic tern arrives about June 17-21 (Pleske, 1928:223), in Spitzbergen about June 1 as a rule but as late as June 23 in late years (Pleske, op. cit.), in high-arctic Greenland during the first half of June (Salomonsen, 1951:345). On the north coast of Ellesmere Island three birds were seen as early as June 16 in 1876 (Feilden, 1877:408). In 1951, MacDonald (1953:10) first saw the species there on June 22 (seven birds). On the east coast of Ellesmere Island, Greely (1886, 2:375) first noted the species in 1882 and 1883 on June 21 and June 18, respectively.

At Slidre Fiord arrival has been recorded several times--in 1951, June 16 (Godfrey, 1953:92); in 1953, two birds, June 23 (Bruggemann, 1953); in 1954, one bird, June 19 (Bruggemann, 1954). In 1955 we first saw the species--a single bird flying above the flooded sea ice--on June 10. The creeks had started to flow only four days earlier and shore leads had not yet formed. On June 11, 12, and 15 we again saw the species--one bird on each date. On June 16, we saw two birds, on June 18, 11 birds. Thereafter we could see the species whenever we wished to.

Slidre Fiord Population. Handley (unpubl. ms.)

visited three small colonies at Slidre Fiord August 9-10, 1947. Bruggemann (1953, 1954) estimated that four or five pairs bred about the fiord in 1953-54. In 1955 a minimum of 14 pairs bred there. Two pairs nested in the Station Creek delta near Eureka. Two miles east of there, a single pair nested in another delta. The extensive delta of Black Top Creek, still farther east, continued to puzzle us. At times there were no terns there. At other times we saw six or more birds, but we found no evidence of nesting. Four and one half miles west of Station Creek, one pair nested in a delta. Still farther west, in the vicinity of Musk Ox Point, three or more pairs nested together in a delta. A colony bred in a large gravelly delta almost directly across the fiord south of Eureka. There, on August 20, we counted 12 flying adults. An isolated pair nested in a smaller delta several miles east of there.

Nesting. In 1947 Handley (unpubl. ms.) saw unfledged young at all three Slidre Fiord colonies visited by him August 9-10. In 1951 Tener (Godfrey, 1953:92) found a nest with one egg at Slidre Fiord on July 14, and two nests each with "newly-hatched young" there on July 23. Bruggemann (1953, 1954) noted two pairs at the Station Creek delta in 1953 and 1954, but did not look for nests for fear of leading dogs to them.

In 1955 the first terns seen were not paired. Two birds seen near Eureka on June 16 may or may not have been

paired. Terns which we saw on June 20 were, however, definitely going about in pairs. On June 22 MacDonald was attacked by two birds that were obviously defending an area on the delta of Station Creek, but so far as we knew no eggs had been laid. On June 28 the pair attacked again, but searching revealed no eggs. At 7:00 p.m. on July 5 we found the nest. In it was one egg.

We found the nest by watching the parent bird alight. There was no real nest, not even a scrape. Throughout the nesting period, one or both adults viciously defended the area and were frequently joined by other terns, particularly a pair that nested close by. Nest 1 had but a single egg. This we watched regularly. A slight crack appeared on July 22. By July 24 the chick had pipped the shell and the chick was peeping loudly. The chick hatched between 3:00 and 3:30 p.m. on July 25. The period of incubation was at least 476 hours (approximately 20 days). The egg probably was laid on July 4, about a day before its discovery. According to Bent (1921:252) the period is about 21 days, according to Dircksen (in Witherby, 1948, 5:37), 21-22 days (43 clutches averaging 21 days 18 hours).

On July 27 we caught one of the parent birds in a butterfly net and banded it (either 523-50279 or -80). The chick was five feet from the nest. We next found it near the beach, 150 yards from the nest, on August 5. It was still downy. The banded parent dove at us repeatedly. We banded

the chick (502-75285).

By August 14 the chick's flight feathers were well developed, but it was not by any means ready to fly. When we first found it that day it was motionless on the gravel. On being handled, it defecated and regurgitated small fish. When released it ran swiftly to the water and swam 30 or more yards out into the heavy swells. One parent kept diving at it. Nine other terns, drawn by the commotion, flew wildly about high overhead, but only the parent attacked us. The following day ice drifted in against the shore. The chick swam out and hid in an ice crevice.

This chick was able to fly a little on August 17--23 days after hatching. At 11:00 a.m. it made several feeble flights (four to six feet each). We caught it easily with a net. Between 4:00 and 5:00 p.m. that day it made several long flights (100 feet or more) from the beach out over the fiord. On one such flight a parent struck it a glancing blow, forcing it to the water below. We could not catch the chick thereafter. In a few hours' time this chick had advanced from a weak flyer to a fairly strong one; but it did not acquire the characteristic "tern flight" for another two days. By August 19, 25 days after hatching, it flew strongly and skillfully and was fully fledged. The very minimum time needed for fledging in this case was 23 days. In the case of one Greenland pair the period of fledging was 21-23 days (Nicholson, 1930:413). According to Bullough (in Witherby,

1948, 5:37) young fly when about "3 weeks old."

Nest 2, found July 19, was on a small delta two miles east of Eureka. It was a mere scrape in the sand, and held two eggs. Like Nest 1, it was vigorously defended. In the same general area we found two other eggs, unbroken and faded, and lying several yards apart. We did not visit Nest 2 regularly. The eggs were not pipped on July 27. On August 9, only one egg (without an embryo) was in the nest. One of the adults flew at us fiercely. We caught and banded it (502-75287).

We found Nest 3 on July 21. It was on the delta of Station Creek, about 120 yards from Nest 1, and was a mere scrape in the sand. The two eggs were strikingly dissimilar in size, shape, and ground color. Only the larger of the two hatched. At 10:30 a.m. on August 3 we found this egg pipped. It hatched between 4:00 and 4:20 p.m. on August 4. The chick was of "brown phase" (Bent, 1921:253). At 8:25 p.m. on August 5, we found the chick four feet from the nest. We banded it (502-75286). We next examined the chick on August 17. It was still more or less down-covered and was about 125 yards inland from the nest. Four adults scolded overhead. They became fierce whenever the close-pressed chick cried out. We did not ascertain exactly when the chick began flying but it did so some time on August 25 or 26, about 21-22 days after hatching. On August 27 it was flying fairly strongly, and we could not catch it. Chick 502-75285, flying near by,

was considerably older, hence stronger of wing.

At the colony across the fiord from Eureka, we saw two strong-flying young birds on August 20 and one on August 23.

Departure. Arctic terns leave high-arctic Greenland from mid-August to early September (Salomonsen, 1951:346). They have been seen on Spitzbergen as late as September 9 and in the Franz Josef Archipelago as late as September 17 (Pleske, 1928:225). At Alert, Ellesmere Island, MacDonald (1953:10) saw them last in 1951 on September 3 (11 birds).

In the vicinity of Eureka terns are often seen in late August but only rarely in September. In 1948 Handley (unpubl. ms.) saw two birds at Slidre Fiord on August 28. In 1953 Bruggemann (1953) last saw the species on August 29 (one bird); in 1954 he last saw it on August 13 (two birds). In 1955 the first signs of migration were noticed on August 29, when a flock of 31 birds flew up-fiord past Eureka at 9:30 p.m. On August 30 and 31 we saw terns about Station Creek delta, as usual. Both chicks from Nests 1 and 2 were still attended by parents. On September 1 the parent birds defended the two chicks vigorously. That afternoon the four adults chased three glaucous gulls (one adult and two young) from the delta.

Nowhere did we see a tern after September 1. On September 2 we searched for the species in several parts of the fiord, but saw not a single bird. Young tern 502-75286 pre-

sumably started its southward migration less than a week after it started flying.

Feeding Behavior. The stomach of an adult tern collected by Tener at Slidre Fiord on June 17, 1951, contained amphipods (Godfrey, 1953:92). An adult taken by MacDonald on August 20, 1955, had eaten a small squid. An adult taken by me on August 23 had eaten three amphipods. Salomonsen (1951: 346) states that young terns are fed fish exclusively. We saw adult terns carrying small fish, held crosswise in their bills, on several occasions. When handled August 14, chick 502-75285 regurgitated fish remains only.

We often saw terns feeding in the shore leads among the ice floes, or in the open sea, but we were surprised, on July 30, to see them inland catching insects. On this date I watched two of them hovering over the tundra, darting this way and that, occasionally alighting. On the same date MacDonald saw several terns near Eastwind Lake catching craneflies on the tundra. The eating of craneflies by arctic terns has been observed elsewhere (Wright, 1909:91).

Predation. The arctic tern is well known for its ability to defend its eggs and chicks against enemies. The Slidre Fiord colonies were small but the attacks of the few birds were effective. Once we started across their deltas, they attacked fiercely, striking hard with their bills. Like the turnstones and knots, however, they left us instantly, even when we were close to their eggs or young, to

chase a gull or jaeger.

Not once did we see a predator attack an adult tern. The long-tailed jaeger, an abundant species, was not the pursuer but the pursued. Wilkie's and Breckenridge's (1955: 11) observations of hapless arctic terns pursued by long-tailed jaegers are of interest in this connection. MacDonald did see a jaeger trying to catch one of our banded tern fledglings on August 20. The tern, which had started flying three days before, escaped the jaeger's repeated attacks by diving downwards and turning quickly to one side. One parent tern flew at the jaeger and finally drove it off; but had the young bird not itself been agile, it would surely have been killed.

Other predatory birds of consequence were the glaucous and Thayer's gulls. The station dogs would have destroyed many birds had they not been tied. Several times they escaped and ran out on the delta. The terns attacked but not effectively against them. Wolves and foxes were abundant. We did not see them anywhere near tern nests during the breeding season, but their tracks indicated that they frequently patrolled the beaches. We never saw a muskox on the deltas in summer, although their tracks indicated occasional visits there.

Description of Specimen. Measurements (in millimeters) of one tern (DFP 153, adult male, August 23) collected at Slidre Fiord in 1955 are: wing, 264.0, tail, 164.0,

culmen (exposed), 30.0, tarsus, 13.5. It weighed 97.5 grams. Its testes measured 4.0 x 2.0 mm. and 3.0 x 2.5.

Annual Breeding Cycle. At Slidre Fiord the arctic tern arrives in mid-June. Pairs soon form. These nest in isolated pairs or in small colonies at the river and creek deltas. Eggs are laid in late June and the first half of July. Both sexes incubate. The incubation-period is about 21 days. The chicks start flying when 21-23 days old. A 25-day-chick is fully fledged. Young are attended by both parents until they migrate. They may migrate within a week of fledging. Parent and young birds leave the fiord by early September, unemployed birds probably much earlier.

CHAPTER XXI

SNOWY OWL

The snowy owl (Nyctea scandiaca) breeds circumboreally from a little north of tree-line to the Polar Sea. Its summer range is discontinuous and its breeding fluctuant, both of these being dependent largely on the distribution of lemmings. It is not definitely known to nest at high latitudes on Spitzbergen (Salomonsen, 1951:470) or the Franz Josef Archipelago (Pleske, 1928:163). In Greenland it nests only in the high-arctic region inhabited by the collared lemming (Salomonsen, 1951:462). In Canada it breeds on the mainland barren grounds and northward throughout much of the Arctic Archipelago.

Ellesmere Island. Both Feilden (1877:403-4) and MacMillan (1918:409-10) found the Snowy Owl nesting in the vicinity of Cape Sheridan on the north coast in 1876 and 1909 respectively, but MacDonald (1953:11) found no evidence of its nesting there in 1951. On the east coast both Feilden (1877: 404) and Greely (1886, 2:380-1) found it breeding "abundantly" in the vicinity of Discovery Harbor in 1876 and 1881-83, respectively. On the south coast Bay (in Sverdrup, 1904, 2:

479) found it decidedly uncommon in 1900-02. It has been seen only infrequently on the Fosheim Peninsula. Handley (unpubl. ms.) mentioned a single bird observed on August 9 or 10, 1947. In 1951 Tener (Godfrey, 1953:92) observed the species four times (one bird on each occasion) at Slidre Fiord. Bruggemann (1953, 1954) did not observe the snowy owl at all in 1953-54.

In 1955 we saw it occasionally. We never saw more than one bird at a time. No bird that we saw hooted or made the slightest move in defense of nest territory. The total population of the peninsula may, for all we could ascertain, have been one bird. We found several roosting rocks but nothing that suggested old nest-sites. Apparently the collared lemming has been very rare on the peninsula since at least 1947. In 1955 we noted very few lemming tracks and we saw only three lemmings during a six month period. Arctic hares were abundant, but we found no evidence that the owls fed on them.

On June 2 we saw the first owl--a large bird with soiled body plumage. It flew in from the northwest, glided low over the sea ice west of Eureka, and alighted far out on the fiord. On June 11 Sim and Marsden saw an owl three miles east of the head of Slidre Fiord. On July 6 MacDonald flushed one from a large rock near Black Top Ridge. On July 18 we flushed one on a ridge near the head of Slidre Fiord. On July 19 MacDonald spotted one from a helicopter several

miles east of the head of Slidre Fiord. On August 3 Sim and Marsden saw one on a rock high up on the side of a valley, 13 miles southeast of the head of the fiord. On August 6 they saw one 19 miles southeast of the head of the fiord. On September 14, I flushed one on a hummocky ridge two miles northeast of Eureka. On September 21, I saw one rise from flat tundra four miles north of Eastwind Lake.

CHAPTER XXII

RAVEN

The raven (Corvus corax) is a bird of wide distribution in both old and new worlds. It ranges northward to very high latitudes, but the northernmost records are not breeding records. The species is not listed for the Franz Josef Archipelago or for Bear, Kolguev, and Vaigach islands, but it has been recorded once on Spitzbergen (Pleske, 1928:124). Far northern Greenland records are of wandering, non-breeding birds; in western Greenland the species probably does not breed north of Etah, the northern limit of the Eskimo and of colonies of the dovekie or little auk (Plautus alle); in eastern Greenland the northernmost records are for Germania Land and Independence Fiord, but no nests have been discovered there (Salomonsen, 1951:552-3). In the Canadian Arctic Archipelago the species has nested as far north as 76°16'N.--at Mould Bay, Prince Patrick Island (MacDonald, 1954:230).

Ellesmere Island. Although Hellmayr (1934:2) states that the species breeds northward to northern Ellesmere Island, I know of no nest record for the island. Neither

Feilden (1877:405) in 1876 nor MacDonald (1953:7-11) in 1951 saw the species at all on the north coast. Greely (1886, 2: 381-2) noted it only occasionally on the east coast in 1881-84 (specimen taken September 28, 1882). In 1900-02 it was frequently seen on the south coast where it probably nested (Bay, in Sverdrup, 1904, 2:479). It was noted at Craig Harbour on August 26, 1938 and August 22-24, 1939 (Shortt and Peters, 1942:346). On the Fosheim Peninsula it has been noted only infrequently. Handley (unpubl. ms.) states that one was seen near Eureka a few days previous to his visit there on August 28, 1948. In 1952 Troelsen (1952:210) saw one near the mouth of Slidre Fiord in late June. Bruggemann (1953, 1954) did not see the species at all in 1953-54. In 1955 we saw only two or three birds, and these all within a 6-hour period.

On June 5, at 7:15 a.m., we saw two ravens flying up Slidre Fiord. They croaked occasionally. A mile or so east of Eureka they circled high above the ice, then separated, one crossing the fiord and flying southwest toward Axel Heiberg Island, the other disappearing to the eastward. Later, at 12:20 p.m., we heard one calling beyond the delta of Station Creek. It was flying. We watched it as it disappeared to the northward. These two or three birds were in heavy molt. Their wings presented a ragged appearance even at a distance.

So far as we could discover, no ravens nested on the

peninsula in 1955. There were cliffs aplenty but there were no seabird colonies aside from the very small colonies of arctic terns. Surprisingly enough, no ravens had been attracted by the artificial food supply at the station (cf Sutton and Parmelee, 1956:206).

CHAPTER XXIII

GREENLAND WHEATEAR

The wheatear (Oenanthe oenanthe), a well known bird in the Palaearctic Region, breeds almost circumboreally. In Eurasia it breeds in both temperate and arctic zones, northward to at least 76°40'N. on the Taimyr Peninsula (Pleske, 1928:159). In Arctic America it breeds in Greenland and Alaska and at many points in between. The Greenland wheatear (O. o. leucorrhoa) ranges from Greenland westward to Ellesmere Island and the Boothia Peninsula and southward to northern Quebec (Hellmayr, 1934:483). It is everywhere common in low-arctic Greenland, but in High-arctic Greenland it breeds only in the southern parts (Salomonsen, 1951:473). Alaskan wheatears are intermediate in size between the nominate race and leucorrhoa and may belong to an undescribed Alaskan race (Bailey, 1948:281). Birds of Iceland and the Faeroes are intermediate in size and color between the nominate race and leucorrhoa (Salomonsen, 1951:472).

Ellesmere Island. Neither Feilden (1877:401-12) in 1875-76, nor MacDonald (1953:7-11) in 1951, saw this species on the north coast, nor did Greely (1886, 2:383) see it on

the east coast in 1881-84. Sverdrup (1904, 1:181-2) noted it at Bay Fiord, on the west coast, in June, 1899. Heretofore it has not been reported from the Fosheim Peninsula. In 1955 it was rare about Slidre Fiord. It may well have been more abundant than our records indicate. We did not often visit the rocky interior, a habitat well suited to its breeding needs.

Arrival. We first recorded the wheatear on June 22. That day MacDonald saw a male bird among several snow buntings in a rocky area near the upper end of Ptarmigan Creek, about a mile from the fiord. A male bunting, defending a nest close by, repeatedly chased the wheatear. We did not see the wheatear near the fiord again.

Nesting. On July 6 MacDonald saw a male wheatear on the west slope of Black Top Ridge, about seven miles north of the head of Slidre Fiord. When we returned to this area on July 14, we immediately heard the excited "check" of a wheatear, then saw a female bird. We watched her carry mouthful after mouthful of food to a protruding mass of rock high on a steep west-facing slope. Finally, we saw her enter the nest-crevice among loose rocks. The nest was in a crevice, a few inches back from the opening. In it were five well-developed young. An unhatched egg lay beside it. By removing a few small rocks we could reach the nest--a single-layered, unlined structure composed of dry grasses. The egg did not have an embryo. All of the brood scampered back into

a narrow crack. We collected two of them (males, weight 29.1 and 29.8 grams)--and the female parent (weight 27.6 grams, ovary 7.0 x 3.0 mm.). The parent bird had recently eaten several craneflies and spiders and one bee. The flight quills of the two chicks were bursting from their sheaths. Natal down was still conspicuous on their heads and backs.

On July 15 we returned to the nest. The male wheatear was about but he was wary. Not once did he go to the nest while we were there. The three remaining chicks had returned to the nest and were lively in spite of the inclement weather. These birds would probably have fledged within a very short time. In southern Baffin Island one brood was ready to leave the nest as early as June 25, another as late as July 16 (Sutton and Parmelee, 1954:295-306). In high-arctic Greenland fledging takes place about mid-July (Salomonsen, 1951: 478). Allowing 25 days for incubation and fledging (Witherby, 1948, 2:150), we estimated that egg-laying at the Fosheim Peninsula nest began in mid-June.

This wheatear's nest was at 897 feet elevation in an area densely populated with snow buntings. The buntings, whose young had fledged, chased the wheatears repeatedly. The two species have almost the same habitat-niche in Greenland (Salomonsen, 1951:475) and in southern Baffin Island (Sutton and Parmelee, loc. cit.).

Annual Breeding Cycle. The wheatear is a rare summer resident on the Fosheim Peninsula. In 1955 one pair nested

in high rocky country well in from the coast. The clutch-size was six. Five young hatched. Egg-laying probably commenced about June 15, hatching about July 4, and fledging about July 16.

CHAPTER XXIV

HORNEMANN'S REDPOLL

Hornemann's redpoll (Acanthis hornemanni) breeds circumboreally from about tree-limit northward to high latitudes. The nominate race is decidedly the larger and more northern of the two races currently recognized. This large race is found only in Greenland and in northern parts of the Canadian Arctic Archipelago. According to Salomonsen (1951: 516-18), it breeds principally in the southern part of "high-arctic" Greenland; it is not known to breed north of Inglefield Land on the west coast and Germania Land on the east coast. In Baffin Island it has been found breeding at 69° 50'N., at the head of Clyde Inlet, on the east coast (Wynne-Edwards, 1952:380-5). On Prince Patrick Island it has been seen in summer at 76°16'N., in the vicinity of Mould Bay (MacDonald, 1954:230). The small, subarctic race, A. h. exilipes, breeds circumboreally at about tree-limit.

Ellesmere Island. Neither Feilden (1877:401-12), Greely (1886, 2:384-5), nor Bay (in Sverdrup, 1904, 2:479-82) mention this species. Vibe (in Salomonsen, 1951:522) observed it "in the breeding-time" somewhere on Ellesmere Is-

land (exact area not stated). Near Alert, on the north coast, it probably breeds in small numbers (MacDonald, 1953: 11). On the Fosheim Peninsula it is uncommon. In 1953 Bruggemann (1953) saw a pair on May 26, an adult on June 16, an adult on June 26, two juveniles on July 31, two juveniles on August 3, four juveniles on August 28, and 20 juveniles on September 3. In 1954 Bruggemann (1954) heard one on July 18. The species nested on the peninsula in 1953 and probably in 1955.

Axel Heiberg Island. On July 23, 1955, at 80°42'40" N. 90°59'W., 18 miles northwest of the mouth of Stang Bay, we saw a parent bird and three juveniles in a steep rocky ravine in high country about three miles from the coast. MacDonald collected one of the young birds. It had recently eaten adult insects, seeds, and buds of Polygonum viviparum.

Arrival. In Greenland, Hornemann's redpoll migrates along the coast, arriving at its breeding areas very early in spring (Salomonsen, 1951:519). Some of these redpolls winter as far north as the Thule District on the west coast and the MacKenzie Bay region on the east coast (Salomonsen, 1951:520). At Alert, Ellesmere Island, MacDonald (1953:11) saw the species as early as April 29 (two birds) in 1951.

On the Fosheim Peninsula in 1955 we first noted Hornemann's redpoll on April 22. That day (high temperature, +18.9°F., low, -9.1°F.) a flock of seven or more birds fed on grass seeds along the wind-swept slopes just west of Eureka.

On April 25 we saw two together on the ground near the Eureka dump. When flushed they flew in different directions, one disappearing among the station buildings. Later that same day we heard one call high overhead. Our latest spring record for the species on Slidre Fiord was May 13 (one bird).

Nesting. On June 26, 1953, Bruggemann (1953) found a nest at about 1,500 feet elevation in a deep gorge on the west front of Black Top Ridge. It was in a niche in a vertical rock wall and was inaccessible. It was discovered by watching a parent bird carrying food.

Black Top Ridge was a favorite redpoll habitat. On May 13, I heard several and saw one flying well inland along the west front. On July 6 MacDonald collected one adult male there at 1,000 feet elevation. The specimen (weight 19.1 grams, testes 8.0 x 7.0 mm.) was molting heavily. It had recently eaten seeds. On July 14 MacDonald saw two birds of uncertain age there at 1,200 feet or more elevation.

In Greenland, Hornemann's redpoll seems to require willows or other large shrubs for its nesting. It therefore nests in the interior, where the temperature is higher and vegetation richer than at sea level (Salomonsen, 1951:518). The Fosheim Peninsula nesting ground was a comparatively barren place, the vegetation on the west front of Black Top Ridge being stunted and scattered.

August Flocking. On August 4 we saw both adult and young Hornemann's redpolls near the fiord. That day we first

saw an adult snow bunting and a redpoll of uncertain age flying together along a rocky creek bed several miles west of Eureka. Later, on a steep ridge near the same creek, and about a half mile from the fiord, we found ourselves surrounded by redpolls--most of them juvenile. We counted 20 birds at one time, but there must have been many more. They moved about singly and in small groups, feeding on seeds of the arctic poppy. At one point we saw nine of them, in a row side by side, looking down at us from a prominence. Then they scattered in all directions. I collected four juveniles. MacDonald, coming up the ridge, collected a juvenile and a molting adult female (brood-patch present). Later, in low country close to the fiord, I collected two of four juveniles that were with an adult. The crops of all the specimens contained poppy seed. All of the young birds seen that day were in juvenal plumage.

Similar flocking in the first half of August (August 1-14 recorded) has been noted by several observers in Greenland (Salomonsen, 1951:519-20). Apparently, families wander about in groups before migrating. The flock of 20 birds seen near Slidre Fiord by Bruggemann on September 3, 1953, probably was composed of several families.

Departure. Although Hornemann's redpoll is resident even in high-arctic Greenland, the northernmost parts of its breeding grounds are vacated in autumn, migrating flocks appearing at the coast as early as mid-August (Salomonsen, 1951:

520). On the Fosheim Peninsula we first noted southward migration on September 8. That day we saw at various times seven, nine, two, four, and two birds flying in high from the north and heading south over the fiord. Just beyond the beach they circled back, as if attracted to the station. Some alighted among the buildings, others circled once or twice, then crossed the fiord. We collected four immature birds and one adult female, all in fresh winter feather. The crops all contained seed.

We next saw Hornemann's redpoll on September 14 at Eureka. A flock of eight flew in high from the north, passed over the station, circled back once, and continued south. On September 17 we shot an immature female--one of two birds that had alighted on oil drums near the beach. Thereafter we did not see this species on the peninsula.

Description of Specimens. Measurements (in millimeters) of six immature specimens taken at Slidre Fiord in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
134	August 4	male	85.0	73.5	8.5	16.5
137	August 4	male	82.5	67.0	9.0	16.5
135	August 4	female	79.5	63.5	8.5	16.5
164	Sept. 8	male	83.0	70.0	9.0	16.5
163	Sept. 8	?	78.5	64.0	9.0	16.5
168	Sept. 17	female	81.0	66.5	8.5	16.5

Average measurements for all six specimens are: wing 81.5, tail 67.4, culmen 8.7, tarsus 16.5. These specimens are much too large for A. h. exilipes (see Ridgway, 1901:80-5)

and belong to the nominate race. Godfrey (1953:92) likewise referred Ellesmere Island specimens (two juveniles and one post-juvenile collected by MacDonald at Alert in 1951) to A. h. hornemanni.

DFP 168, unlike other September specimens, had numerous pinfeathers on the body. As is clearly shown by the specimen, the rectrices are not entirely free of sheathing; some of them are not full length. Whether this is a replacement of normally molted juvenal rectrices, I do not know. It may be a replacement of feathers lost through accident. In Acanthis flammea the rectrices are not replaced during the post-juvenal molt (Witherby, 1948, 1:72). The molts of Acanthis hornemanni are not known (Graber, 1955).

Annual Breeding Cycle. Hornemann's redpoll has appeared on the Fosheim Peninsula as early as April 22. It occurs both inland and along the coast in spring, less often on the coast in June and July. Pairs inhabit the barren inland rocky areas during nesting. One nest was in a rock crevice at 1,500 feet elevation. Family groups (up to at least 20 birds) wander about the coastal lowlands during August, perhaps early September. Southward migration commences by September 8, probably earlier. Wintering birds have not been reported from the peninsula.

CHAPTER XXV

LAPLAND LONGSPUR

The Lapland longspur (Calcarius lapponicus) breeds principally in the low arctic. It is common on the mainland of Eurasia, but Pleske (1928:143) does not list it for Spitzbergen, Bear Island, or the DeLong Archipelago. Though not found in Iceland, it is alleged to range as far north as the Franz Josef Archipelago (Witherby, 1948, 1:147). In Greenland, where it breeds northward to 77°30' on the west coast, it has in "recent years spread out to the southern part of the high-arctic region owing to the climatic amelioration" (Salomonsen, 1951:524-5). It breeds commonly in Arctic Alaska (Bailey, 1948:299-303) and is a "common breeding bird" at Mould Bay (76°16'N.), Prince Patrick Island (MacDonald, 1954:230).

Ellesmere Island. A male bird collected at Craig Harbour on the south coast August 26, 1938, was at that time thought to represent a "northern record" for the species (Shortt and Peters, 1942:347). So far as I know the only other locality from which this species has been reported is the Fosheim Peninsula. In 1949 Hatfield (in Handley, unpubl.

ms.) saw a "few sparrow-like birds" which he thought were longspurs. In 1951 Tener collected two longspurs in "well-developed juvenal plumage" near Eastwind Lake on August 5 (Godfrey, 1953:92). In 1953 Bruggemann (1953) saw the species near Eastwind Lake on July 9 and 10 (one bird on each date) and near the head of Slidre Fiord on August 29 (one bird). In 1954 Bruggemann (1954) saw five longspurs near Eastwind Lake on June 28 "in the same general region where the species had been seen in 1953." In 1955 the species nested on the peninsula in limited numbers.

Arrival. In late spring we looked carefully for longspurs on the slopes near Slidre Fiord, but not once did we see them. We hoped to see them among the large flocks of snow buntings. We could have overlooked them, of course; but if they lingered on the coast at all, as did the buntings, their stay must have been very short. The species does not arrive in high-arctic Greenland (Thule District) until June (Salomonsen, 1951:528).

Nesting. Sim and Marsden saw a male longspur just north of Eastwind Lake on June 28. The following day, as MacDonald and I were walking along the east shore of the lake, we suddenly realized that several longspurs were singing flight-songs near us. We watched several females and followed one of them to its nest--a grass-lined cup (no hair or feathers) in the side of a hummock in wet, well-vegetated tundra.

On June 29 the nest held four newly hatched young and two eggs, on July 1 five young and an egg. On July 10 it was empty except for numerous particles of feather-sheath and the unhatched egg--fair proof that several chicks had fledged successfully. Two grass-lined nests found in southern Baffin Island were unsuccessful (Sutton and Parmelee, 1955:118-9).

If we allow 12 days for incubation (Wynne-Edwards, 1952:385), we are justified in believing that the first egg in the Fosheim Peninsula nest was laid about June 12. Egg-laying started at Clyde Inlet, Baffin Island, in 1950, on June 6 (Wynne-Edwards, loc. cit.); at Nettilling Lake, Baffin Island, June 14, in 1925 (Soper, 1928:114); at the head of Frobisher Bay, Baffin Island, in 1953, on June 10 (Sutton and Parmelee, 1955:120); at Mould Bay, Prince Patrick Island, in 1952, on June 9-10 (MacDonald, 1954:230); at Southampton Island, in 1930, on June 17 (Sutton, 1932:240); and at Bowman Bay, on the west coast of Baffin Island, in 1929, on June 26 (Soper, 1946:423). In the Upernavik District of Greenland eggs are laid "after mid-June" (Salomonsen, 1951:531).

The 1955 Eastwind Lake population of longspurs (about 20 pairs) occupied about two square miles of tundra. A few birds may have occupied an additional stretch of low hummocky tundra northwest of the lake where we heard a bird singing on July 10. We noted no longspurs otherwise between Slidre and Greely fiords, an area of roughly 400 square miles. Much of this country appeared to be suitable longspur tundra. Sim

and Marsden saw the species (one bird) nine miles east of Slidre Fiord on July 12. Marsden saw one near the head of Slidre Fiord on August 1, and Sim saw one 18 miles southeast of there on August 4. These birds may have been juveniles wandering singly over the peninsula. This seemed to be the case when, on August 22, we encountered a single juvenile on a high plain several miles south of Slidre Fiord. We collected it--a male that had nearly completed the post-juvenal molt. It had recently eaten adult insects and plant seeds.

We collected four breeding adult male specimens, one on July 1 (testes, 12.0 x 7.5 mm., 11.0 x 9.0, stomach contents, three caterpillars, a fourth caterpillar in the bill); another on July 3 (testes, 12.0 x 8.0, stomach contents, four caterpillars); and two on July 4 (Testes, 5.5 x 5.5, and 7.5 x 7.5 respectively, stomachs empty). The plumage of all four specimens was worn, but the post-nuptial molt had not started.

The longspurs at Eastwind Lake performed flight-songs several hundred feet above the nesting grounds. These flights were considerably higher than those observed by Sutton (1932: 239) on Southampton Island, by Salomonsen (1951:528) in Greenland, and by Sutton and Parmelee (1955:110-27) in Baffin Island.

Departure. Both immature and adult longspurs were among bunting flocks that appeared on the fiord slopes in late summer and fall. Inconspicuous and wary, they came to Eureka early in the morning before the bunting flocks dis-

persed for the day. We first noted them there on August 23, on which date we saw six birds and collected an immature female (stomach contents, buttercup seeds). On August 24 we saw three birds. On August 27 we saw 11 on the eroded ridge tops just north of Eureka. Of four males collected, one was adult (testes, 2.0 x 2.0 mm.), three immature. All of them were in fresh winter feather and all had been eating seeds.

In crossing the Eastwind Lake nesting grounds on September 5, we failed to note a single longspur. The lake was nearly frozen and the whole area seemed to be devoid of bird life. On September 6, a mile south of Eastwind Lake, we saw two south-bound longspurs high overhead. At Eureka we saw two birds on September 7 and two birds on September 8. On September 9, about two miles northwest of Eureka, we saw one flying northwestwardly with 55 buntings. Thereafter we did not see a longspur near the coast.

By mid-September the buntings and longspurs were becoming scarce. But as late as September 20 we encountered a lone longspur in a frozen creekbed near Eastwind Lake--within the nesting area. It flew towards us and suddenly dropped to the ground close by. We shot it as it picked a seed from the shallow snow. It was a male in first winter plumage. In this same area, during twilight of September 21, we flushed a few longspurs and many buntings from their roosting places on hummocky tundra. The following day a lone longspur flew erratically about the nesting grounds. This was the last

bird we saw. In Greenland the southward migration takes place from mid-August to mid-September (Salomonsen, 1951:531).

Description of Specimens. Measurements (in millimeters) of four males collected at the Fosheim Peninsula in 1955 are:

DFP No.	Date	Age	Wing	Tail	Culmen	Tarsus
105	July 1	adult	94.5	68.0	12.0	21.5
106	July 3	adult	94.0	63.5	12.5	20.5
149	August 22	immature	94.0	66.5	11.0	21.0
170	Sept. 20	immature	93.0	61.0	11.0	21.5

Wing and tail measurements of the above specimens average larger than those of three breeding males collected in southern Baffin Island (Sutton and Parmelee, 1955:125).

Annual Breeding Cycle. The longspur probably arrived at its Eastwind Lake breeding grounds in late May or early June in 1955. The nest-habitat was well-vegetated, wet hummocky tundra. Egg-laying commenced about June 12. The clutch-size at one nest was six. Young left this nest about July 10. Juveniles wandered over the country before migrating south. Molting was largely completed by early September. Southward migration commenced in late August. At this time both adult and immature birds flocked with snow buntings near the coast. Some immature birds remained on the nesting grounds until late September.

CHAPTER XXVI

SNOW BUNTING

The snow bunting (Plectrophenax nivalis) breeds circumboreally throughout both the low and high arctic. In Eurasia it ranges as far north as Spitzbergen and the Franz Josef Archipelago (Pleske, 1928:442-3). In Greenland, where it is the commonest land bird, it breeds "throughout the country" (Salomonsen, 1951:540). In the Canadian Arctic Archipelago it breeds northward to the limits of land. In Arctic Alaska it prefers coastal to inland areas (Bailey, 1948:303).

Ellesmere Island. All observers have found this species common on the island in summer. Feilden (1877:404-5) found a nest as far north as 82°33'N. on June 24, 1876. MacMillan (1918:411) found the species "nesting" on the north coast of Grant Land in 1909. "Eggs, nests, and young" were obtained by the U.S. Expedition to Lady Franklin Bay in 1881-84 (Greely, 1886, 2:382). The Second Fram Expedition of 1898-1902 collected one adult female snow bunting at Winter Harbour, 79°N., on June 8, 1899, two nearly-fledged nestlings at Rice Strait on July 21, 1899, and one nest on Ellesmere

Land on June 28, 1902 (Schaanning, 1933:142-3). MacDonald (1953:11) collected three adult males and located several nests at Alert in 1951.

In 1955 Plectrophenax nivalis was the commonest bird of the Fosheim Peninsula. We noted it also at 80°46'N. 88° 23'40"W., on the northeast coast of Nansen Sound, on July 24 (one seen by Roots); at 80°57'N. 88°44'W., on the south shore of Otto Fiord, on July 24 (five birds including a stub-tailed adult male with a fledgling); and at Caledonian Bay, Canyon Fiord, east of the Fosheim Peninsula, July 23-27 (several birds seen by Sim and Marsden).

Axel Heiberg Island. On July 23, 1955, at 80°42'40" N. 90°59'W., we found this species extremely abundant in rough, high country three miles from the coast. Of many adults and fledglings seen that day, we collected five adult males. On July 25 we saw two adult males, two adult females and six fledglings at 80°20'N. 89°16'W., five miles west of Flat Sound. That same day, at 80°12'N. 87°54'W., on the Schei Peninsula, Roots saw several birds. But on a steep, barren slope eight miles southeast of Cape Stallworthy (81°18'40"N. 92°40'W.), at the edge of the Polar Sea, no one saw buntings or, for that matter, birds of any sort on July 25.

Arrival. The arrival of the snow bunting on its breeding grounds is better documented for Greenland (Tinbergen, 1939:4; Salomonsen, 1951:542-4) than for Eurasia (Pleske, 1928:132-3). Petersen (in Tinbergen, op. cit.) ob-

served arrival at Angmagssalik, Greenland, for many years, finding that the date varied considerably. This variation is due to climate variation in the breeding area (Pleske, 1928: 132) and in the wintering area and along the migration route (Tinbergen, 1939:4-5).

On the north coast of Ellesmere Island, in 1876, Feilden (1877:404) did not see the snow bunting until May 13 (one bird), but MacDonald (1953:11) saw it on April 27 (one bird) in 1951. On the east coast Greely (1886, 2:382) first noted it at Fort Conger on April 14 in 1882 and on April 24 in 1883; at Cape Sabine, in 1884, he first noted it on April 13. On the Fosheim Peninsula Bruggemann (1953, 1954) first noted it on May 3 (one bird) in 1953 and on April 27 in 1954.

On our arrival at Eureka, April 16, 1955, we immediately discovered snow bunting tracks. Then we saw a male bird. The following day we found a few tracks on ridges several miles inland from the head of Slidre Fiord.

From April 18 to 21 a blizzard kept us indoors. We heard a bit of bunting song as the storm started. Although hardly a trace of snow fell, the fierce south and southeast winds drove the old snow about. On April 21, as the storm abated, we saw several buntings feeding at the trash wagon and dump. At Angmagssalik, Greenland, in early spring, many buntings often arrive in flocks during "an easterly wind accompanied by a heavily clouded sky and rather thick snowfall" (Tinbergen, 1939:5).

On slopes near Eureka we found bunting tracks in the thin snow leading from one grass tuft to another. Thorough investigation of the north shore of the fiord disclosed thousands of such tracks. The scattered grass tufts here provided buntings and redpolls with seed throughout the pre-nesting season. Buntings found grass seed also at hare diggings. Buntings obtain seed only with great difficulty where snow is deep (Salomonsen, 1951:544); they depend extensively on the Eskimo settlements for food in the "thickly snow-covered country" of Angmagssalik (Tinbergen, 1939:6-7).

On April 23, 1955, we travelled northwestward from Eureka six miles, climbing to about 1,500 feet elevation. In high places we saw neither buntings nor their tracks, but on the low fiord slopes we saw both the birds and their tracks everywhere. This was difficult to understand because grass seed was available and the air was warmer at higher elevations.

Male buntings became common at Eureka about April 25. The patter of their feet on the roof and their "chee, chew, djjj" callnotes were familiar. On April 25 we noted 16 males scattered near Eureka at one time, and there probably were many more on the slopes close by. We heard several full songs that day. From April 25 on we regularly heard full songs. In 1951 Tener (Godfrey, 1953:92) first noted "singing" at Slidre Fiord on May 5.

Banding at Eureka. On April 28 we began trapping and

banding buntings. The birds came readily to toasted whole wheat cereal, and we succeeded in catching them by pulling a string attached to a stick supporting a propped-up net. By attaching the lower edge of the net (which was stretched over a wire frame) to the spring of a rat trap, we speeded action. The wire frame slammed down, and the trapped buntings, instead of scurrying outward, flew up and into the descending net.

The 21 male buntings caught April 28-May 1 (52-80747 to 52-80767) we marked additionally with blue color-bands. Some of the 41 males caught May 2-May 13 (52-80768 to 52-80797; 52-80576 to 52-80586) we dabbed with red paint for prompt field identification. Throughout this whole 20-day period we did not see a single female bunting. After May 18 no buntings visited the trap. From that date on we could not attract the species with food.

Many of the banded buntings were caught twice, one of them three times. Of 62 banded, 44 were re-caught, not counting those recaptured on the day of banding. Noteworthy repeats were: 52-80749, banded April 28, re-caught April 29, April 30, and May 4; 52-80766, banded May 1, re-caught May 10; 52-80790, banded May 4, re-caught May 6 and May 15. Two birds with blue color-bands were flushed from a roost near Eureka on May 13. We did not see banded or color-marked birds anywhere after May 24 despite the fact that we looked closely at hundreds of buntings during our travels on the

peninsula.

Some male birds were in boldly black and white feather as early as April 26. The bills of these birds were black. Tinbergen (1939:6) noted great variation in the plumage of males in Greenland, but not a single bird observed during the "first few weeks" was in "complete" breeding feather. Salomonsen (1951:534-5) discusses individual, seasonal, and geographical variation as well as what he calls "normal" and "retarded" males. Some males at Eureka had "retarded" primary coverts. Nearly all of our trapped birds were veiled with brown, but three were boldly black and white. No. 52-80774 was washed with pinkish lavender on the crown, neck, jugulum, and auriculars. No. 52-80758 was brown when banded on April 29 but had only a trace of brown on the head when recaptured May 1. Some individuals stayed brown well into the nesting season.

Peck-order. Certain individuals were dominant at the feeding tray. We naturally expected the boldly black and white birds to be the most aggressive, but we soon learned that dominance was in no way correlated with color. Dominant birds lowered their heads and charged the others with opened or closed bills, sometimes striking, but usually only bluffing. Occasionally a fight developed between two birds. These were head-on, bill to bill rushes or, less frequently, face to face flutterings (see Tinbergen, 1939:15) a few inches above the tray. When the birds struck each other, the

feathers flew. A dominant individual often occupied the tray by itself, but birds of equal status in the peck-order fed side by side without any show of animosity.

We also noted a peck-order at the natural feeding places apart from Eureka. This feeding behavior was strikingly similar to the territorial behavior of the species as described by Tinbergen (1939:8-18).

Establishment of Territories. It appeared that some of the buntings were establishing territories at Eureka early in May, for there was much fighting and singing at that time. But they continued to flock. Some males were staying by themselves but not defending territories. The buntings at Eureka visited the feeding tray as regularly early in the morning as at any other time, indicating that they were not on territories. Tinbergen (1939:9) observed that when males were establishing territories, they stayed within them in early morning, but left them by mid-day to feed elsewhere.

As stated above, we noted bunting tracks several miles inland from the head of the fiord as early as April 17, but it was not until May 8 that we observed the birds far inland. On that date we saw a flock of five buntings flying low across a broad valley near Eastwind Lake. Up to that time we had failed repeatedly to find birds or tracks far from the low coastal areas.

On May 11 the number of buntings decreased appreciably at Eureka. Few visited the feeding tray. The follow-

ing day the decrease was even more noticeable. A gyrfalcon visited Eureka that day and for a time we thought that this predator's presence had frightened the buntings away. The falcon was not seen again, however, and the buntings continued to be scarce. Resident birds simply were moving inland. On May 13 we saw the species at 2,000 feet elevation on the barren west slope of Black Top Ridge. Here there was only a meager growth of plants, and the aspect was decidedly wintry. We saw several male buntings, including a flock of five. No bird behaved at all as if on territory.

By mid-May some of the buntings were defending territories inland. No territories were ever established at Eureka, and the whole station area was practically abandoned by males even before the arrival of females.

Pairing. In 1955 we first saw a female bunting on May 21--at about 2,000 feet elevation on Black Top Ridge. With it was a male in black and white feather. The two birds moved together over the rocky ground. Flying to a rock wall, they popped in and out of niches and fissures as if looking for a nest-site. When they left the wall, the male rose to a height of 10 feet and fluttered to the ground in full song--the first flight song noted by us. The pair kept together, feeding side by side; when separated, one soon flew to the other. Some distance away another male sang full songs. It occupied a territory but appeared to be mateless. On May 24, 1951, at Slidre Fiord, "paired birds were on their terri-

tories and males were defending these vigorously" (Tener, in Godfrey, 1953:92).

On May 23 we saw a loose flock of buntings on the slopes west of Eureka. Two females fed side by side as did three males close by. When a third female joined the company, all flew off except a male and female. These two birds kept together even when flushed. On May 24 we saw a flock of 11 buntings in flight. Four suddenly left the flock, alighted, and commenced feeding. There were two of each sex, but they did not go about in pairs. Large numbers of buntings, mostly males, fed on the slopes north of Eureka that day. On May 26 we saw at least four unattached females. On May 27 we saw two pairs "on territory" near the fiord several miles west of Eureka. Males displayed and chased each other about. Unmated birds of both sexes fed on the slopes near by.

On May 28 one of the men at the station saw a "snow-bird" flying with a grass stem in its bill. This was the first indication of nest building. We visited the area in which the bird had been seen and immediately saw a male bunting singing near the top of a high bank. On leaving its perch it gave a flight-song and alighted on a hummock. It then performed another flight-song, rising to a height of 15 feet. We watched this bird and its mate for some time but neither of them led us to the nest-site.

That same day a flock of 18 buntings passed northward high over the fiord at 2:45 p.m. Apparently the species mi-

grates mostly at "night." Tinbergen (1939:5) noted migrating flocks "during the first three hours after midnight." Salomonsen (1951:543) also observed night migration.

On May 30 good-sized flocks of females appeared for the first time. The largest flock seen was composed of 21 females and seven males. We continued to see them in flocks the following day. The largest flock seen at that time was one of 19 females and three males. These were the last flocks we saw that spring.

Despite the constant influx of new males, we did not observe any such gradual decrease in size of territories as that reported by Tinbergen (1939:19-20). This may have been because most of the birds nested in the rocky interior. The species was fairly abundant at lower elevations in the rough gullies, but the concentrations in the rocky interior were dense by comparison. Even on the well-vegetated tundra some buntings bred, for the cracks and crevices in the large frost-heaved piles of mud provided nest-sites. We found several old bunting nests in such mud mounds. The exact nature of these mounds is not fully understood. Dr. E. F. Roots, of the Canadian Geological Survey, informed us that they are found commonly only at very high latitudes in the Canadian Arctic.

Nesting. A snow bunting nest found by Tener (Godfrey, 1953:92) on the Fosheim Peninsula on June 25, 1951, contained six eggs. In 1955 we found our first bunting nests

on June 17. At that time some birds had not yet commenced laying, while others had already completed their clutches. During the summer we found nine active nests in all, seven near Slidre Fiord, two far inland. Data concerning these nests are:

Nest No.	Date found	Contents when found	Clutch-size	No. young hatched	No. young fledged
1	June 17	5 eggs*	7	7	0
2	June 17	1 egg	6	6	0
3	June 17	7 eggs	7	(last checked June 19)	
4	June 17	7 eggs	8	(collected June 19)	
5	June 17	0 eggs	7	(collected June 26)	
6	June 19	1 egg	7	0	0
7	June 22	6 eggs	6	(last checked June 25)	
8	June 30	7 eggs	7	(last checked June 30)	
9	June 30	5 young*		5*	0

* minimum number

Egg-laying must have started at least as early as June 11 at Nests 3 and 4. The last young of Nests 1 and 2 hatched about July 1 and 5 respectively. Eighteen days elapsed between the laying of the first egg and the hatching of the last young at Nest 2, the period of incubation for the last egg being 12-13 days. Unequal size of embryos in eggs at Nests 4 and 5 and of siblings at Nests 1 and 2 indicated that incubation had started before completion of the clutch. The female of Nest 6 incubated steadily after laying the fourth egg.

Six nests were in shallow niches in sandstone outcrops, two were under loose rocks, and one was 14 inches

down in a narrow fissure in soft soil on a bank. All nine were readily accessible. They were composed of dry grasses and bits of dry leaves, roots, mosses, etc., and were rather thinly lined with feathers (principally white ptarmigan feathers), long hairs and "wool" of the muskox, and the fur of lemmings and hares. Nests 3 and 4 were old nests lined afresh with grass and ptarmigan feathers. In removing Nest 4 from its crevice, we discovered that parts of the old structure were still frozen hard.

One old unoccupied nest, a long way from rocks or mud mounds, was on the ground between two small hummocks. Bits of egg-shell and numerous feather sheaths indicated successful hatching. Another unoccupied nest, flat against a rock wall on a ledge less than three inches wide, resembled the nest of the Phoebe (Sayornis phoebe). In it were bits of shell and feather sheath. Another "exposed" nest was in a sandstone outcrop that was used as a roost by buntings in early spring. It was a nest of the year, but we did not find it until September 10. On that date it held one unhatched egg and bits of shell and feather sheath.

At Nest 4 we caught the female and banded it (52-00258 on left leg, red color band on right) on June 19. We collected the nest and eggs and did not see the bird again.

In 1955 some buntings probably commenced laying as early as June 4. As stated above, a bird was seen carrying a grass stem on May 28. Allowing six days from the very

start of nest building to the laying of the first egg, as was the case at a Baffin Island nest (Sutton and Parmelee, 1954: 178), one Fosheim Peninsula female probably began laying in early June. This is not entirely speculative. Our seeing a long-tailed young bird on July 15 justifies such a belief. Even at 80°N. the snow buntings should have time to raise two broods, but I am not at all sure that they do so. In any event the Fosheim Peninsula birds in 1955 started nesting no later than did the buntings in southern Baffin Island in 1953 (Sutton and Parmelee, loc. cit.). Eggs have been found in Greenland from May 25 to July 24 (Salomonsen, 1951:545).

Nearly all sexual activity had ceased by mid-July, but we occasionally saw males chasing other males as late as July 21 and heard full songs as late as August 4. Young were fed as late as August 9.

By July 15, 1955, many fledglings had left the nest-crevices. Their food calls were loud, and both parent buntings responded to them. The post-nuptial molt in males started by mid-July, in females somewhat later, but by late July all adults were molting heavily. These birds, some attending young, retired to secluded places back from the coast in August. At times they were almost incapable of flight. Most of the young birds left the adults in late July and early August and flocked near the coast. Here they completed the post-juvenal molt by early September. In high-arctic Greenland the molt takes place very rapidly, the new

plumage being acquired before early September (Salomonsen, 1951:547).

Departure. In high-arctic Greenland migration of snow buntings starts in early September, but some snow buntings remain even on the north coast until early or mid-November (Salomonsen, 1951:547). The species winters in low-arctic Greenland, but there are few winter records for it in high-arctic parts (Salomonsen, loc. cit.). On the north coast of Ellesmere Island the species was last seen on September 24 (one bird) in 1875 (Feilden, 1877:404) and on September 1 (two birds) in 1951 (MacDonald, 1953:11).

W. Chapman, U.S. Weather Bureau, saw two snow buntings on the north coast during the dark period. They fed on spilled oats at the Alert weather station within a day or two of November 27, 1952. The station cook saw them several days later, verifying Chapman's observation. When flushed, the buntings flew off into the darkness beyond the station lights.

Near Slidre Fiord, in the fall of 1953, Bruggemann (1953) saw large flocks repeatedly. About 250 birds arrived on September 13 and "stayed around for many days in gradually diminishing numbers...October 1, 25 birds were still around... last straggler was seen on the 8th October during a near-blizzard." Bruggemann's (1954) latest date for 1954 was October 11 (one bird).

In 1955 we noticed something in the nature of pre-migratory flocking or wandering among the buntings of the

thickly-populated interior as early as July 30. Whatever the cause for these movements, many of the birds moved from high ground to low in late July and early August. More and more of them appeared in the coastal areas as the days passed. By mid-September very few of them remained in the interior.

Buntings visited Eureka very rarely during the nesting season. When, on August 5, the species did return to the weather station, most of the birds were full-tailed, unattended juveniles. They visited Eureka early in the morning, often before 4:00 a.m. The large flocks usually dispersed two or three hours later, the birds then temporarily abandoning the fiord shore for the inland slopes. There they fanned out and fed singly or in small groups. Occasionally large flocks formed again, but small wandering parties were the rule throughout the rest of the day. Young birds visiting Eureka early in August were from early broods. One young almost in complete winter plumage appeared at Eureka on August 17.

The largest numbers occurred in late August. On August 24 we estimated a minimum of a thousand buntings at once about Eureka; there must have been many more on the slopes near by and elsewhere along the fiord. They still visited Eureka during the early mornings, breaking up and dispersing inland during the rest of the day. At times the much rarer Lapland longspur accompanied them. Some of the buntings probably migrated south at this time. Their

flights were, however, puzzling. We saw flocks passing from north to south high over the fiord; likewise, we saw them pass from south to north over the fiord as late as August 26. We again estimated a thousand buntings at Eureka on August 27. Then their numbers declined slightly until mid-September, but rapidly thereafter. On September 10 we saw an immense flock of about 800 birds on a ridge west of Eureka and another, about 150 birds, near the same ridge on September 15. On September 16 we saw a flock of 30 at Eureka, on September 17, a flock of 30 within two miles of Eureka. We collected a lone adult male at Eureka on the 18th. A flock of 20 appeared near camp at Eastwind Lake on September 19. We did not see a single bird anywhere on September 20, but the following day we flushed about 100 buntings and a few longspurs from hummocky tundra just north of Eastwind Lake. We saw two near Eastwind Lake on September 22 and we heard one at Eureka on the 24th. From then until our departure on September 27, we watched in vain for buntings at Slidre Fiord. W. Chapman continued to look for birds after our departure. He noted six buntings at Eureka on October 16.

Roosting. The sun was continuously above the horizon when the first male buntings returned from the south. All of these early birds roosted when the sun was low. At Eureka they slept in a lumber pile--as many as 28 of them together--but away from the station they chose shallow niches in the sandstone outcrops. Here, sheltered from the wind, they

squatted, sleeping with their bills tucked under their scapulars. Not even in coldest weather did we see them crouched "close together" (cf. Salomonsen, 1951:542).

The numbers of buntings at a given roost fluctuated considerably in spring. Even the most favored places were unoccupied at times. Birds seen roosting about a single sandstone outcrop numbered from one to 24. Several roosts were in a single gully. For some time we entertained the idea that roosting buntings preferred shadowy places. Light recordings taken in the gullies during the roosting hours showed that the light there was much less strong than elsewhere. Buntings did not always roost in shadowy niches, however. We saw some of them sleeping in direct sunlight.

After territories had been established in the gullies, few buntings roosted there, but those that did so continued to use the same roosting spots. When we flushed a roosting male, it often flew to another roost and alighted beside the defender of another territory. Surprisingly enough, there was no fighting. Both birds, with heads turned back, went to sleep. If flushed together, there was some show of animosity, some chasing, and even singing until both settled down again, sometimes side by side. We noted this peculiar behavior only before the females were established on the territories.

The gullies near Eureka were occupied by comparatively few buntings from about mid-May on. New flocks arrived daily, however, and more buntings than ever inhabited the

fiord slopes during latter May. These newly-arrived birds roosted in eroded snowbanks. Although daily maximum air temperatures did not reach thawing until May 28, the snow disappeared through evaporation and through heat absorption by imbedded grains of wind-blown sand. Whole bank fronts became deeply pitted and the pits provided excellent roosting spots. Most of these banks were accessible to predators, but mammals could not climb them without shattering the ice crystals which formed during the cool hours. The largest number of buntings seen at a snow roost was 14. Both sexes roosted together.

In southeast Greenland Tinbergen (1939:11) observed that buntings awoke earlier from day to day in early spring, but that they did not awake any earlier (about 1:00 a.m.) from about the middle of May onward, two or three hours of sleep being essential to them. During May the Slidre Fiord buntings roosted principally between 9:00 p.m. and 2:00 a.m. A few birds, especially the hungry new arrivals, moved about at all hours. With the influx of new males and females, and the commencement of courtship, roosting became less regular. More and more buntings chased about and sang during these hours. By early June roosting was decidedly irregular. Most buntings, even then, roosted when the sun was lowest.

During the nesting period the male roosted within the territory while the female incubated and brooded. Roosting became more regular once courtship was over. We observed no

communal roosting during nesting.

In August, family groups fanned out among the rocks on steep banks when going to roost. These roosting groups or flocks became gradually larger. Some flocks roosted on rocky slopes, others among boulders in the nearly-dry stream beds. One flock roosted under a huge snowbank undercut by running water. Thirty or more buntings flushed from this place when we first discovered it on August 21. Numerous droppings indicated that it had been used for some time. The flocks appeared to be composed of both sexes and all ages.

During August and September a few birds continued to roost singly or in small groups in sandstone outcrops, piles of rock, cracks in the mud, etc. Gully roosts again became popular. But the large flocks, especially in September, commonly roosted on the open tundra where the ground was eroded or hummocky. On September 14 and 21 we flushed roosting flocks containing 100 or more birds. Sometimes Lapland longspurs roosted with the buntings.

The buntings, as in spring, fed heavily from 6:00 to 8:00 p.m. before retiring. By September, roosting started somewhat earlier, usually between 8:00 and 9:00 p.m. With the coming of night it started still earlier. By late September the buntings roosted as early as 7:30 p.m.

Predation and Survival. Not one of the four nests we had under continuous observation in 1955 was successful. All of the nine nests found by us were, to be sure, far from the

best breeding places. The hordes of young buntings seen by us in the rocky interior in July were fair proof of a high rate of nesting success in rough country back from the lower fiord slopes.

Nests placed in fissures or deep crevices among the rocks obviously have better survival value than those placed in mud cracks or shallow niches. Not one of 19 Baffin Island nests in crevices or deep in the rocks was wholly unsuccessful (Sutton and Parmelee, 1954:179). The choice of nest site is extremely important to the reproductive success of this species.

In 1955 three Fosheim Peninsula nests were destroyed just before the young fledged. Nests 1 and 9 were torn to pieces and scattered as if by a fox. Scattered flight quills of the chicks clearly showed that the broods had been eaten. Nest 2, situated in a mud crack, was robbed while the young were very small. Predation at Nest 6 was peculiar. Two of the seven eggs were punctured and empty, but the other eggs, the nest itself, the flat rock above it, and the soft ground about it showed no evidence of having been disturbed. The only plausible explanation is that a lemming fed on the two eggs but did not return to eat the others. Lemmings were extremely scarce in 1955, but we did note their tracks near Nest 6 in the fall. When last checked, September 12, all seven eggs were still in the nest. Similar predation has been reported from Baffin Island (Wynne-Edwards, 1952:387-8;

Sutton and Parmelee, 1954:175-6). Lapland longspur eggs are occasionally eaten by lemmings (Sutton and Parmelee, 1955: 115-6).

Foxes were common on the peninsula in 1955 and probably destroyed a good many buntings. At Eureka they paid no attention to the bunting flocks, nor did the buntings show special fear of them. Away from the station the foxes showed more interest in the buntings. In May we saw a fox sneaking up on a flock and found fox tracks leading to a bunting kill. We did not see foxes or their tracks nearly as often in the high interior as on the coast or in well-vegetated areas near lakes. Foxes did, nevertheless, visit the rocky places where buntings were common. On July 14 we were attracted to the loud clamor of 20 adult male buntings, all fluttering back and forth close behind a fox running among the rocks on the west slope of Black Top Ridge. Fledged buntings were common on the ridge that day.

The gyrfalcon caught many buntings. We found fresh bunting remains at an eyrie south of Slidre Fiord on August 22 and numerous pellets thereabout indicated that the gyrfalcons had fed extensively on buntings. The gyrfalcon is rare near Eureka in spring and summer, but appears there regularly in fall and feeds regularly on buntings along the coast. In 1954 Bruggemann (1954) saw a gyrfalcon attempt to catch a snow bunting at Eureka on September 13. On September 9, 1955, at 8:30 p.m., MacDonald collected a gyrfalcon which

had recently eaten four buntings.

Although the long-tailed jaeger was common, we never saw it attack adult buntings. A downy jaeger chick, however, regurgitated the remains of a bunting fledgling.

Description of Specimens. Measurements (in millimeters) of nine snow buntings taken at Slidre Fiord in 1955 are:

DFP No.	Date	Sex	Wing	Tail	Culmen	Tarsus
93	June 4	male	107.0	69.5	10.5	22.0
167	Sept. 15	male	110.0	75.0	10.0	20.5
169	Sept. 18	male	108.5	71.0	10.0	21.0
142	Aug. 17	male*	106.0	69.5	9.5	21.0
166	Sept. 14	male*	111.0	69.5	9.5	22.0
92	June 4	female	100.5	64.0	9.5	20.5
104	June 26	female	97.5	61.5	10.5	20.0
114	July 16	female	99.5	64.0	11.0	20.5
165	Sept. 10	female*	102.5	65.0	9.0	21.5

* immature

The average of the three adult males is: wing 108.5, tail 71.8, culmen 10.1, tarsus, 21.1; of the three adult females: wing 99.1, tail 63.5, culmen 10.3, tarsus 20.3. An adult male (DFP 120) collected July 23 at 80°42'40"N. 90°59'W. on Axel Heiberg Island measured: wing 104.0, tail 62.0, culmen 11.0, tarsus 22.0. The October-November plumage of P. n. nivalis is characterized by light-brown feather edges, a white rump, lack of dark spots on the nape, pure white primary coverts or white primary coverts with small apical spots, and pure white or nearly pure white first primaries (Salomonsen, 1951:536). DFP 167 and 169, although collected in Sep-

tember, show all of these characters. I refer all of the above specimens to the nominate race.

Measurements (in millimeters) of 15 eggs (two sets) collected at Slidre Fiord in 1955 are:

Set 55-6	Set 55-9
22.0 x 16.0	23.0 x 16.5
23.5 x 16.0	22.0 x 16.0
23.0 x 16.0	23.0 x 16.5
23.0 x 16.0	23.0 x 16.5
23.5 x 16.0	22.5 x 16.5
23.5 x 15.5	22.0 x 16.5
23.0 x 16.0	23.0 x 16.5
22.0 x 16.5	

The 15 eggs average 22.8 x 16.2. They are all pale bluish white, thinly marked with brown. Not all eggs found were of this type. Those at Nest 6 were heavily marked, the ground color being obscured by overlying brown markings.

Annual Breeding Cycle. Male snow buntings arrive at Fosheim Peninsula as early as mid-April. The scattered few gradually become flocks which feed on the coastal lowlands. By mid-May some males move inland and establish territories. The first females then arrive. Flight singing and pairing take place as early as May 21. Late arrivals of both sexes are common near the coast in late May. By June the last flocks disperse, most birds moving into the rocky interior.

A few pairs breed in rough gullies near the coast. Nest construction starts about May 28 and continues well into June. Nests are placed in crevices in rock or mud, or rarely on the ground between low hummocks. Old nests are sometimes

repaired and used again. Eggs are laid in June. The eggs number six or seven as a rule, but up to eight may be laid. The female begins to incubate before the completion of the clutch, usually after the laying of the 3rd or 4th egg. The incubation period is 12-13 days. Most young fledge by mid-July. Both sexes feed the nestlings and attend the broods after fledging. We obtained no evidence that two broods are reared. Sexual activity as well as singing declines rapidly by mid-July. In 1955 we heard the last full song on August 4. The post-nuptial molt starts in mid-July in males, later in females. Young birds flock near the coast in early August and molt there. Most adults remain inland until the molt is nearly completed. Family groups kept together as late as August 17 in 1955. Young and old swarm over the lowlands from late August to mid-September, being very conspicuous near the coast. Southward migration probably commences in late August. The winter plumage is acquired by September. By late September most buntings have left, but a few remain until mid-October.

CHAPTER XXVII

CONCLUSIONS

Among the 23 Fosheim Peninsula birds discussed in this paper seven orders, 13 families, and 22 genera are represented. The genus Larus is represented by two species. As to certain shorebird genera, there is a sharp difference of opinion. Most British ornithologists believe that the peeps and their allies, including the knots, belong in one great genus, Calidris. Most American ornithologists reserve Calidris for the knots only and place most of the peeps, including Baird's sandpiper, in Erolia. In any event, all 23 birds of the Fosheim Peninsula are very distinct forms.

Some of the most controversial problems in avian taxonomy today concern arctic birds. The greater snow goose, brant, gyrfalcon, ringed plover, Thayer's gull, and Hornemann's redpoll all have been, and are, storm centers of argument. This paper deals with all of these forms but sheds little light on their taxonomy. This is largely because they were so rare that we saw very little of them and collected very few specimens.

The fact that each of the 23 Fosheim Peninsula birds

is so very different from all the others plus the fact that at least three of them migrate to and from, and winter exclusively in, the old world, makes this study especially interesting. For convenience in visualizing the avifauna of the peninsula as a whole, the following table is presented:

TABLE I

Fosheim Peninsula Birds

Species		Earliest date observed	Latest date observed
1. Red-throated Loon	*	June 11	September 10
2. Greater Snow Goose	*	May 13	August 28
3. Brant	***	June 7	July 2
4. Old-squaw	*	June 5	September 15
5. King Eider	*	June 11	September 3
6. Gyrfalcon	*	May 12	September 17
7. Rock Ptarmigan	*	April 1	September 29
8. Ringed Plover	***	June 26	
9. European Turnstone	*	May 26	September 3
10. Old World Knot	*	May 27	September 8
11. Sanderling	*	June 29	September 16
12. Baird's Sandpiper	*	July 15	August 27
13. Red Phalarope	**	June 18	July 11
14. Long-tailed Jaeger	*	May 31	September 1
15. Thayer's Gull	**	June 10	August 25
16. Glaucous Gull	*	May 25	September 28
17. Arctic Tern	*	June 10	September 1
18. Snowy Owl	***	June 2	September 21
19. Raven	***	June 5	August
20. Greenland Wheatear	*	June 22	July 15
21. Hornemann's Redpoll	*	April 22	September 17
22. Lapland Longspur	*	June 28	September 22
23. Snow Bunting	*	April 16	October 16

* breeds
** probably breeds
*** no evidence of breeding

The avifauna of the peninsula may not be as complex or as diverse as that of temperate and tropical regions in

which many habitat niches exist, but among these 23 species there are both aquatic and terrestrial forms, both large and small forms, both highly migratory and comparatively non-migratory forms, forms that build elaborate nests and forms that build no nests at all, forms with altricial young and forms with very precocial young, forms with short incubation and fledging periods and forms with long incubation and fledging periods. The significant fact is that all these species are, despite the differences just mentioned, reproductively successful in one of the coldest regions of the world. They survive despite their failure, some summers, to breed at all. The reproductive part of their year fits into the same short summer period. Varying as they do in migration, food habits, roosting habits, and breeding habits, they neither arrive simultaneously, in one great throng, nor depart in that way.

Arrival of the Fosheim Peninsula birds covered an 80-day-span in 1955. The snow buntings arrived within a 50-day-span, the turnstones and knots within a 6-day-span. So far as we know, no bird winters regularly on the peninsula. The gyrfalcon, snowy owl, and raven, often considered resident at even high latitudes, were so rare in 1955 that we saw almost nothing of them--let alone determine the span of their arrival and departure.

Birds which return to northwestern Ellesmere Island before the thaw find an ample food supply. Precipitation in

this whole region is extremely light--less than two inches per year. On slopes exposed to the wind the snow cover is very thin even in the dead of winter and many places are quite bare. To these bare patches go the newly arrived birds early in the spring. Famished as they are, they feed greedily on grass seed and other vegetable matter. Birds which have migrated northward through southern parts of the Canadian Arctic Archipelago have been obliged to pass over areas throughout which all food was buried deep in snow. The turnstones, knots, ringed plovers and wheatears which have returned from the old world have been obliged to make long flights without food or rest. Some of these may have passed over the Greenland ice-cap. It is an extremely interesting fact that in 1955 the turnstones arrived on their desertlike Ellesmere Island breeding ground earlier than new world turnstones of more southern breeding areas, e.g., Southampton Island, regularly do. Many newly returned shorebirds subsist largely on plant foods, but animal foods in the form of lepidopterous larvae are also obtainable before the thaw. Such larvae live beneath loose chunks of dry earth and are readily available where the ground is bare. Turnstones, in particular, take advantage of these early animal foods.

The birds just mentioned arrive early and survive despite low air temperatures. The truly aquatic birds, on the other hand, are dependent upon water, hence arrive and depart as ice conditions dictate. Ocean waters are, of

course, first to open, and arriving loons, eiders, and old-squaw ducks find food and a place to rest in the narrow leads just off the mouths of rivers. They are not long detained at the coast as a rule, for the water of the inland breeding areas soon opens. Fresh water is requisite for the successful nesting of some of these birds. The red-throated loon depends on both salt and fresh water, nesting as it does on tundra ponds but flying to the coast daily to feed in the shore-leads.

Gulls appear about the time parts of the ocean ice open up and stay until the whole sea freezes shut. The glaucous gull, a hardy species able to endure air temperatures as low as -58°F. (Scholander et al., 1950:233), could survive at high latitudes the year round if assured of a steady food supply. It finds virtually all of its food in ocean waters in the spring and fall.

All flocks of migrating birds seen by us in the spring of 1955 came from the south or southeast and some of them continued northward or northwestward. In some species, e.g., the snow bunting, males arrived well in advance of the females. Male and female knots arrive together. Spring flocks consisted of a few to upwards of 200 individuals. Some species remained near the coast before migrating inland, others went directly to the inland breeding areas. Most land birds, including the majority of snow buntings, arrived during the very last days of May and first week of June. Semi-

aquatic birds arrived from late May to mid-June. Aquatic birds arrived after June 10 (the old-squaw arrived as early as June 5 in 1954).

Semi-aquatic and land birds of the high latitudes need not be delayed in their nesting much longer, if at all longer, than those of the low arctic, excepting in such special regions as the Bering Coast. The comparative data available for the Canadian Arctic Archipelago, though admittedly meager, seem to bear this out. Some of the pan-arctic species arrive and nest earlier in the high latitudes of the Archipelago than in the low latitudes. This is especially true of those species coming from both old and new world wintering grounds which very likely influence migration patterns in different ways. Those birds from the old world arrive at the Canadian breeding grounds first. Apparently this is the case with Greenland species arriving from both sides of the Atlantic (Tinbergen, 1939; Salomonsen, 1950-51).

The low precipitation of the high latitudes not only allows an easy procurement of food, it also permits an early nesting of the ground-nesting species. As a rule the barren coastal lowlands are snow-free in winter. These barrens are not used extensively as nesting-habitat. The more heavily vegetated, hummocky tundra areas, which are usually covered with snow in winter, are the favored places. It is remarkable that within a period of only four days snow-covered tundra can become a nesting-habitat. The snow rapidly melted on

June 6, 1955. Patches of turf quickly appeared. By June 10 many of the ground nesters were laying eggs on these patches less than five feet wide in places.

Theoretically, the hardy ground nesters could lay eggs on the snow-free areas very early in the season. One rock ptarmigan, at least, nested on one of the bare slopes of winter, and in all probability, commenced laying by June 5. Geese and other not truly aquatic birds requiring a long breeding cycle have this advantage.

Spring at high latitudes in Canada, as pointed out earlier in this manuscript, is long delayed; but once it starts it proceeds rapidly and, in a real sense, catches up with spring at lower latitudes. Within a very short time conditions are right for nesting. If any part of the avian breeding-cycle is speeded-up at this time, it is courtship and pairing. Some species have overcome this problem by beginning courtship and even pairing before they reach the breeding grounds. Some of the birds, e.g., the turnstone and snow bunting, did not rush into courtship or pairing immediately on arrival. One species that did was the knot, but it did not nest any earlier than those birds that delayed courtship. Since it is possible for birds to arrive early and commence nesting early at high latitudes, there is at the very onset no need for a speeded-up breeding-cycle. In those years of very delayed spring, birds probably do not breed at all. Non-breeding years are known for high-arctic Greenland

(Salomonsen, 1950-51).

Incubation in the case of the snow bunting started before the completion of the clutch, but this phenomenon also occurs in the lower parts of its breeding range. Other species commenced incubation after the laying of the last egg. We found no unusually short incubation periods. That of the European turnstone of the Fosheim Peninsula is approximately the same as the black turnstone that commences egg-laying about 12 days earlier on the comparatively warm Alaskan Coast. The incubation period of the snow bunting was no less on the Fosheim Peninsula than at regions farther south. We found no unusually short fledging periods. Indeed, the period of fledging for the rock ptarmigan and arctic tern of the Fosheim Peninsula was slightly longer than those reported from more southern latitudes.

Overlap of brood-rearing and post-nuptial molting occurred in some but not all species nesting on the peninsula. Some species, e.g., the long-tailed jaeger, did not have an extensive post-nuptial molt throughout the summer. The Baird's sandpiper molted heavily on the breeding grounds while attending young, but it molts early at lower latitudes also. Geese with young molted later than those without young. Buntings started to molt while attending young. In Greenland these birds are known to acquire the winter plumage earlier in the high arctic than in the low arctic (Salomonsen, 1951: 547). On the Fosheim Peninsula the molt was rapid and the

new plumage was acquired early.

Some species showed remarkable uniformity throughout the breeding cycle. The turnstones especially were very regular in their movements. Most of them arrived, performed courtship, commenced nesting, and departed as if in one body. The snow bunting was highly irregular in this respect. Its arrival-period and nesting-period even overlapped. Interestingly enough, these two species were the most widespread and abundant birds of the region.

The departure period on the Fosheim Peninsula covered at least 70 days, which is somewhat comparable to that of arrival. We were not certain when the first birds actually departed. Some non-breeding birds probably left by mid-July. Most birds migrated south by early September, nearly all of them by mid-September. Only the rock ptarmigan, glaucous gull, snowy owl, Lapland longspur, and snow bunting have been recorded on the peninsula after September 20. The only bird that has been recorded there later than October 1 is the snow bunting.

Some birds migrated south long after attending young, others immediately after attending young, still others, notably the arctic tern, while attending young. The departure of some species covered a period of at least 50 days, of others, less than a week. At the end of the breeding cycle the turnstones and knots left the country as suddenly and dramatically as they had arrived. Their young, however,

delayed their southward flight and joined in flocks at the river deltas and fiord beach, the last of them leaving fully a month after the departure of adults.

The short summer of the high latitudes can be severe for those species, especially loons, ducks, and terns that normally endure late nesting. If their nestings are dangerously delayed, young and old still enjoy the marine waters for at least two weeks after the fresh ones close. This point was forcibly brought home to us upon finding flightless young old-squaws at Slidre Fiord on September 2--three days before the inland waters froze solidly. The long breeding cycle of the greater snow goose almost demands its early arrival and nesting which is often undertaken far from water. However, they find refuge in water while attending young and molting, and the open waters of the fiord provide this refuge for even these birds in late summer. Flightless greater snow goslings occurred at Slidre Fiord as late as August 26. The wholly aquatic red-throated loon that endures both late nesting and a long breeding cycle surely suffers the most in those years of early freeze-up.

All migrating flocks seen by us in the fall flew south or southeast over Slidre Fiord. Principal migrations over the peninsula at this time appeared to be from north to south. Fall flocks consisted of a few to upwards of several hundred individuals. Some species remained near the coast, sometimes forming enormous flocks that dispersed before mi-

grating south; other species left the country immediately after abandoning the breeding grounds.

We found no evidence of two-broodedness whatsoever. After marking the parent birds we destroyed the nests of several species in trying to learn if second nestings would be attempted; but none of these birds were seen again. Theoretically, the arctic summer even in high latitudes is long enough to accommodate two-broodedness in some species, particularly the small passerines.

In conclusion, we found little evidence that selection has been at work among these birds in bringing about a shorter breeding-cycle by way of accommodation to shortness of summer. In normal years the summer is of sufficient duration. The land areas of northwestern Ellesmere and northern Axel Heiberg islands are favorable to bird life, but the seas enclosing these regions support few birds.

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EXPLANATION OF FIGURES

The following maps (Figures 1 and 2) are intended to supplement descriptions of various localities given in the text. Both official and unofficial place-names have been used. Several former names have been used since they well describe the major land areas of Ellesmere Island. King Oscar Land, Ellesmere Land, Grinnell Land, and Grant Land are former names of the western, southeastern, northeastern, and northern parts of Ellesmere Island, respectively. These names were used repeatedly by the early explorers. Today the entire northern part of Ellesmere Island is sometimes called Grinnell Land.

The photographs (Figures 3 to 18) were made directly from kodachrome transparencies. All of the photographs were taken by the author on the Fosheim Peninsula in 1955.

Fig. 1. Map of Ellesmere Island and adjacent land areas, based on map published by National Geographic Society, Washington, D. C. (1951).

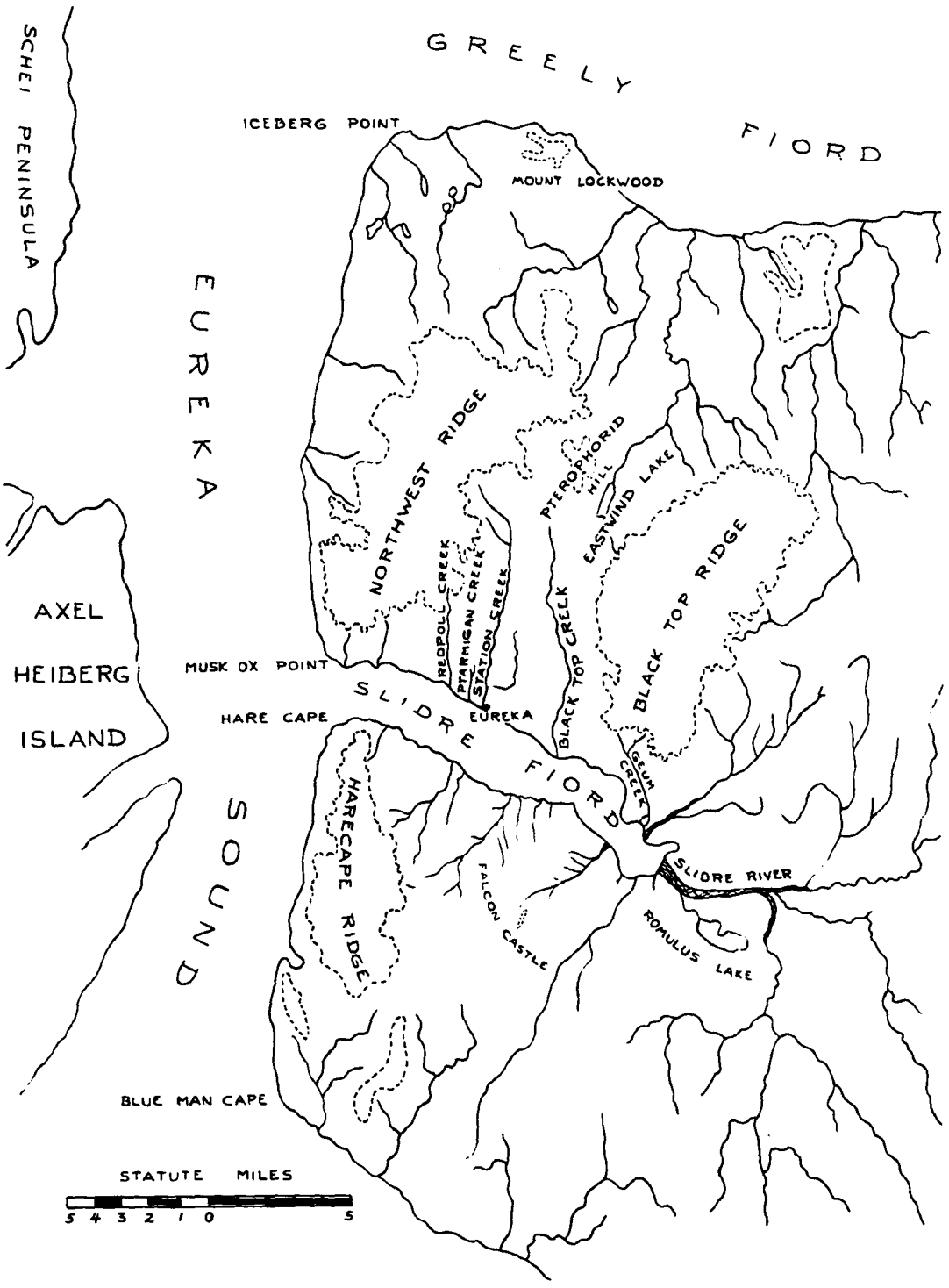

Fig. 2. Map of western Fosheim Peninsula, based on maps published by the Geographical Branch, Department of Mines and Technical Surveys of Canada, Ottawa (1951). Several place-names are those used by Paul F. Bruggemann (1954).

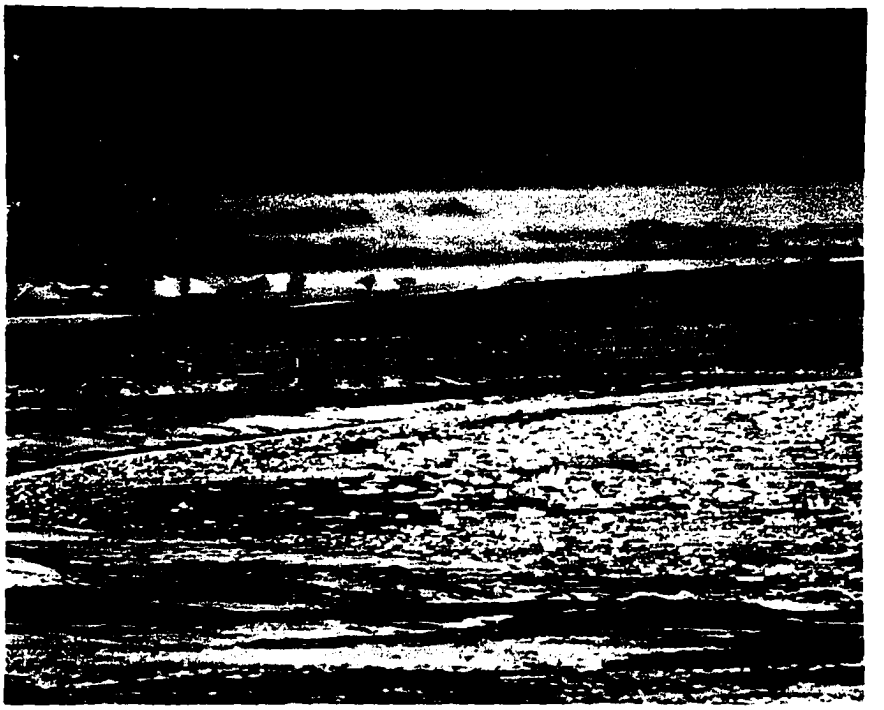

Fig. 3. Eureka Weather Station at Slidre Fiord. Sawtooth Range in far background. Photographed September 17.

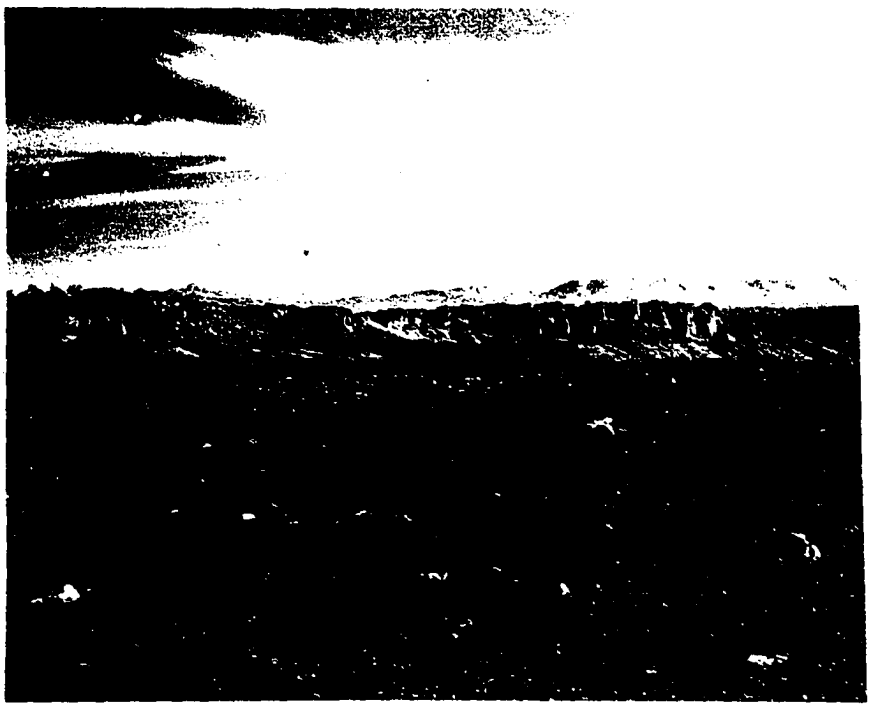

Fig. 4. Arctic desert south of Slidre Fiord. On the hundred-foot sandstone cliffs ("Falcon Castle") nested a pair of gyrfalcons. Photographed August 23.

Fig. 5. The arctic hares of northwestern Ellesmere Island stay white all year. Photographed August 20 on Hare Cape Ridge near Eureka Sound.

Fig. 6. A herd of white-faced muskoxen. The tundra in the foreground is the nesting habitat of the Lapland longspur. Black Top Ridge in background. Photographed September 5 near Eastwind Lake.

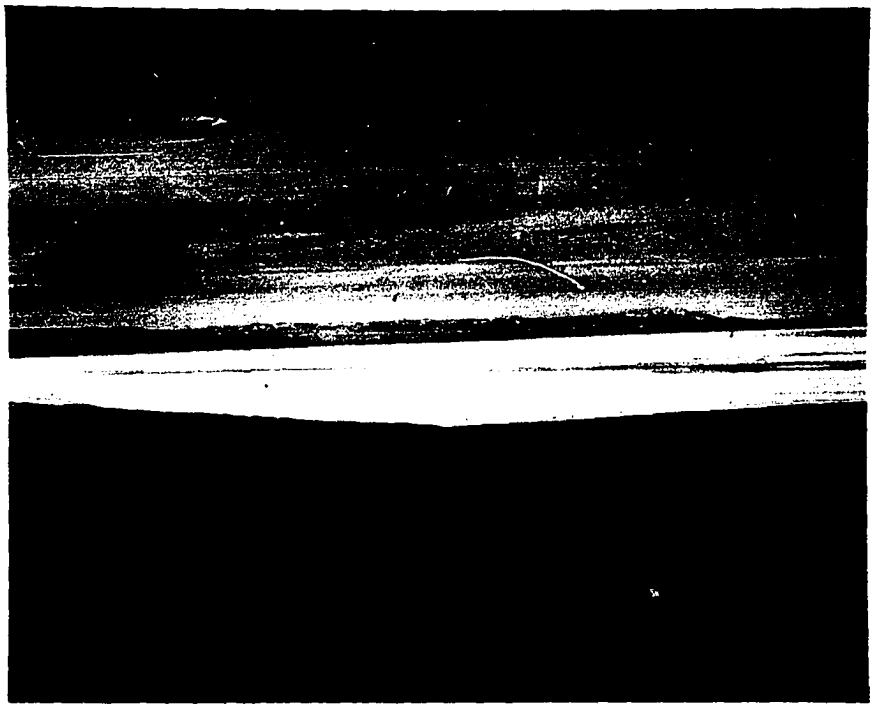

Fig. 7. Greater snow goose nesting habitat south of Iceberg Point. In the far background, beyond ice-covered Eureka Sound, is Axel Heiberg Island. Photographed July 11.

Fig. 8. Nest of greater snow goose. Photographed July 11 south of Iceberg Point.

Fig. 9. Male (left) and female rock ptarmigans in changing plumage. The molt is much retarded in the male. Photographed May 31 near Slidre Fiord.

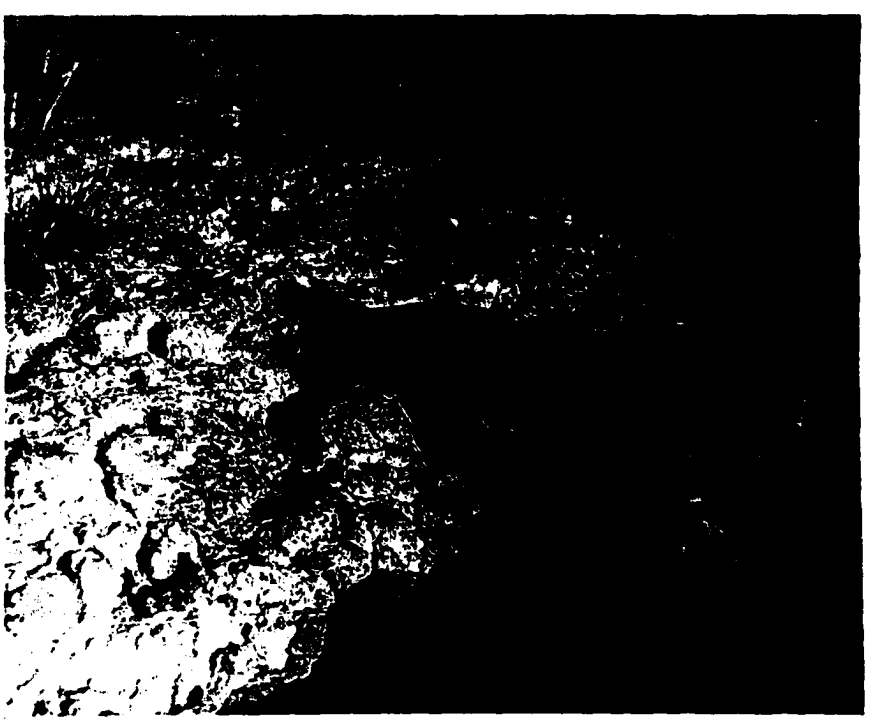

Fig. 10. Female rock ptarmigan on nest. The molt into summer feather has been completed. Photographed July 5 near Slidre Fiord.

Fig. 11. Nest of long-tailed jaeger in hoof print of muskox. Photographed June 19 near Slidre Fiord.

Fig. 12. Female old-squaw on nest. Photographed July 9 near Eastwind Lake.

Fig. 13. Turnstone nesting habitat near Slidre Fiord. Nest 1 was on snow-free ground near center of picture. Photographed June 11.

Fig. 14. Turnstone Nest 1. Photographed June 11 before completion of the clutch.

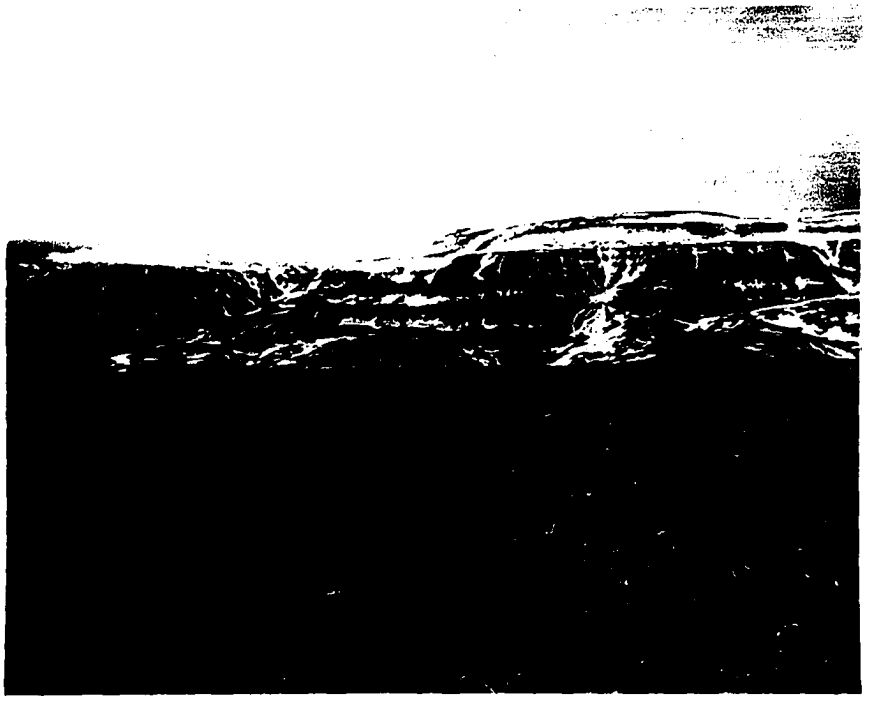

Fig. 15. Muddy tundra: the nesting habitat of the knot. Black Top Ridge in background. Photographed June 21 near Slidre Fiord.

Fig. 16. Incubating knot at Nest 2. Photographed July 2 near Slidre Fiord west of Eureka.

Fig. 17. Thayer's gulls. Photographed June 14 at Eureka, Slidre Fiord.

Fig. 18. Incubating sanderling. Photographed July 14 near Eastwind Lake.