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One hundredth and seventh meeting. The one hundred and seventh meeting of the Arctic Circle was held in the No. 9 Transport Company Mess, R.C.A.S.C. on 9 May 1961.

Mr. Milton Freeman spoke on "Ecology and society on the Belcher Islands".

On the abundance and distribution of certain mammals in the Western Canadian Arctic Islands in 1958-9 [1]. By A.H. Macpherson

One of the duties of the Canadian Wildlife Service is to supply information on the sizes of animal population in the Northwest Territories to government agencies concerned with the welfare of the indigenous peoples. While compiling such information I found that most of the available estimates of the numbers of mammals on the arctic archipelago were "informed guesses" rather than figures calculated from series of observations. On hearing of proposed geological airborne expeditions to certain of the islands, I arranged with the geologists for mammal observations to be recorded in such a way that they could be used as a basis for calculated estimates. The results obtained have added to our knowledge of animal distribution and of fluctuations in the sizes of the insular populations, and plans are being made for questionnaires for the use of agencies wishing to cooperate with the Wildlife Service. Those who expect to have the opportunity of making observations of this kind are earnestly requested to write to the Canadian Wildlife Service for these questionnaires and information.

[1] A contribution of the Canadian Wildlife Service, Department of Northern Affairs and National Resources.

A special series of wildlife survey flights expected to take place over the next two summers should provide more definite estimates than those recorded here. Comparison of the estimates obtained by intensive and casual methods will provide valuable information for the evaluation of the latter. As the wildlife survey will doubtless be too expensive to repeat at frequent intervals, observations of the kind reported here, with accuracy limits improved by the comparison mentioned above, will be useful in estimating increases or decreases in the mammal populations, or changing patterns of distribution.

Most of the present observations were made by Geological Survey field parties, working with light, fixed-wing aircraft on wheels (for a description of their work see Thorsteinsson and Tozer, 1959 a). They recorded mammals sightings in their notebooks in 1958 and on questionnaires in 1959. I am most grateful to the observers, Drs. R. Thorsteinsson and E.T. Tozer in 1958, and Drs. Thorsteinsson, Tozer, J.G. Fyles, and R.L. Christie in 1959. A few questionnaires were completed by Army Survey Establishment personnel, and I am grateful to Mr. G. Arnold, who directed the project, for his cooperation.

In addition to the material received from the parties listed above, other older or less systematically recorded observations have been used for comparison or amplification. However, I have included few of the very numerous observations on game animals made in the course of the several expeditions in search of Franklin's crews, feeling that it would be best to leave their analysis to more detailed regional treatments.

The species discussed are the arctic hare (Lepus arcticus), the wolf (Canis lupus), the arctic fox (Alopex lagopus), the polar bear (Thalarctos maritimus), the caribou (Rangifer arcticus), and the muskox (Ovibos moschatus).

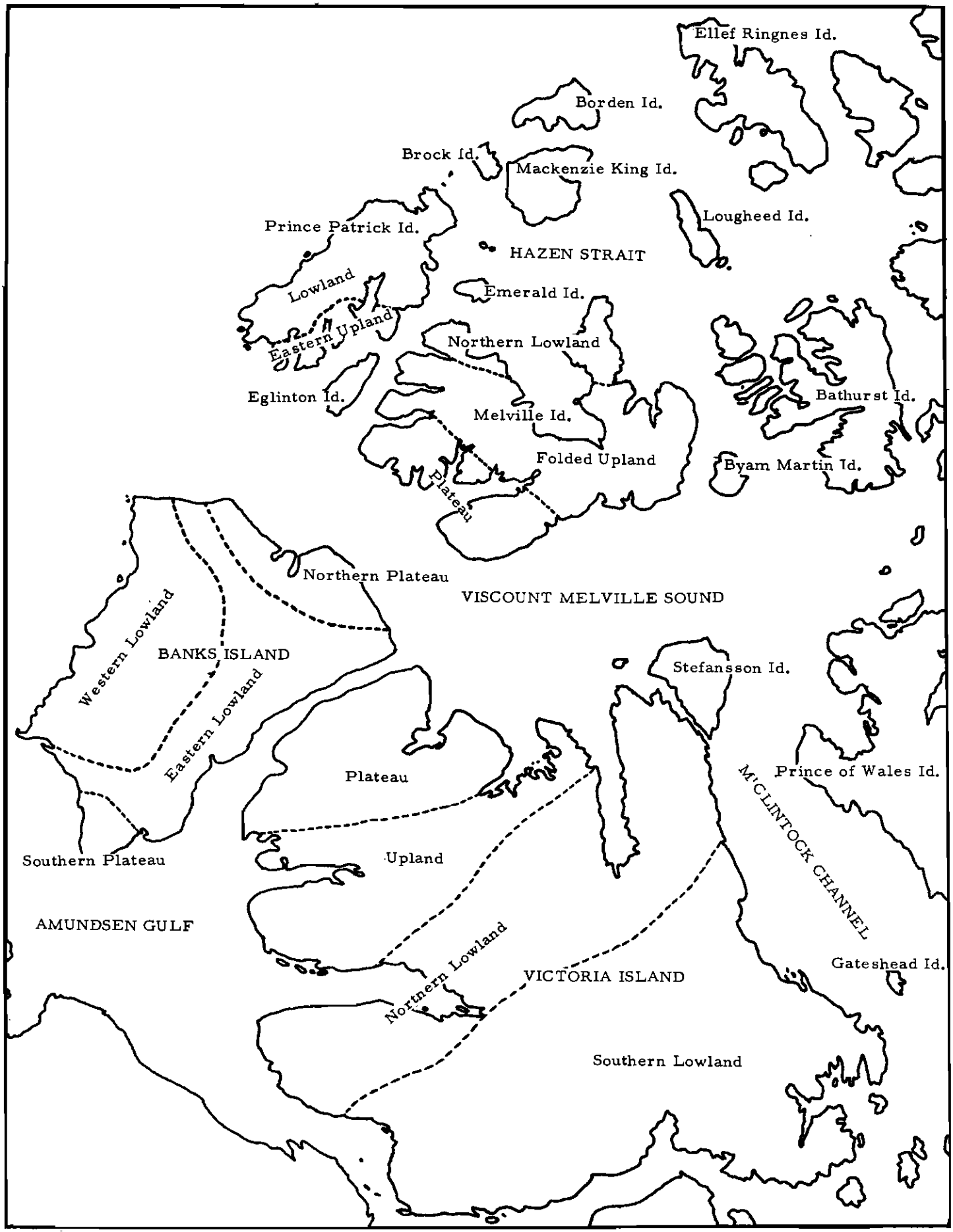
Indices given for the various species are of different kinds. The average number of animals seen per mile flown is given, or is readily derivable from other figures given, for every species. In the case of caribou and muskoxen, for which it seems possible to suggest reasonably accurate average transect widths, the number seen per square mile and an estimate of total number for each region surveyed are given.

The flights on which observations were made did not cover in their entirety the areas for which population estimates are required, and caution must therefore be used in projecting the observed densities over the rest of the areas. One of two situations must prevail if simple projections are to be valid; first, that the proportions of poorly inhabited to densely inhabited country in the region as a whole are equivalent to the proportions of observing done in each, or second, that the region is uniform as regards the distribution of animals. In making the estimates given below the second situation was assumed to prevail, and, to increase the likelihood of the necessary condition being met, the islands were divided into physiographic regions, in general following Dunbar and Greenaway (1956), and flights over differing regions were kept separate in the calculations. The areas of these regions (see sketch-map) were estimated with the aid of a dot area grid, and the flight lines, when plotted, were measured with a rotary map measurer. For a description of the topography and a map of the geology of the area examined in 1958, see Thorsteinsson and Tozer (1959 b).

The aircraft were usually flown at heights between 50 and 2,000 feet; most of the individual flights reported were, however, made between 100 and 500 feet. Both pilot and geologist acted as observers.

Average transect widths were estimated, with the aid of the observers, to reflect the conspicuousness of the animal as well as the care with which the ground was searched. The estimate varies from three-quarters of a mile for muskoxen, to one-third of a mile for caribou (in the more southerly islands). These estimates may be compared with a track width of two miles used by a Canadian Wildlife Service caribou survey party flying at a height of about 1,000 feet above the ground, in mid-March 1960, on Baffin Island. Most of the data used are shown in Table 1. Additional notes on abundance will be found under the species concerned in the systematic list.

The game animals of the following areas regularly provide harvests: southern and western Banks Island, southern and western Victoria Island, and southeastern Bathurst Island. Animals live


Ellef Ringnes Id.
Borden Id.
Brock Id.
Mackenzie King Id.
Lougheed Id.
Prince Patrick Id.
HAZEN STRAIT
Lowland
Eastern Upland
Emerald Id.
Northern Lowland
Eglinton Id.
Melville Id.
Bathurst Id.
Folded Upland
Byam Martin Id.
Plateau
Northern Plateau
VISCOUNT MELVILLE SOUND
Western Lowland
BANKS ISLAND
Eastern Lowland
Stefansson Id.
Plateau
Prince of Wales Id.
M'CLINTOCK CHANNEL
Southern Plateau
Upland
AMUNDSEN GULF
Northern Lowland
VICTORIA ISLAND
Gateshead Id.
Southern Lowland

practically undisturbed by man on northern and eastern Banks and Victoria islands, and on the islands west and north of Bathurst Island.

Arctic hare

Arctic hares of the races inhabiting the Queen Elizabeth Islands and northern Greenland seem to live mostly in flocks. The arctic hares of the mainland and Victoria Island are usually seen singly; twos and threes in the spring and loose family groups in the late summer are the exceptions. The Banks Island hares seem to be somewhat intermediate in habit. Furthermore, hares living north of Parry Channel rarely change into dark pelage for the summer months. These differences prevent the numbers of hares seen per mile from island to island from being directly comparable. Arctic hares are most commonly found in summer on the sides of steep slopes overlooking broad valleys or plains, or on bluffs and bold capes overlooking the sea. They are rarely found on low terrain at that season.

No hares or signs of hares were seen on Brock, Borden, or Mackenzie King Islands, and Stefansson remarks on the absence of hares from the group (1921, p. 333). Although no hares were seen on Prince Patrick Island by the geologists in 1958, nor by Dr. E.T. Tozer or myself in 1954, MacDonald (1954, p. 219) recorded them in 1952 in the vicinity of Mould Bay as fairly common, and more abundant than on a previous visit in 1949. On Melville Island a total of 84 was seen by the geologists, chiefly in flocks of between 10 and 25 on the Folded Upland and Plateau regions.

Wolf

Wolves have been recorded in most parts of the region considered. There is a breeding record for Prince Patrick Island (MacDonald, 1954, p. 219) and a record of a wolf den on Banks Island (Manning and Macpherson, 1953, p. 56). In spite of the delicacy of Cabine (1824, pp. clxxv, clxxvi), it is clear from his

remarks [1] that the mating of a female wolf with a dog was repeatedly observed at Winter Harbour, Melville Island. The approximate date of the matings (16 January, 1820) is given by Parry (1821, p. 136). It is probable that wolves breed on Victoria Island also, although there are no definite records.

Single wolves were seen from the air on the Eastern Upland of Prince Patrick Island, on the Folded Upland of Melville Island, and in the northeastern corner of Banks Island. None were seen elsewhere, although one was heard howling on 19 and 20 August 1959, from a camp between Tahoe Lake and the head of Prince Albert Sound, Victoria Island.

Arctic Fox

Foxes are found throughout the area, Banks Island in particular being famous for its abundance of foxes. Fox dens have been reported from Prince Patrick Island (MacDonald, 1954, p. 217) and from Banks Island (Manning and Macpherson, 1958, p. 59). I examined twenty fox dens on the peninsula between Minto Inlet and Prince Albert Sound, Victoria Island, in August and September 1959. A den believed to be a hare warren, but doubtless an arctic fox den, was found by Parry (1821, p. 194) near the head of Hecla and Griper Bay, Melville Island. There is a more definite breeding record for Melville Island; a vixen and six cubs were observed in September 1853, on the southeast coast (M'Dougall, 1857, p. 318).

An examination of the catch figures (Table 2) indicates a peak year for Resolute Bay trappers in 1957-58. The geologists reported that foxes were numerous and tame on the western Queen Elizabeth Islands in 1958. No sign of breeding activity was observed, and the reported tameness of the foxes seen suggests that they were not caring for litters. Dead lemmings and recent lemming signs were seen everywhere, indicating a possible lemming crash in the winter or spring. The geologists noted no foxes from the air on Banks Island or Victoria Island in 1959, and of the twenty dens examined on Victoria Island that year, none was occupied.

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1 " ..... they were usually together from two to three hours, and as they did not go far away unless an endeavour was made to approach them, repeated and decided evidence was obtained of the purpose for which they were thus associated ... ".

A comparison of the catch figures for Resolute Bay and Victoria Island shows some evidence of synchrony between the fox population fluctuations of the two areas. This is surprising in view of the difference in lemming availability (probably the chief factor in fox production) in the two regions: north of Parry Channel only one species of lemming occurs, on the more southerly islands there are two species. Very little definite information is available, however, on the synchrony of cycles in sympatric lemming species, synchrony of cycles between insular lemming populations, or extent of fox movement in response to food scarcity.

Polar bear

Bears are very rare in the western Queen Elizabeth Islands, except on the south coast of Melville Island, where they appear at times to be rather more abundant. Stefansson (1921, p. 333, 502, 544) mentions the scarcity of bears in the western islands in comparison to their abundance east of Hassel Sound, as recorded by Sverdrup. Actually, Sverdrup (1904, Vol. 2, p. 357) found the abundance of bears varied from winter to winter, and suggested that in the winter following a season in which there had been little open water, the ice would be too thick for the seals, which would migrate to more favourable regions, and that bears would consequently desert the area. It therefore seems possible that the scarcity of bears in the Hazen Strait region is due to the prevalence of old ice. Only one bear was seen by the geologists in 1958, near Skene Bay, southern Melville Island.

No bears were seen on Banks Island, although they were common in the Nelson Head region in late July (not August) 1952 (Manning and Macpherson, 1958, p. 61). A female bear with two cubs was seen southeast of Minto Inlet, Victoria Island, on 26 August 1959, and another bear on Gateshead Island on 25 June 1959. Most of the bears of the region were doubtless living on the pack ice which persisted about the islands in both summers.

An average of 15 or 20 polar bears are traded each year at Holman Island post, and about the same number are killed annually by the inhabitants of Banks Island.

Table 1. The numbers of caribou, muskoxen, and hares seen on aerial traverses of the Western Arctic islands in 1958-9 (cc nt'd on next page)

Region	Area sq. mi.	Caribou				
		Est. av. track-width	Sq. mi. sur-veyed	No. seen per sq. mi.	Est. total no.	% area sur-veyed
Brock Id.	300	1/2 mi.	27	0	0	9.0
Borden Id.	1,000	"	55	1.2	1,200	5.5
Mackenzie King Id.	1,900	"	220	0.464	882	11.6
Emerald Id.	250	"	15	1.5	450	6.0
Prince Patrick Id.						
Eastern Upland	2,400	"	145	0.559	1,342	6.0
Lowland	3,500	"	45	0	0	1.3
Eglinton Id.	600	"	57	0	0	9.5
Melville Id.						
Folded Upland	7,800	"	2,135	0.159	1,240	27.4
Plateau	4,300	"	275	0.382	1,643	6.4
Northern Lowland	2,200	"	280	0.064	141	12.7
Banks Id.						
Northern Plateau	3,900	1/3 mi.	30	0	0	0.8
Southern Plateau	800	"	77	0	0	9.6
Eastern Lowland	8,600	"	380	0.036	310	4.4
Western Lowland	10,800	"	293	0.189	2,041	2.7
Victoria Island						
Plateau	9,500	"	227	0.009	86	2.4
Upland	12,500	"	1,530	0.045	563	20.4
Southern Lowland	35,900	"	1,070	0	0	3.0
Northern Lowland	22,300	"	1,007	0.001	22	4.5

Table 1. The numbers of caribou, muskoxen, and hares seen on aerial traverses of the western arctic islands in 1958-9 (cont'd)

Region	Muskoxen					Hares
	Est. av. track-width	Sq. mi. sur-veyed	No. seen per sq. mi.	Est. total no.	% area sur-veyed	No. seen per linear mile flown
Brock Id.	3/4 mi.	41	0	0	13.7	0
Borden Id.	"	83	0	0	8.3	0
Mackenzie King Id.	"	330	0	0	17.4	0
Emerald Id.	"	23	0	0	9.2	0
Prince Patrick Id.						
Eastern Upland	"	218	0.014	34	9.1	0
Lowland	"	68	0	0	1.9	0
Eglinton Id.	"	86	0	0	14.3	0
Melville Id.						
Folded Upland	"	3,203	0.028	218	41.0	0.014
Plateau	"	413	0.019	82	9.6	0.005
Northern Lowland	"	420	0.121	266	19.1	0
Banks Id.				(see		
Northern Plateau	"	68	0.279	(tem	1.7	0
Southern Plateau	"	173	0	0	21.6	0.004
Eastern Lowland	"	285	0.003	26	9.9	0.006
Western Lowland	"	660	0	0	6.1	0.002
Victoria Island						
Plateau	"	510	0.028	266	5.4	0.003
Upland	"	3,442	0.0003	4	27.5	0.001
Southern Lowland	"	2,408	0.001	36	6.7	0.0003
Northern Lowland	"	2,265	0.027	602	10.2	0.0003

Table 2. The number of arctic fox skins traded at Resolute Bay, Holman Island, Read Island, and Cambridge Bay in the years 1949-50 to 1959-60 (data courtesy Hudson's Bay Company, Royal Canadian Mounted Police, and Department of Northern Affairs and National Resources).

Year	Resolute Bay	Holman Island	Read Island	Cambridge Bay
1949-50		466	985	1,671
1950-51		3,618	6,694	11,151
1951-52		1,606	2,376	2,642
1952-53		232	769	2,120
1953-54	156	1,810	3,224	4,849
1954-55	335	3,963	4,262	6,099
1955-56	763	889	1,355	980
1956-57	380	468	520	1,896
1957-58	825	2,235	1,611	2,049
1958-59	738	683	973	1,148
1959-60	57	81	360	834

Caribou

Caribou were more ubiquitous than any other species, being seen on all islands except Brock Island and Eglinton Island. The greater track-width estimated for the more northerly group of islands (see Table 1) was intended to compensate for the greater conspicuousness of the caribou of that region as compared with those of Banks Island and Victoria Island. Drs. Thorsteinsson and Tozer considered the difference very pronounced (see Manning, 1960, for a discussion of pelage differences and relationships).

Calculated densities varied from 1.5 and 1.2 per square mile on Emerald Island and Borden Island respectively, to 0.001 on the Northern Lowland of Victoria Island. The former figures seem very high, and may cast doubt on the accuracy of the track-width estimate. However, I have thought it best not to amend the estimate in the light of the conclusions to which it leads. These estimates compare with a previous estimate for Banks Island of

approximately one caribou in six square miles, or 0.166 per square mile, and one for the lowlands of central west Baffin Island of one caribou in two square miles, or 0.5 per square mile (see Manning and Macpherson, 1958, p. 65).

The caribou of Victoria Island comprised a large migratory segment now extinct, and a smaller segment resident on the island throughout the year. The former group crossed from the mainland in the spring and returned in the fall. Its history, or as much of it as can be reconstructed, and its taxonomic distinctions, are detailed in Manning's (1960) recent study. The migrants, called the Dolphin and Union herd by Manning, vanished shortly after the establishment of trading posts near or on their crossing places on Dolphin and Union Strait. Manning (1960, p. 9), combining earlier estimates suggests that the migrant herd may have numbered about 100,000 animals, and the resident population about 8,000 or less. The present size of the latter herd is estimated as 671 animals. Although the new estimate is no doubt subject to considerable error, it seems clear that the present population is far less than 8,000, and in view of the sparse vegetation of Victoria Island it seems unlikely that the resident population was ever that great. The ecological problems posed by the existence of sympatric migrant and resident populations on Victoria Island (and also on Boothia Peninsula) remain unanswered. It would seem logical, however, to expect that a migrant population would be exploiting a surplus of seasonal forage that the residents were unable to exploit owing to a differential between summer and winter range; residents being limited by a shortage of winter food.

From observations made in the period 1914 to 1917, Stefansson estimated the summer caribou population of Banks Island as 2,000 or 3,000; an estimate based on numbers seen during timed walks in 1952 and 1953 put it at about 4,000 (Manning and Macpherson, 1958, p. 65). The latter authors have discussed an exodus of caribou from Banks Island in the winter of 1951-52 to the mainland, Baillie, Herschel, and Victoria islands; the finding of numbers of dead animals on southern Banks Island in the early summer of 1952; the scarcity of fawns among caribou seen in 1952 and 1953; and a reportedly heavy winter mortality in 1954-55. The present estimate of 2,351 caribou for Banks Island is therefore in line with previous estimates if in fact a decline did occur between 1951 and 1955.

Stefansson's party found caribou quite common in the spring of 1915 on Brock Island, where the geologists saw none in 1958. It is difficult to say whether Stefansson's remark (1921, p. 331), that caribou tracks were more numerous than in the area that they had visited on Banks Island, refers to Brock Island or Mackenzie King Island. Brock Island was re-visited in 1916; members of the party killed five caribou near Cape Murray about May 1, and Natkusiak found numerous traces in the hilly interior on May 5 (Stefansson, 1921, pp. 492, 495). Caribou did not appear to be very numerous on Borden Island; somewhere near Cape Mackay in May 1916, Noice (1924,p117) writes, "... judging by the number of caribou we had seen so far - nine (in the whole group of islands) - we could not expect to kill enough for sustenance..." Tracks were noted and five animals killed on Mackenzie King Island in late April 1916 (Noice, 1924, p. 109), but a visit in September 1916, to the southeast shores of that island, provoked the following from Stefansson (1921, p. 476) "... we found a striking difference between our New Land at the time of discovery, when caribou traces were more numerous than we have seen them almost anywhere in the Arctic, and that same land in the fall of 1916 when the wolves appeared to be as numerous as the caribou and the caribou not one-tenth as numerous as a year and a half before." None the less, the party saw several (Noice, 1924, pp. 171, 172).

Stefansson (1921, pp. 343, 558) landed on Emerald Island briefly in the spring of 1915, and again in the fall of 1916. On the latter occasion he walked over it but failed to see game, perhaps owing, as he implies, to the "continual snowstorm". He does not, however, mention any abundance of tracks.

Even without the present estimates there is thus good evidence for past changes in the sizes of several of the island populations. The evidence suggests that the caribou of the islands north of Prince Patrick Island move freely from island to island, or that the population fluctuate considerably in size. Although both alternatives are probably true to some extent, it is likely that inter-island movement is responsible for most of the differences observed, as the ice on the straits between the islands seems to be solid enough for crossings for about ten months of the year.

Stefansson (1921) does not appear to have visited the southeastern parts of Prince Patrick Island. He found those parts of the western Lowland that he visited devoid of game, as did the geologists in 1958. Caribou distribution on Melville Island as suggested by the remarks of Bernier (1910), Stefansson (1921), and Noice (1924) seems to accord roughly with that described in the present report.

Estimates of caribou numbers that have been made from observations on other of the Queen Elizabeth Islands are outlined below. A party under Stefansson spent the period 4 August to 9 September 1916, on Lougheed Island and other islands of the Findlay Group. Caribou were shot on Lougheed Island and probably on Edmund Walker Island. Stefansson (1921, p. 542) estimated the local population of Lougheed Island in the summer of 1916 as 300. This estimate accords exactly with that of Thorsteinsson (oral) who visited Lougheed Island in September 1955. From the summit of a hill in the southwest part of the island, which he believed overlooked about a fifth of its area, he counted 56 caribou. Dr. A.H. McNair, Department of Geology, Dartmouth College, Hanover, has told Dr. Thorsteinsson that he estimated the caribou population of Bathurst Island to be about 300 in the summer of 1959 (Thorsteinsson, oral). McNair was using a light wheel-equipped aircraft for his geological investigations.

Muskox

Existing records of muskoxen on Banks Island have been discussed by Tener (1958, p. 404) and by Manning and Macpherson (1958, pp. 70, 71). Muskoxen seem at one time to have been very numerous on Banks Island, perhaps before the visits of M'Clure and Collinson in the early 1850's. However, that they were also fairly abundant in the last half of the 19th century may be inferred from the number of remains associated with wood from the abandoned Investigator. Muskoxen were absent or very rare on the island when it was visited by the Canadian Arctic Expedition between 1914 and 1917, but more recent records indicated a considerable resident population, which Tener (1958, p, 404) has estimated to number 100 or more.

Nineteen muskoxen were seen by the geologists in 90 miles of flying on the Northern Plateau of Banks Island, and two

on the Eastern Lowland in 1,140 miles of flying. Those seen on the Northern Plateau form a very biased sample, for almost all of the observing in that region was done along the major river valleys which the species favours, and therefore no estimate of the total population has been made.

No recent records for Victoria Island were available to Tener (1958), and he therefore did not estimate the muskox population of that island. However, he gives a recent record (p. 406) for Stefansson Island (included in the Northern Lowland of Victoria Island in this report). Stefansson (1913, p. 455) believed that muskoxen had been exterminated on Victoria Island, "... unless indeed there may be a few on the north coast, which is but seldom visited by the Minto Inlet Eskimo." Anderson (in Hoare, 1930, p. 50) shows a small area at the head of Richard Collinson Inlet as being occupied by muskoxen. Hoare (1930, p. 47) gives further information suggesting that small numbers of muskoxen were to be found in the early part of the present century in both northern Victoria Island around Richard Collinson Inlet, and somewhere on the island northeast of Prince Albert Sound, perhaps toward Hadley Bay. The present survey shows a very similar situation to that suggested by Hoare (1930, p. 47) and, from information obtained at Holman Island in September 1959, it might be inferred that the muskoxen of Victoria Island have always yielded a small annual harvest (7 or more muskoxen were killed on Victoria Island in 1958-59). Stefansson (1913, pp. 450, 455) suggests that the muskox and the Eskimo are unable to live in the same area, owing to the ease with which the muskox is exterminated locally; the present distribution of muskoxen and Eskimos on Banks and Victoria islands could be taken as supporting Stefansson's view.

Anderson (in Royal Commission, 1922, p. 76) quoting Captain Joseph F. Bernard, says that muskoxen were probably killed on Gateshead Island by Eskimos in 1915-16. It is interesting to note that the geologists observed a solitary bull on the island in 1959. Regarding the distribution of muxkoxen on the islands north and east of Queen Maud Gulf, Superintendent Henry Larsen has told me that he once noted the droppings of muskoxen on the Royal Geographical Society Islands.

The muskox population of Prince Patrick Island has evidently undergone a very considerable reduction in the last decade. The reduction is, as far as we know, a natural one. In 1948, J.G. Dyer, U.S. Weather Bureau, while searching for a site for a weather station on southeast Prince Patrick Island, counted 149 muskoxen (Thorsteinsson, oral). Tener's (1958, p. 406) "minimum estimate" of 200 is probably in close agreement with Dyer's observations. The present estimate of 34 indicates a severe decline.

MacDonald (1954, p. 220) observed between 19 May and 1 September 1952, from 2 to 56 muskoxen in each day's travel, but in the summer of 1954 neither Dr. E.T. Tozer nor I saw live muskoxen on Prince Patrick Island, although carcasses were common on the land (a small group of carcasses was also found on the sea ice near Eglinton Island).

Stefansson (1921, pp. 332, 521, 544) recorded no muskoxen on Brock, Borden, Mackenzie King, Ellef Ringnes, Amund Ringnes, Lougheed, or Meighen islands. There are recent records for Ellef Ringnes Island (Tener, 1958, p. 405: Heywood, 1957, p. 4). Thorsteinsson found a fresh carcass on Lougheed Island in 1955, and he and Tozer found an ancient skull on the Leffingwell Crags, Mackenzie King Island, in 1958 (Thorsteinsson, oral). The latter constitutes the most northerly record for the species west of Ellef Ringnes Island. A skull has been recorded on Eight Bears Island (Stefansson, 1921, pp. 332, 342) and on Emerald Island (Thorsteinsson, oral).

Muskoxen were clearly very abundant on Melville Island in 1916 and 1917. For example, in April 1916, from winter quarters at Liddon Gulf to Hecla and Griper Bay, Stefansson (1921, p. 488) saw an average of 50 muskoxen a day, and 114 from Hooper Island on a clear day. Storkerson (Royal Commission, 1922, p. 14) estimated that there were some 4,000 head on Melville Island in 1917, of which about 400 were killed for food by the Canadian Arctic Expedition. Tener (1958, p. 405) estimated the total number living there in the early 1950's to be 200, and Thorsteinsson (oral) does not think that there were more than that on the island in 1958; the observations of Thorsteinsson and Tozer, however, give a calculated estimate of 566. A comparison of the estimate made by Storkerson (which, judging from the accounts of Stefansson and Noice, appears to be well founded) with the more recent ones given above, indicates

a decline of similar magnitude to that which has evidently occurred more recently on Prince Patrick Island.

A recent estimate of the number of muskoxen on Bathurst Island, made by Dr. A.H. McNair following an intensive coverage of the island by aircraft, is 300 (Thorsteinsson, oral). Thorsteinsson saw 149 on a single flight on 24 June 1953, in the broad valley between Goodsir Inlet and Bracebridge Inlet.

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Radio in the north

The extension of full-scale CBC radio service into the north began in 1958 when Parliament voted special funds for the creation of a Northern Service. The CBC's plan is in two parts: first, the construction of a powerful new shortwave station aimed at the High Arctic, and second, the establishment of local medium-wave stations in all the major centres of the north.

The new shortwave station is still under investigation, but a limited shortwave service was started in September of 1960 when the transmitters of the CBC's International Service at Sackville, N.B. were put on a northern beam for seven hours a day. The transmission is in two parts: a 45-minute programme of news in English and French aimed at the Eastern Arctic between 5:00 and 5:45 pm. EST; and a 6-hour schedule of news and features for the Central and Western Arctic from 8:00 pm. to 2:00 am. EST. All transmissions are carried on two frequencies: 9.585 and 11.72 megacycles.

Besides relaying talks and variety shows from the Trans-Canada Network, the nightly Northern Shortwave Service also presents several programmes specially prepared for northern listeners. News bulletins, combining national and international news with coverage of events in the north, are presented three times each night, at 5:00 pm., 8:00 pm., and midnight EST. Regular CBC network newscasts are carried on all other hours of the transmission. They are followed by sports scores and a summary of weather conditions prepared for the CBC by the Arctic Forecast Office in Edmonton. Other shortwave features include "Points North" (Saturdays and Sundays) a quarter-hour of interviews and stories recorded at northern points, and "Northern Newsletter" (Thursdays, Saturdays and Sundays) in which Canadian Press correspondent Arch MacKenzie reviews the week's events in Ottawa that affect the north. On Monday, Wednesday, and Friday the shortwave service presents an Eskimo-language programme, "Uqausi", prepared and announced by the CBC's first Eskimo producer, Miss Ann Padlo. The weekly "Northern Messenger", first started in 1933, will still be on the air in the winter months.

CBC regional stations have now been set up at 13 communities in the North: at Whitehorse, Dawson City, Watson Lake, Elsa, and Mayo (all in the Yukon), Inuvik, Yellowknife, Hay River, Fort Smith, and Frobisher (all in the Northwest Territories) and at Fort Nelson, B.C., Fort Churchill, Manitoba, and Goose Bay, Newfoundland.

The regional stations, ranging in power from 1,000 watts at Inuvik to 40 watts at Watson Lake, provide a full daily programme service, much like that of any station in southern Canada. By means of new landlines in the northwest, the stations in the Yukon are now connected directly to the southern networks. This live connection will soon be extended to the stations in the Great Slave Lake area. At more isolated points, such as Inuvik and Frobisher, the CBC stations are supplied with music and drama programmes on tapes flown north from Montreal. For live news and sports the stations turn to the Northern Shortwave Service, which they rebroadcast on their own transmitters. Nine of the thirteen stations have studios and a local staff; the other four are unmanned relay transmitters. At the studio locations a high percentage of local programmes are produced. These range from the daily Yukon Regional News broadcast at Whitehorse, to the efforts of the Eskimo Drama Group at Frobisher.

Copies of programme schedules may be obtained by writing to the CBC at P.O. Box 806 in Ottawa.

Department of Transport icebreakers and ice-strengthened ships

In Vol. 11 No. 3 of the Circular (pp. 55-6) some specifications of the D.O.T. icebreakers were given. A number of ships for northern service, which were then under construction, have now been completed. The following list includes more specifications for all the D.O.T. icebreakers and ice-strengthened ships. Some slight differences from the earlier list are due either to different kinds of tonnage or to slight changes in final specifications of the ships from those planned.

Department of Transport icebreakers and ice-strengthened ships (p. 1)

Ships	Year built	Length (ft.)	Breadth (ft.)	Depth (ft.)	Mean draft (ft.)	Gross tonnage	Engine type	Horse power
Saurel	1929	200	42	12	17	1,176	Steam	3,000
N.B. McLean	1930	277	60	31	19	3,254	Steam	6,500
Ernest Lapointe	1940	184	36	17	15	1,179	Steam	2,000
Edward Cornwallis	1949	259	43	20	18	1,965	Steam	3,000
C.D. Howe	1950	295	50	26	18	3,628	Steam	4,000
d'Iberville	1952	310	66	40	30	5,678	Steam	10,800
Labrador	1954	269	63	38	29	3,823	Diesel electric	10,000
Montcalm	1957	220	48	21	16	2,017	Steam	4,000
Wolfe	1959	220	48	21	16	2,022	Steam	4,000
Sir Humphry Gilbert	1959	220	48	21	16	1,930	Diesel electric	4,250
Camsell	1959	223	48	21	16	2,020	Diesel electric	4,250
Sir William Alexander	1959	272	45	21	17	2,153	Diesel electric	4,250
Alexander Henry	1959	210	43	21	16	1,674	Diesel	3,500
John A. MacDonald	1960	315	70	33	28	6,186	Diesel electric	15,000
Tupper	1959	204	42	18	14	1,357	Diesel electric	2,900
Simon Fraser	1960	204	42	18	14	1,357	Diesel electric	2,900
Thomas Carleton	1960	180	42	18	13	1,217	Diesel	2,000

Department of Transport icebreakers and ice-strengthened ships (p. 2)

Ships	Speed (knots)	Range (miles)	Cargo (tons)	Helicopter platform	Location	Crew	Passengers	Remarks
Saurel	11	5,000	250	No	East	44	3	Icebreaker
N.B. McLean	15	11,000	400	Yes	East	51	15-20	Icebreaker
Ernest Lapointe	13	2,000	40	No	East	30	7	Icebreaker
Edward Cornwallis	13	7,500	700	No	Maritimes	47	12	Strengthened for work in ice but not an icebreaker
C.D. Howe	13	10,000	1,100	Yes	East	52	90	Supply vessel; strengthened but not an icebreaker
d'Iberville	15	12,000	450	Yes	East	50	70	Icebreaker
Labrador	16	24,000	105	Yes	Maritimes	102	14	Icebreaker
Montcalm	13	6,000	430	Yes	East	41	12	Sister ships. Icebreakers
Wolfe	13	6,000	430	Yes	Maritimes	41	12	
Sir Humphry Gilbert	13	10,000	450	Yes	East	39	12	
Camsell	13	12,000	450	Yes	West	39	12	
Sir William Alexander	15	10,000	600	Yes	Maritimes	40	12	Supply vessel; heavily strengthened but not an icebreaker.
Alexander Henry	13	6,000	785	Yes	Great Lakes	31	20	Strengthened but not an icebreaker
John A. Macdonald	15	20,000	525	Yes	East	84	12	Triple screw, icebreaker
Tupper	13	5,000	225	Yes	East	34	12	Sister ships; for search and rescu heavily strengthe
Simon Fraser	13	5,000	225	Yes	West	34	12	but not icebreake
Thomas Carleton	2	5,000	495	Yes	Maritimes	40	7	Strengthened but not an icebreaker.

"A grammar of the east and west coasts of Hudson Bay". By A.E. Spalding

When, in 1948, I first began the grammar, which was later published by the Department of Northern Affairs under the title of "A grammar of the east and west coasts of Hudson Bay",[1] I had spent about two years with the Hudson's Bay Company in the north. I was, as many others have been before and after, fascinated by the Eskimo people and their culture and language. In my attempts to learn more about their language, I found myself handicapped by the lack of written material in English on the subject.

The only work written in English, which I was able to get my hands on, was Peck's small grammar. It was however of such a sketchy and erratic nature, that I could not find in it much with which to continue my study. Fortunately, I was later able to borrow copies of both Turquetil's and Bourquin's grammars which gave much greater scope for study. I do not mean to infer, of course, that I learned most of my Eskimo by perusing grammars; this would be far from the truth. While attempting to study the language academically, I was all the while gaining in fluency and insight from living and working with the Eskimo people.

My basic incentives then for writing a grammar were my interest in the Eskimos and their language, and the lack of tools for English-speaking people to learn Eskimo, and at the same time, I wanted a grammar which was not merely a dry academic thing following the traditions of latin grammars, but a working grammar which also contained the life, the humour, and the language of live everyday Eskimos. (Whether this colour can combine with theory to produce a good workable grammar is a matter which needs must be discussed elsewhere).

In order to accomplish these aims, I decided that live dialogue would form a large part of the work, based on a cyclical and topical, rather than on a strictly grammatical, structure. Hence the grammar begins in late summer, goes through fall, winter, and spring, back to summer, encompassing a range of topics with its accompanying vocabulary, concerning each season as it appears. The grammar is explained throughout as each problem arises in the dialogue. Descriptive passages are also interspersed through the work in order to give the reader some idea of the thought and customs of the Eskimos. Indices for finding grammatical and topical items, for verbs, and for vocabulary, are also included.

1. Copies can be obtained from the Queen's Printer, price ($1.00) (178 pp. + vocabulary). ED. A.C.

By its title, the grammar purports to cover the areas of "East and west coasts of Hudson Bay". Actually this is a gross overstatement, because the basic dialect in the dialogues is that of Repulse Bay and Igloolik, which would also be suitable enough for the fringe areas of Arctic Bay, Southampton Island, and Chesterfield Inlet, but which by no means would cover adequately these latter areas. The 'eastern' part of the title is also far-fetched, because it only includes my scanty knowledge of the Great Whale River dialect in the footnotes and in some of the grammatical explanations.

During the period in which I wrote the grammar, there was little activity concerning the devising of a standard spelling system for the Eskimo language. Had there been, I would have been most happy to write the grammar in such a system. Now, with the movement towards producing a standard orthography based on scientific linguistic principles, there is a great need to explore new methods of writing grammars and dictionaries in line with the new principles, and, therefore, unless the grammar was revised so radically as to be unrecognizable, it would be of little value in the new movement. As I am keenly interested in helping the new movement and exploring the new methods, I would prefer to close off any further discussions about the future value of the grammar. Let us say that, until the new grammars are realized, it can be a useful tool to those working in the field next to the Eskimos. The new methods are better, but like everything new, they can be aided and put into clearer perspective by the merits and mistake of the past.

CORRESPONDENCE

Dear Mrs. Rowley:

I am writing to ask the help of the members of the Arctic Circle in preventing damage to wildlife in northern Canada. The development of any area must always affect the animals and birds that live there. Sometimes it has led to the unnecessary slaughter which exterminated the passenger pigeon and the Eskimo curlew. Sometimes, as in the case of the buffalo, measures have been taken only just in time to save the species from extinction. At present, the north is being opened up rapidly and large areas are being disturbed by man for the first time. This cannot fail to affect the wildlife in many ways. Without careful conservation measures it could lead to

the destruction of herds of animals and the extinction of certain species. Many of these species breed in the north, migrating to the south each fall. If we allow them to perish not only the north but all Canada and indeed the world as a whole will become the poorer.

As the members of the Arctic Circle are well aware, the caribou herds, on which many Indians and Eskimos depend for food and clothing, are at present in a critical condition. Several years ago the number of muskox fell to such a low figure that they had to be completely protected from hunting, and they are still rare in areas where they had been abundant. The whooping crane, numbering under forty in all, is North America's most spectacular bird and one of the rarest species in the world. It is fighting a desperate battle for existence. Many other species of northern birds and mammals are too few in numbers or too restricted in breeding range to allow exploitation or even significant disturbance. For these reasons game animals and birds are strictly protected and, except under licence, they can be killed only in the face of actual starvation or when it is essential in order to protect life or property. If this is done a full report must be made as soon as possible to a Game Officer or R.C.M. Police detachment.

A major concern to naturalists has been the increased use of aircraft, which can now fly anywhere in the north. Aircraft operating at normal altitudes have little effect, but low flying aircraft can seriously disturb wildlife, particularly during the breeding season. Repeated "buzzing" by aircraft can disrupt and destroy a herd or a flock as effectively as unrestricted hunting. Many of those working in the north have, I know, been aware of this danger. Recently, however, reports from game officers of wildlife being buzzed by aircraft have become too frequent to be ignored. I am sure that very little of this low flying is done maliciously. Most of it is the result of genuine interest in the animals seen, but without understanding the consequences of disturbing them. I should be very grateful therefore, if, through the Arctic Circular, this could be drawn to the attention of those working in the north, particularly to the pilots of aircraft operating there, so that they will refrain from any low flying over wildlife unless their task specifically demands it. I know that northern pilots in general are most interested in wildlife and I feel certain that when they understand the problem fully they will cooperate in every way.

I should also like to say how greatly the Department is indebted to a number of people working in the north who regularly send in information on the location of game and the numbers, proportion of young, etc., of the various species. These data are very valuable, particularly in areas like the Queen Elizabeth Islands which have been rarely visited and for which records are few. The Canadian Wildlife Service, Department of Northern Affairs and National Resources, 150 Wellington Street, Ottawa, is most anxious to increase the number of sources of this information. The Service would also be very pleased to provide details of matters of special interest to them in any particular area and to suggest ways in which those interested in wildlife can assist in conservation. In general, any data from beyond the tree-line and in the Mackenzie Mountains would be welcomed, particularly on such species as the caribou, muskox, polar bear, mountain sheep, mountain goat, narwhal, walrus, bowhead or Greenland whale, and on the location of goose colonies. Those of your readers who are interested in wildlife could make a real contribution by collecting for the Canadian Wildlife Service any information of this nature they can obtain in conjunction with their normal work. It is, however, most important that this should be attempted only when it can be done without disturbing the birds or animals involved.

Yours sincerely,

R.G. Robertson,
Deputy Minister of Northern Affairs
and National Resources

Dear Mrs. Rowley:

Mention of the whaler George Henry in the Arctic Circular, Vol. 13, No. 3 brought to mind that, in 1934, during our charting of the Savage Islands area at the eastern entrance to Hudson Strait, we came across relics of that barque.

The relics we found were on the southwestern end of the Lower Savage Islands and consisted of old pieces of heavy sail canvas, a block, several sheaves, a belaying pin, the top of a topmast and a Royal yard about 35 ft. long, with the life and clewline bands still on. Several turned legs of a cabin table,

parts of a stove, and a small quantity of hard coal were strewn around as well as iron hoops, barrel staves, and a large pile of rusty hoop iron. This must have come from the whaler George Henry and there is a vivid account of the wreck of the ship in 1863 in the Appendix to the volume "Arctic researches and life among the Eskimos" by C.F. Hall. The book also includes a picture of the vessel in winter quarters.

I described this find in an article, "The Canadian Hydrographical Survey of the Hudson Bay Route" published in the Geographical Journal, Vol. 87 (Feb. 1936, pp. 127-40).

Yours sincerely,

F.C. Goulding Smith –
Dominion Hydrographer - Ret'd.

Change of Address

Members are earnestly requested to advise the Treasurer, Miss M.C. Murray, 249 Irving Avenue, Ottawa 3, promptly of any change of address.

Editorial Note

The Editor would welcome contributions from those who are at present in the Arctic or have information about work in the Arctic. All material for the Circular should be sent to

Mrs. Graham Rowley,
245 Sylvan Road,
Rockcliffe,
Ottawa 2, Ontario.

T H E A R C T I C C I R C U L A R

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One hundred and eighth meeting. The one hundred and eighth meeting of the Arctic Circle was held in the No. 9 Transport Company Mess, R.C.A.S.C. on October 10.

Mr. S.D. MacDonald gave an illustrated talk on "Wildlife of the Queen Elizabeth Islands".

One hundred and ninth meeting. The one hundred and ninth meeting of the Arctic Circle was held in the No. 9 Transport Company Mess, R.C.A.S.C. on November 14.

Dr. J.R. Weber spoke on "The Penny Icecap, Baffin Island" and showed the kodachrome film taken on the Arctic Institute's expedition of 1953.

Work of the Division of Building Research in northern Canada. By H. Brian Dickens

When the Division of Building Research of the National Research Council was established in 1947 it was assigned responsibility for providing a research service to the Canadian building industry. Since this industry is one of Canada's largest, with a broad range of research requirements, the Division's time and effort has from the outset had to be concentrated on selected projects. The policy established was to give particular attention to those problems of building that were of special importance to Canada, which arose because of conditions peculiar to this country, and which could be studied adequately only here. This led, naturally, to studies of building in the north.

Until relatively recently there was very little construction in northern Canada. Before 1920 most building was done by the Hudson's Bay Company and other traders, the Royal Canadian Mounted Police, and the various missions. During the next two decades construction gradually increased, with such notable achievements as the drilling of the first oil well at Norman Wells in 1920, the completion of the Hudson Bay Railway to Churchill in 1929, and the introduction of mining in the Northwest Territories, beginning with the discovery of radium at Great Bear Lake in 1930.

The imperative of war led to a marked increase in the rate of northern building, marked by the construction of the Canol Pipeline, the Alaska Highway, and the airfields associated with the Crimson and Northwest Staging Routes. In the post-war period there has been the establishment of the Joint Arctic Weather Stations in the far northern islands, developments in gold and uranium and nickel mining and in oil exploration, defence installations including the DEW and Mid-Canada lines, and a major construction programme of schools and other administrative buildings. This work has emphasized the distinguishing features of northern building, and in particular has shown the special technical problems of engineering construction in the north to arise mainly from the presence of perennially frozen ground - or permafrost as it is more commonly known - a condition which occurs over nearly one-half of the land area of Canada.

DBR's early work. Before the war there was virtually no organized knowledge of permafrost problems in North America. A major source of information was to be found in Russian publications, but increasing activity in Canada's north soon demonstrated the need for permafrost information related specifically to Canadian conditions. Accordingly a Permafrost Section was established within the Division in 1950, and work was begun that same summer on a survey of the performance of buildings over permafrost in the Mackenzie River valley. This survey was carried out jointly with the Directorate of Engineer Development of the Department of National Defence and was followed the next summer with an expedition to the Northwest Territories, made in cooperation with the Arctic Section of the Defence Research Board and Purdue University, to examine the application of air-photo interpretation methods to preliminary site surveys. These assessments showed the need for studies of site selection methods and of factors affecting the construction and performance of foundations in permafrost, studies which now form two of the three broad lines of permafrost research being currently undertaken by the Division. The third is a study of the distribution, occurrence, and properties of permafrost in Canada.

Since many aspects of permafrost research could be studied adequately only in the field, the Division in 1952 established a northern research station at Norman Wells to provide a field base. The Mackenzie valley area was chosen because it had shown evidence of some of the worst soil and permafrost foundation problems in the north; Norman Wells was selected because of its central location in this region, its excellent transportation service by barge and air, and the presence of the Imperial Oil Company, whose friendly cooperation has been of particular value. Initially, the Division was in rented quarters but in 1956 these were replaced by two new buildings, providing accommodation for six to eight research workers, and a combined soil mechanics laboratory, workshop, and garage for special soil studies and equipment.

The detailed work of the Permafrost Section has included the development of special drilling and soil sampling techniques to investigate the properties of perennially frozen soils, and the continuing compilation of data on building performance in relation to soil and permafrost conditions. Some of the early phases of this work were carried out at the townsite of Aklavik and demonstrated the unusually poor nature of the permafrost of that area. This was an important factor in the ultimate decision to relocate the town.

In 1954 the entire northern staff of the Division was diverted to assist the government team assigned the task of selecting an improved location for Aklavik. This provided a valuable opportunity to use air-photo interpretation methods in preliminary permafrost investigations and to give a practical test to the drilling and sampling techniques which had been under study. These included somewhat unusual field photographic procedures for recording details of ice formation in frozen soil samples in summer without recourse to costly refrigerated equipment for sample storage and transport.

Inuvik. The town of Inuvik now built at this new site has provided an excellent base for further studies of permafrost. These have included observations of the effect on permafrost of the construction of various facilities associated with a town, such as roads, airstrip, building foundations, and services as well as detailed assessments of their performance in this area of continuous permafrost. A careful record has been kept of the original permafrost conditions to permit a comparative assessment of any changes that may occur.

The initial phase of the programme has been observation of construction procedures and establishment of suitable instrumentation on the structures to be studied. To follow the performance of most of the major structures including the powerhouse, hostel, school,and oil storage tanks, elevation reference points have been marked on the pile foundations. This has entailed setting a series of elevation bench marks throughout the townsite to which these structures are referenced. In addition, three specially designed deep bench marks were installed in drilled holes to a depth of 50 feet to serve as reliable permanent datum points. These are themselves under observation to determine their effectiveness, since the design of precise bench marks in permafrost areas is still not well established.

Studies have also been made of the refreezing of piles placed in steamed holes. Records of steaming and driving details, boiler water and fuel consumption, ground temperatures, and pile movements during the freeze-back period were obtained for piles both singly and in groups; these were aimed at providing an estimate of the time required before piles are sufficiently anchored by refreezing for erection of the superstructure. Results to date indicate that, in an area such as Inuvik, sufficient refreezing

occurs within approximately eight weeks from the time of pile placement, provided that the piles are sufficiently embedded in the permafrost and that excessive disturbance of the site has been avoided during the piling operations. It is not therefore necessary in these areas to leave piling over an entire winter to obtain sufficient refreezing.

Observations of ground temperatures to depths of 30 feet are being carried out by means of thermocouple installations under buildings, utilidors, bridges, sections of road, and the airstrip. Those at the airstrip are of particular interest indicating that, four years after construction began, the original ground at the bottom of the 8-foot rock fill remains frozen. Temperature measurements are also being obtained in undisturbed natural areas to depths of 30 feet and two special installations have been made to depths of 100 feet to permit an assessment of long-term changes in the permafrost. The depths of natural thaw in various soil types and under varying surface cover conditions have been measured at selected points in the townsite by means of hand probings.

The major part of the construction programme at Inuvik is now over and the Division's instrumentation in the area is complete. Further work will be confined to regular collection and analysis of ground temperature readings, with periodic visits to observe and assess the performance of the various structures.

Kelsey dyke studies. Another area in which the Division has been active is in northern Manitoba at the site of the Kelsey hydro-electric plant on the Nelson River. This plant, built for the Manitoba Hydro-Electric Board to supply power to the new nickel mining town of Thompson, is in an area of discontinuous permafrost where frozen soil occurs in scattered patches and is close to melting. These conditions are common near the southern boundary of permafrost and often prove more troublesome for construction than those in the more northerly regions, where permafrost is continuous and several degrees colder.

The Division therefore welcomed the opportunity to initiate in 1958 a study of the performance of a sand-filled dyke over permafrost at the Kelsey plant. Thermocouple cables have been installed in the reservoir formed by the raised river level and in the dyke itself. Similar cables in an undisturbed area of the site serve

as reference points. The dyke has been instrumented with settlement gauges to follow any soil movement resulting from the thawing effect of the reservoir. The soil in this area is a varved clay of unusual interest, containing varying quantities of ice in layers up to 8 inches thick. The water level was raised to its final elevation in the reservoir in November 1960, but there has as yet been no indication of significant thawing effects on the frozen ground beneath. Observations indicate that the mean ground temperature for the area is about 31° F.

The thawing effect of water in contact with permafrost is an important consideration in many construction projects in permafrost regions. Both the rate and depth of thaw are questions of importance to the engineer, as was recognized in the design of the Kelsey project, and yet these are not readily answered with the information now available. One method of improving knowledge and of providing guidance for future engineering design is by studying the present level of permafrost under natural bodies of water in the north such as lakes and rivers. Such a study was begun by the Division in the spring of 1961 in the Mackenzie delta, not far from Inuvik, where drilling was done to determine the permafrost profile under several small lakes and a river channel.

The difficult construction conditions caused by discontinuous or sporadic permafrost are also much in evidence at Thompson, some fifty miles to the southwest of the Kelsey hydro-electric plant. In order to broaden its work in these fringe areas of permafrost the Division has recently initiated a programme of field observations of construction at this townsite.

Permafrost distribution. Paralleling this work on the problems of construction in permafrost areas has been the compilation of information on the occurrence and distribution of permafrost in Canada, particularly for defining the southern limit of permafrost. This information in the form of ground temperature records or, more commonly, direct observations of permafrost occurrence, has been obtained from many sources including references in the technical literature, reports from individuals or agencies in the north, and the Division's own field studies, and is being recorded in card index form and on large-scale maps. Recently

a Permafrost Questionnaire has been prepared for circulation under the auspices of the Permafrost Subcommittee of the Associate Committee on Soil and Snow Mechanics to appropriate groups in the north.

In spite of these aids and even with the fullest cooperation of those in the north, this way of obtaining a picture of permafrost distribution in Canada is inevitably a long-term project. The Division has therefore begun a study of the climate and terrain factors that, jointly, influence the ground thermal regime and hence the occurrence and continued existence of permafrost. It is only with such knowledge that the limited observations of permafrost now available can be used to predict permafrost occurrence in other areas. This work, started in 1959, has been mainly carried out at Norman Wells and has already indicated some significant differences in evapo-transpiration, net radiation, and ground temperature readings between some types of vegetative cover.

General permafrost investigations. Closely allied to these studies of permafrost occurrence have been a number of general scientific investigations of permafrost as a natural phenomenon. These have been largely concerned with the study of ground temperatures at depths greater than are normally affected by engineering construction and are aimed at demonstrating whether permafrost in Canada is static or changes with time.

The first of these installations consisted of two 200-foot deep holes at Norman Wells, completed in 1958 and instrumented with thermocouple cables. The two 100-foot deep ground temperature installations made at Inuvik in 1959 are being supplemented by a 200-foot deep hole in the Mackenzie delta. Temperature observations have also been made in pingos, those peculiarly shaped mounds found along the western arctic coast near Tuktoyaktuk.

Instrumentation. In all this work, the Division has spent much time developing and improving equipment, field operating techniques, and instrumentation. Methods of measuring ground temperatures have been constantly reviewed in an attempt to develop a system which has the desired accuracy and reduces to a minimum the possibilities of observer error. This latter requirement is of particular importance since volunteer or part-time observers are serving in many of the Division's field studies. In the method

now used, the thermocouple wires are encased in an oil-filled plastic tube to protect them from moisture and from damage during installation. A special electronic direct temperature reading instrument has been adapted for field use throughout the year with a portable gasoline-fed generator for power.

Another project has been the development of methods of obtaining information on subsurface soil conditions in permafrost. This has dealt mainly with refinements of drilling techniques in frozen ground but recently geophysical methods for determining the depth to permafrost have been considered and field studies have been carried out with a portable shallow refraction seismograph and an earth resistivity measuring device. The reliability of the information obtained with either instrument appears to depend to a large extent on the experience of the interpreter, and prior knowledge of subsurface conditions is necessary for effective use. Both instruments seem to be mainly useful for supplementing subsurfaces information obtained from boreholes where the permafrost table is too deep or soil conditions too difficult to be readily probed by hand.

Northern housing. Building activity in northern Canada has also created much interest in superstructure design. Although experience has clearly demonstrated that conventional wood-frame building systems can give satisfactory service as heated building enclosures, the high cost of construction in the north has sparked a search for more economical systems.

One result has been an increased emphasis on prefabrication techniques, and the Division has undertaken a number of studies on northern housing to meet the demand for information on these and other aspects of superstructure design. Technical and economic evaluation of prefabrication methods for northern use have been made, based on visits to Canadian prefabricators and surveys of the performance of these buildings in the field. The study has suggested significant economies with some of the light-weight fully prefabricated units now on the market . The stressed skin frame units offer 50 per cent reduction in weight and considerably greater reduction in site erection time over conventional construction, and have received the widest acceptance of the prefabricated systems proposed. The recently developed plastic core structural sandwich units, which are even lighter in weight, have not yet realized the low cost potential of which they appear capable. A comprehensive report on these findings has been prepared.

An earlier phase of the Division's study of northern housing dealt with the high cost of fuel and demonstrated that a much greater thickness of insulation than is normal in southern Canada can be justified on an economic basis for all heated northern buildings.

In all this work the overriding importance of economics in any practical assessment of building techniques in the north has been evident. The careful documentation of the costs of northern construction in terms of their three main components - transportation, labour, and materials - is greatly needed.

The prime objective of all of the Division's work is the provision of information. In the first instance, this may mean simply that the Division acts as a channel for information from other sources, assembling and organizing it in a form suitable for effective use by industry. Where the available information appears inadequate, actual research in the laboratory or in the field may be undertaken to fill the gap. It is largely this aspect of the northern work that has been described in some detail here. In both instances, however, the aim is the publication of information. Only when this has been done, and the information put into the hands of those who can use it, can the research studies be considered effective and the work complete.

Field activities of the Geological Survey of Canada in the north in 1960. By R.G. Blackadar [1].

Operation Back River. The major northern field project of the Geological Survey in 1960, known as Operation Back River, resulted in the mapping of about 55,000 square miles in the District of Keewatin. The boundary of the area mapped runs from the arctic coast south on the 102nd meridian to latitude 67°N., thence east to the 100th meridian and south to latitude 66°N., thence east to the 90°W. longitude, and thence north to the arctic coast at the south end of Pelly Bay; the northern limits follow the arctic coast and the boundary between the districts of Keewatin and Franklin to the starting point.

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1. Published by permission of the Director, Geological Survey of Canada.

together with Dr. Heywood carried out the geological programme. Mr. J.L. Blanchard was the radio officer and the party also included two student assistants and two cooks.

Geological traverses were made using two Bell 47-G helicopters under contract from Spartan Air Services; after break-up a Cessna 180 of Lamb Airways was also used for this work. Camp moves were accomplished by means of a Norseman also supplied by Lamb Airways.

Gas caches were established between 22-31 May 1960 throughout the area using a TransAir DC-3 on skis which flew the fuel from a Geological Survey cache established by ship at Baker Lake.

The advance party left Churchill on June 4, and on June 7 the main party was landed on the ice by DC-3 at the first camp within the map-area. Break-up followed soon after and within a week it became dangerous to land even the Norseman on the ice and the camp was moved to the largest gas cache where operations were carried out during the break-up period. In all six camps were occupied during the season, some for as little as six days, others for up to three and one-half weeks, depending on the work required in each area.

During the field work the Dease and Simpson cairn at Cape Britannia was visited but no records were found. This cairn is on a bare, boulder-free, rocky knoll and at present consists of two partially collapsed small cairns. However the amount of material present seems adequate to account for the 14-foot cairn mentioned by Dease and Simpson and its present form may be the result of Eskimo activities. No relics of the Franklin expedition were found in the sourse of the geological traverses.

In August the party was working in the northern part of the area where they noted very little ice in Rasmussen Basin and Simpson Strait and found Chantrey Inlet to be completely clear of ice.

The area mapped in the course of Operation Back River comprises an assemblage of granitic rocks, gneisses, and schists. A belt of metasedimentary rocks extends from Chantrey Inlet northeast to the headwaters of Murchison River and peridotite plugs, dykes, and sills characterize a zone extending from a point about 80 miles west of the head of Wager Bay to the upper reaches of Kellett River. Palaeozoic rocks, mainly limestones and dolomites, outcrop in northern Adelaide Peninsula and on the east shores of Rasmussen Basin and Rae Strait between Cape Selkirk and Spence Bay. The area has been glaciated and ice flow features indicate that movement was northeasterly towards the Gulf of Boothia and northwesterly towards Victoria Strait and Queen Maud Gulf early in the period of retreat. Later all movement was northwesterly as the ice front shrank back towards the Keewatin ice divide. Marine transgression during and following the retreat of the ice was extensive. West of Chantrey Inlet marine silt and clay and shoreline features are found up to about 550 feet above present sea level some 40 or 50 miles inland from the present coast. An arm of the sea probably extended up the valley of Back River, and Adelaide Peninsula was completely inundated. Southeast of Chantrey Inlet, along the lower reaches of Hayes River, the limit of marine transgression lies at about 500 feet and on Boothia Peninsula within the area mapped the limit appears to have have between 650 and 700 feet above present sea level.

Field work was completed on August 20 and the party was moved back to Churchill first by Norseman and then, following the wreck of the Norseman in a gale at Baker Lake, by Otter aircraft. The excellent service provided in all phases of the airborne work did much to make Operation Back River a success.

Southeastern Ellesmere Island. Dr. R.L. Christie and Mr. L.D. Ayers, a university student, arrived in Resolute Bay from Churchill by R.C.A.F. schedule flight on April 11 and a few days later they were flown to Grise Fiord in a McMurray Air Services Otter aircraft under charter to the Polar Continental Shelf Project. This aircraft was also used to establish a cache on Makinson Inlet.

During the latter part of April fine, cold, weather prevailed and two Grise Fiord Eskimos, Elijah and Isaac, and their dog teams were employed to make short trips in the vicinity of the settlement.

Early in May, Christie, Ayers, and the two Eskimo began a month-long sled trip along the east coast of Ellesmere Island. They travelled east to Craig Harbour, along Coburg Island to Queen Charlotte Monument, thence north along the Ellesmere coast to Smith Bay. After re-supplying from the cache in Makinson Inlet, the party continued south to the head of Starnes Fiord, and then returned to the settlement at Grise Fiord. Later, several weeks were spent at the head of Grise Fiord, where studies were made of the Palaeozoic strata, followed by a trip to the mouth of Sydkap Fiord. On the return from this journey, Harbour Fiord, the site of Sverdrup's winter quarters in 1899-1900, was visited but few traces of his occupancy were found.

On July 1 W.W. Phipps of Bradley Air Services landed at Grise Fiord with a Piper Super Cub on wheels and several reconnaissance flights were made extending as far north as Stenkul Fiord on Baumann Bay, and Makinson Inlet. During this period the weather was generally poor with coastal fog or over-all overcast conditions. A final reconnaissance flight was made to the east to Fram Fiord where Ayers was left to study the geology; Christie joined him a few days later with the dog teams. The party returned to Grise Fiord on July 17 at which time the sea ice was becoming quite broken.

A Beaver aircraft equipped with low-pressure tires landed at Grise Fiord on July 24 on a roughly prepared landing site and Christie and Ayers returned to Resolute Bay and thence south.

Southeastern Ellesmere Island is the northernmost exposure of the Canadian Shield; to the west the basement rocks consist of gneisses of granitic appearance whereas to the east quartzite, marble, and gneisses of sedimentary appearance predominate. Small remnants of sedimentary rocks tentatively correlated with the Thule Group of Greenland (Proterozoic age) outcrop at Clarence Head. A Proterozoic age was suggested by earlier workers for similar strata around Craig Harbour and Fram Fiord but these are now known to be Palaeozoic. Early Palaeozoic limestone and dolomite ranging in age from Cambrian to Silurian

unconformably overlie the gneisses west from Fram Fiord. These rocks have been faulted with the result that many isolated patches of carbonate rock are found. On the east side of Fram Fiord a thin fossiliferous limestone bed contains crystalline cavities filled with a thin amber-coloured oil. This limestone is probably of Cambrian age, is much faulted, and is part of a Palaeozoic outlier and thus is of limited extent.

Field work will be continued by Dr. Christie along the east coast of Ellesmere Island in 1961 with Alexandra Fiord being used as the project base.

Southern Baffin Island. The reconnaissance mapping and study of the magnetite deposits of southwestern Baffin Island was continued by Dr. R.G. Blackadar in 1960. The area examined extends from Hudson Strait north to latitude 65°N. between longitudes 72° and 74°W. Dr. Blackadar arrived at Cape Dorset in early April and accompanied by Echalook Parr as assistant and Paulassie and Pudlat Pootogook as dog-team drivers, made a traverse through the area, establishing several caches and setting up a tent camp north of Keltie Inlet for use later in the spring. No caribou were observed at this time although there were numerous tracks. The party returned to Cape Dorset (some 100 miles west of the field area) in mid-May and on May 22 a ski-equipped Otter aircraft chartered from Wheeler Airlines arrived from Frobisher Bay bringing R.M. Williams, who was to serve as geological assistant. Blackadar and Williams, accompanied by Echalook Parr and Kovianatilliak "A" and two dogs, were then flown to the tent camp. Field work began on June 2 when the snow cover was considerably diminished and during the next six weeks back-packing trips were made as far north as the valley of Aukpar River, which drains into Foxe Basin. More than 50 caribou were seen but only one of these was a fawn. The sea ice cleared from the inlets in early July and a 20-foot freighter canoe was used to extend the area of work. The party was picked up on July 18 by peterhead boat and returned to Cape Dorset where they had a rendezvous with the C.D. Howe. The next two months were spent primarily in coastal reconnaissance using the Aivik, a peterhead boat owned by Paulassie Pootogook, as a base. As is usual in arctic regions the more or less settled spring weather gave way to stormy periods, and there were several violent gales, lasting upwards of four days.

Williams returned south in early September to resume his university studies but Blackadar continued field work until September 18, when deteriorating weather and freezing conditions stopped further field work. C.M.S. John A. Macdonald, then on the first phase of her maiden voyage, arrived at Cape Dorset on September 27 and Blackadar proceeded to Churchill aboard her.

The geological features of this area have been described in a previous issue of the Arctic Circular (see Vol. 13, No. 1, p. 8). It is expected that the reconnaissance of southwestern Baffin Island will be continued in 1961 when Dr. Blackadar will begin the examination of the area between Hudson Strait and Foxe Basin lying between longitudes 74° and 76°W.

Anthropological field work among the Arviligjuarmiut of Pelly Bay, N.W.T. By Asen Balikci.

This is a summary of two field trips among the Pelly Bay Eskimos undertaken for the National Museum of Canada during the summer of 1959 and in the winter of 1959-60. The general objectives of the expedition were as follows:

1) To study the contemporary social organization and ecological adaptation of these Eskimos. The Pelly Bay people are marginal, non-systematic trappers and rely almost wholly on local resources for subsistence. It was thought therefore that they would illustrate the beginning phase of the general acculturation process going on among the Canadian Eskimos.

2) To collect artifacts, mostly faithful models of traditional originals, for the National Museum.

3) To gather material on other aspects of Arviligjuarmiut traditional culture such as religion and folklore.

Considerable material both on the contemporary and traditional Arviligjuarmiut culture was obtained. This information can be briefly described under the following headings:

Traditional ecology. Forty years ago the Arviligjuarmiut annual cycle was characterized by a summer inland adaptation

with caribou hunting in kayaks at the crossing places and a winter marine adaptation with sealing at the breathing holes. While only isolated, extended families travelled inland with the help of one or two dogs per hunter, meeting later at the caribou crossings, winter camps were large, grouping often twenty or more sealers. Food was extensively shared according to rigid rules. Owing in part to the extreme scarcity of driftwood, tools, including harpoons, were made of antler and sled runners of sealskin with crossbars of bear bone.

Traditional social organization. Despite the fact that numerous collaborative patterns existed in subsistence activities, the Arviligjuarmiut had an extremely low level of social integration. The very high rate of female infanticide in the past resulted in far more women than men. Wife stealing was common, so was polyandry. Murder became a frequent occurrence. This low level of social integration was reflected in the very high suicide rate.

Religion. Numerous cases of shamanistic behaviour were recorded, together with data on the training of the shamans, social control as exercised by shamans, different classes of shamans, and shaman-shaman, shaman-patient, and shaman-community relations. A survey of malevolent magical activities as practiced by non-shamans produced interesting results.

Acculturation. The introduction of the rifle around 1919 produced a sudden increase in game returns, essentially caribou and muskox, enormously extended the migration circuit of the people, and restricted the size of the basic economic unit following the abandonment of the old cooperative caribou hunting methods. The average number of dogs increased to four per hunter.

Present trends. Today the following trends can be observed: relative stabilization and concentration of the Eskimos around the Kugardjuk Roman Catholic Mission; replacement of the old antler technology by iron tools; hunting techniques based more on the individual than the group; emergence of the nuclear family as the basic economic unit; decrease of

ecological pressure following the introduction of the fishing net and sealing at the floe-edge; and increase of individual mobility. The large winter camp is no longer an economic unit as it was before, but just an agglomeration of autonomous nuclear families. The number of dogs now averages eight per hunter.

From the point of view of the new religion, the Pelly Bay Eskimos are one large religious unit, but numerous traditional religious beliefs still find supporters today, mostly among the older generation.

A collection of traditional artifacts, mostly models, numbering over 100 items was secured with the help of the local missionary. Among these are: two sealskin tents, a snow shovel made of antler and sealskin, a fishing harpoon with a detachable antler point and a float, a bear spear, a caribou spear, five soapstone lamps, a complete set of implements for sealing at the breathing holes including an antler harpoon, sealskin clothing used by the caribou hunters from kayaks, muskox horn bows and arrows, caribou clothing for men and women, various containers, six dog harnesses of bearded sealskin with toggles, two dog whips made of sealskin, four caribou fur sleeping bags, and a series of shaman's belts and headdresses.

Nearly fifty tape reels were made, recording folk songs, and drum dances. It was fortunately possible to include a number of shamanistic seances, using the shaman's own vocabulary.

Colour banding of snowy owls.

Each winter snowy owls from the north move into southern Canada and the northern United States. Owing to the lemming population having reached a low point in its population cycle, the owls went farther south in the winter of 1960-1 than usual. Operation "Snowy Owl" was a research project of the University of Wisconsin to trace the movements of these owls by colouring sixty-one of them with bright dyes. If anyone has information on these coloured snowy owls would they please inform Operation "Snowy Owl", Plainsfield, Wisconsin, U.S.A., where and when the bird was sighted, and the colour and location on the bird of the dye.

Change of Address

Members are earnestly requested to advise the Treasurer, Miss M.C. Murray, 249 Irving Avenue, Ottawa 3, promptly of any change of address.

Editorial Note

The Editor would welcome contributions from those who are at present in the Arctic or have information about work in the Arctic. All material for the Circular should be sent to:

Mrs. Graham Rowley
245 Sylvan Road,
Rockcliffe,
Ottawa 2, Ontario

THE ARCTIC CIRCULAR

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Annual Dinner. The Annual Dinner was held at the Eastview Hotel on 24 November 1961. Following the dinner, at which a variety of arctic dishes was provided, Mr. T.A. Harwood spoke on "North Pole stations and a visit to North Pole 7".

One hundred and tenth meeting: 12 December 1961. Miss Moira Dunbar gave an illustrated talk on "Ice and other observations from C.M.S. John A. Macdonald, 1961".

Annual General Meeting. The Annual General Meeting was held in the No. 9 Transport Company Mess, R.C.A.S.C. on 9 January 1962. The President, Mr. G.W. Rowley, was in the Chair and opened the meeting by calling on the Treasurer, Miss M.C. Murray, to read the financial statement, which was then adopted. The financial position was not as favourable as in the preceding year, largely because of the purchase of a two-year supply of paper and the writing-off of the public address system.

In accordance with the Constitution the following Officers and Members of the Committee resigned: Mr. T.A. Harwood, Vice-President, Supt. W.G. Fraser, Mr. E. Menarik, Mr. W.W. Phipps, and Dr. J.S. Willis. The Treasurer, Miss M.C. Murray, had also resigned because of pressure of other activities. To fill the vacancies the Committee proposed: for Vice-President, Supt. W.G. Fraser; for Treasurer, Mrs. A.H. Macpherson; for Committee, Dr. G.F. Hattersley-Smith, Mr. D.G. Oliver, Rev. Fr. A. Renaud, and Mr. B.G. Sivertz. These candidates were elected unanimously.

The Officers and Committee for 1962 are as follows:

Officers

President:	Mr. G.W. Rowley
Vice-President:	Supt. W.G. Fraser, R.C.M.P.
Secretary:	Dr. R.G. Blackadar
Treasurer:	Mrs. A.H. Macpherson
Publications Secretary:	Miss Mary Murphy
Editor:	Mrs. G.W. Rowley

Committee members

Mr. C.M. Bolger	Dr. E.F. Roots
Dr. G.F. Hattersley-Smith	Dr. D.C. Rose
Mr. I.W. Loomer	Mrs. A.G. Sangster
Mr. A.H. Macpherson	Mr. B.G. Sivertz
Mr. D.G. Oliver	Mr. D. Snowden
Rev. Fr. A. Renaud	Dr. A. Taylor
Col. J.P. Richards	Maj. Gen. G.R. Turner

Following the elections Mr. Rowley expressed the thanks of the club to the retiring members of the executive, especially to Mr. T.A. Harwood and Miss M.C. Murray. He also thanked the auditors, Maj. Gen. G.R. Turner and Mr. J. Cantley and the meeting re-appointed them for 1962.

In view of the success of the recent Annual Dinner it was agreed that a dinner should be held in the fall of 1962. The meeting then thanked Col. J.P. Richards and Mr. A. Stevenson for organizing the recent dinner.

The President expressed the gratitude of the Club to Major R.A.D. Kelly for the use of the Transport Company Mess.

At the conclusion of the Club business three films were shown: "Caribou tagging", "High Arctic", and "The Navy goes north".

One hundred and twelfth meeting: 13 February 1962. Mr. Raymond D. Wood spoke on "Arctic summers - with plant photographers in the North American Arctic" and illustrated his talk with a large number of coloured photographs.

One hundred and thirteenth meeting: 13 March 1962. Dr. J. Ross Mackay gave an illustrated talk on "Pingos and other geomorphological features of the Mackenzie delta area".

Epidemiological investigation of Brucellosis in the Canadian Arctic.

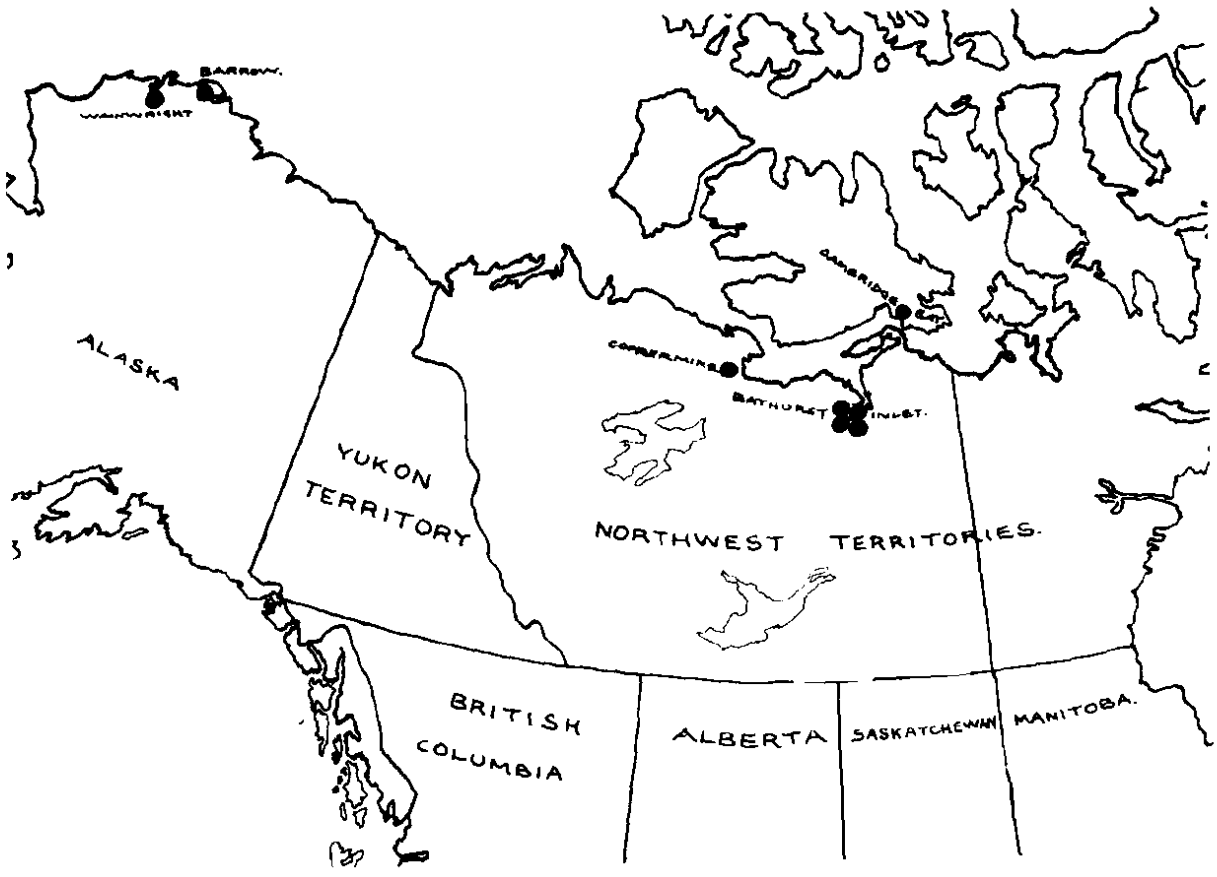
By Sheila Toshach[1]

Brucellosis is primarily a disease of animals and man acquires the infection by consuming infected meat or milk or by direct contact with animal tissues. The main reservoirs of infection are cattle, goats, and swine, but the disease has occasionally been reported in a variety of other animals including buffalo, elk, hares, and rodents. It is a debilitating disease, rarely fatal. Clinically it is characterized by an irregular temperature curve with undulations of pyrexia, hence the term Undulant Fever. The symptoms vary widely from a mild fever to a severe illness with chills, nocturnal sweats, abdominal pain, and neuralgic symptoms. The duration of the illness varies from a few weeks to more than one year. It is estimated that approximately 5,000 new cases appear annually in the United States and the disease is well known in many European countries. Those affected are usually veterinarians, butchers, or packing-plant workers. The disease is rare in Canada.

During the period 1950 to 1960, 6 cases of Brucellosis in Eskimos were confirmed by the Provincial Laboratory, Edmonton. Our curiosity was aroused as to the source of the infections since the usual animal hosts are not found in arctic regions. We speculated that the source might be reindeer or caribou[2] but no opportunity arose to investigate the possibility.

The cases occurred mainly in the Cambridge Bay and Bathurst Inlet area (see sketch-map) and four were in children or young adults. With one exception, where death was due to other causes, all the Eskimos recovered. The average hospital stay was

1. Provincial Laboratory, University of Alberta, Edmonton.
2. Sheila Toshach. 1955. "Brucella melitensis in the Northwest Territories". Can. J. Public Health, Vol. 46, No. 4, pp. 155-7.



Location of human Brucellosis cases

approximately three months, but histories indicate a period of fatigue and lethargy before hospitalization. Bacteriological investigation of the organisms isolated from these cases revealed that the species of Brucella isolated (Brucella melitensis) was different from that normally found in human infections in Canada. A report on the bacteriological data is to be published. Recently we have learned through personal communication with the Alaskan Department of Health that they too have isolated a similar organism from Eskimos in Alaska.

In November 1961, with the assistance of a medical research grant from the University of Alberta, I was able to travel north to investigate reindeer as a possible source of infection. Dr. C. Corrigan of the Indian Health Services arranged with the Reindeer Station resident manager, Mr. John Lambert, that I be permitted to be present at the reindeer slaughter. Mr. John Teal of Vermont, co-manager of the station, indicated that he would welcome any type of research. Their cooperation was much appreciated.

There are two ways to diagnose Brucellosis, One is to detect antibodies in serum, the other is to isolate the particular bacterium in culture. The latter, more difficult, approach was chosen because it was the organism itself we had found to be different in the human cases, and it was this we wished to obtain. In order to cultivate the bacteria, one must have special culture media and an incubator to keep the cultures at body temperature. The ideal substitute for all this paraphernalia is an animal susceptible to the disease. The guinea pig is such an animal. Twelve guinea pigs were taken north to serve as incubators and they survived the journey well.

The trip from Edmonton to Inuvik was made by aircraft, and hence to the station by snowmobile. The slaughter started Monday, November 20,and continued through to the following Saturday. Some 500 animals were processed. Each day blood disk samples, bone marrow, and, where possible, lymph glands were secured. The cooperation of the veterinarian, Dr. A. Chambers of Regina, and his assistant, Mr. Popovich of Calgary, was of inestimable value. The materials collected were then taken down from the abattoir (by this time they were frozen), ground up, and inoculated into the animals. One animal was used for six specimens thus extending the

possibilities of a positive result. At the same time duplicate material was reserved for subsequent investigation at the Edmonton Laboratory. To date the results are negative but it must be noted that the sampling was very restricted, with only 103 animals being represented. Since the incidence of Brucellosis is known to be low in these herds (serum tests by the Canadian Wildlife Service[1]) the results are not surprising. Control-known positive cultures survived the conditions of test and were recovered in culture media, indicating that the various techniques tried out were worth while.

It would be extremely valuable to have samples from caribou and I would appreciate word from any of your readers working with caribou who might contribute samples, or, better, information about any caribou slaughter which I might attend. The most suitable samples would be lymph glands (particularly the supramammary or iliac) and bone marrow (long leg bone) if they could be shipped by air at once. As the tissues deteriorate and the bacteria die off, it is much better to be on the spot.

The trip north was very interesting and informative. It provided an opportunity to see the territory, hear stories of Eskimo customs and food habits, and evaluate bacterial techniques. We have not solved the riddle of the source of Brucellosis in the Arctic, but still do not exclude either reindeer or caribou as a likely source.

The Cambridge Arctic Canada Expedition, 1961 to Cumberland Peninsula, Baffin Island. By R.E. Langford

Until 1953, when the Arctic Institute expedition led by P.B. Baird carried on scientific work on and around the Penny Icecap, the mountaineering possibilities of Cumberland Peninsula were not realized. This expedition climbed some of the peaks, but the region to the southeast of Pangnirtung Pass remained unknown.

1. L.P.E. Choquette. 1960. Canadian Wildlife Service , personal communication.

The aims of the Cambridge Arctic expedition to Cumberland Peninsula were to climb some new peaks in this area and to carry out certain research projects, including survey and photography of the Rundle Glacier as a check for future movement, collection of geological specimens, study of mountain tops for evidence of glaciation, and investigation of certain physiological phenomena, such as the relation between activity, energy expenditure, and human microclimate.

The six members of the expedition were: R.E. Langford (leader), T.A.J. Goodfellow, A.R. Crofts, G.F. Bonham-Carter, C.W. Barlow, and J.W. Dale. Financial support was given by the Mount Everest Foundation and many other institutes and individuals, and each member contributed to the cost.

On July 6 we were flown, together with nearly 3,000 pounds of stores and equipment, to Cape Dyer by commercial air transport. During our week here, Bonham-Carter examined rocks of Tertiary age and made a small geological collection which included paleomagnetic specimens. We also took the opportunity to get fit by climbing two easy peaks, neither of which had been climbed previously.

The DC-3 servicing the DEW Line had been temporarily grounded with engine trouble, but in due course we flew to Broughton Island where the school teacher, Miss Vivien Julien, introduced us to the Eskimos and generally looked after us. We spent three days there waiting for the fiord ice to clear and this allowed us to take part in a seal hunt on the ice by dog-sled and Eskimo dances (mainly of the Scottish Reel type). Alec Buchan, the Hudson's Bay Company post manager, put me in touch with Pangnirtung by radio, and I was able to arrange with the R.C.M. Police there for the party to be picked up at the head of Pangnirtung Fiord on September 3. When the land-fast ice cleared, the Eskimos took us up North Pangnirtung Fiord by whaleboats, leaving us at the head on July 19.

The following two weeks were mostly spent carrying heavy loads on pack frames up the Owl Valley leading to Pangnirtung Pass. Mount Fleming, an impressive mountain named in 1953 but unclimbed, dominates this valley, and was climbed from a high camp by a party of four who the following day climbed a striking obelisk-

shaped peak. The others climbed Mount Battle, 4,420 feet, a good belvedere overlooking the pass, and began the survey of the Rundle Glacier. Two more peaks to the east of the pass were climbed from the survey camp.

We found a change in the geography of the pass since the map was made. Glacier Lake which formerly flowed north, had joined with Summit Lake which empties to the south. As we had planned to descend on the other side of the valley, it was necessary to cross the stretch of water between the lakes if a long detour was to be avoided. The level of the water dropped daily as the weather became cooler, but we had to construct a twin-hulled raft in order to make the crossing.

The raft enabled us to site a camp high up the Turner Glacier, although the weather was deteriorating. Mount Asgard, 6,596 feet, climbed and named in 1953 by the Swiss members of the Arctic Institute expedition, dominated our camp. Opposite Asgard stands a mountain massif supported by several sheer rock buttresses, and topped by two snow summits. By a long route involving some steep ice, all the members of the expedition climbed one of these virgin summits. It was now snowing daily, but we would never have been satisfied without at least approaching Mount Asgard. In spite of very severe conditions and difficulties including some rock pitches, steep and covered with ice, we managed to climb to within about 450 feet of the summit. One more peak, at the end of the Turner Glacier, lower than Asgard but dramatically shaped to a pointed summit, was attempted, but minor frostbite caused the party to turn back.

The survey work was then completed before we began our evacuation down the Weasel River to Pangnirtung Fiord. We had resolved to complete the move in one journey, with the result that our loads were initially 120-130 lb. each. The R.C.M. Police Peterhead boat took the expedition aboard near the head of the fiord on September 2, and we reached the Eskimo settlement of Pangnirtung that evening. We spent an interesting week there, enjoying much hospitality. We sailed aboard the Department of Transport ship C.D. Howe to Frobisher Bay, whence the expedition returned by air to Montreal on September 15.

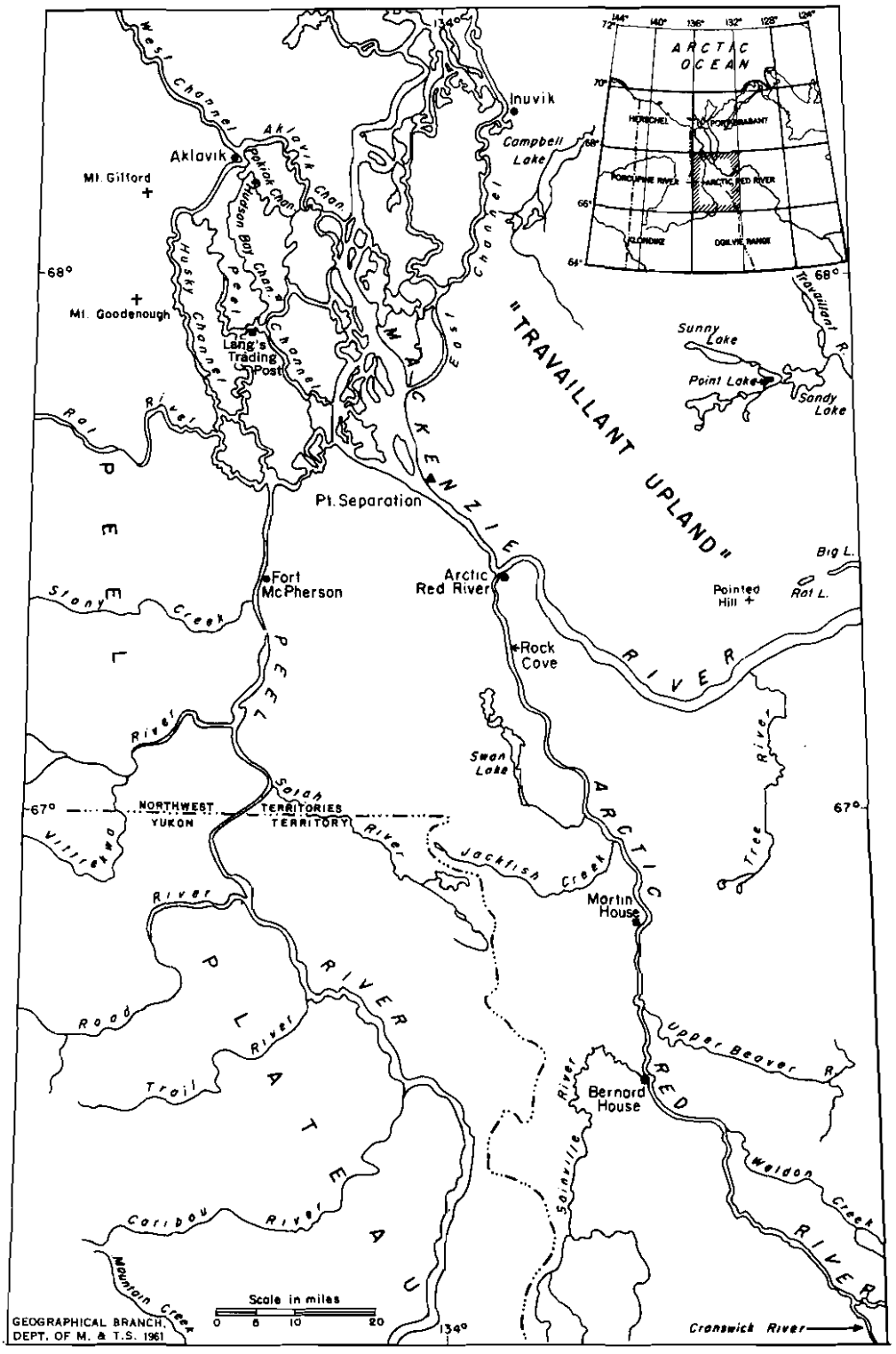
Our short reconnaissance, in which we crossed Cumberland Peninsula by the Pangnirtung Pass and climbed five virgin peaks, showed that the mountains in the area of the Pangnirtung Pass offer considerable scope to mountaineering expeditions for several years to come.

Geographical survey of the lower Mackenzie and Arctic Red River area, 1960[1]. By W.E.S. Henoch

During the field season of 1958 I was sent by the Geographical Branch to study the Peel River area and parts of the Mackenzie delta as far west as the Richardson Mountains (see Arctic Circular, 1960, Vol. 13, No. 1, pp. 9-15). In the summer of 1960, my assistant, Stephen Blasko of the University of Western Ontario, and I extended the survey to the Arctic Red River area and the eastern side of the delta and completed the reconnaissance of the western part of the Arctic Red River 8-mile map sheet. For our canoe trip up the Arctic Red River and the Mackenzie River, I employed Antoine André, a Loucheux Indian, as guide and cook.

While geomorphology was our chief interest, particularly glacial evidence, other geographical material was also gathered. For instance, on the way north during an enforced stay at Hay River we studied the settlement, with its industries of fishing, trapping, and hunting, and examined the local flooding problem. We also visited part of the new road to Yellowknife and studied the escarpment running along the south shore of Great Slave Lake and the terraces of the ancient Great Slave Lake. At thirteen localities along the Mackenzie River we enlisted the cooperation of R.C.M. Police officers, officials of the Department of Northern Affairs and National Resources, Roman Catholic priests, and private individuals to record the environmental factors affecting freeze-up and break-up. Later, at Aklavik, we were given notes on the dates of freeze-up and break-up since 1924 from the diary of the Roman Catholic Mission; the earliest date for break-up recorded at Aklavik during this period was May 21 in 1930 and the latest, June 6 in 1935 and 1949; the earliest

1. Published with the permission of the Director, Geographical Branch, Department of Mines and Technical Surveys, Ottawa.


ARCTIC OCEAN
HERSCHEL
PORCUPINE RIVER
ARCTIC RED RIVER
FLORDIKE
OGILVIE RANGE
Inuvik
Campbell Lake
Aklavik
Mt. Gilford
Mt. Goodenough
Lang's Trading Post
West Channel
Aklavik Chan.
Peninsula Point Chan.
Husky Channel
Peel Channel
MACKENZIE
Isle Channel
"TRAVAILLANT UPLAND"
Travaillant R.
Sunny Lake
Point Lake
Sandy Lake
Big L.
Rat L.
Pointed Hill
Pt. Separation
Fort McPherson
Arctic Red River
Rock Cove
PEEL
Rat River
Stony Creek
Peel River
Snake River
Swan Lake
ARCTIC RED RIVER
Trout River
NORTHWEST TERRITORIES
YUKON TERRITORY
67°
68°
134°
Jackfish Creek
Martin House
Upper Beaver R.
Bernard House
Willow River
Waldon Creek
Caribou River
Mountain Creek
Scale in miles
0 5 10 20
GEOGRAPHICAL BRANCH, DEPT. OF M. & T.S. 1961
Cranswick River

date recorded for freeze-up was October 1 in 1957 and the latest, October 28 in 1944.

We arrived at Aklavik on June 21, but were again delayed waiting for some equipment. We spent the time studying the settlement, particularly the effect of the transfer of much of the population to Inuvik. Aklavik showed readjustment and new activities, including the rapidly expanding government-sponsored Fur Garment Centre, which indicates that the town may grow again, responding to the needs of the natives. We also made a trip to Mount Gifford on June 29 and examined a felsenmeer found near the summit.

On July 1, when we were at last ready to leave, the river was too rough to travel by Peel Channel to Arctic Red River as intended. To avoid further delay we crossed the Aklavik Channel into "Hudson Bay Channel" which is seldom used as it meanders and enters several lakes making orientation difficult, but its narrowness provides shelter in stormy weather. We arrived at Knut Lang's trading post in the evening, where we were detained by the weather until the afternoon of the 2nd.

Leaving Lang's cabin late the next afternoon, we continued on our way to Arctic Red River, and arrived at the junction of Peel Channel and the Mackenzie River at midnight. From the mouth of Peel River the channel of the Mackenzie widens towards Point Separation where the river is over two miles wide. This open reach of the river was churned up by a northwester; as farther progress was impossible we camped near the mouth of Peel River. By late morning of the 3rd the Mackenzie had calmed down, and we resumed our journey and arrived at Arctic Red River late in the afternoon.

While awaiting clear weather to reconnoitre and deposit caches, observations on the formation of the alluvial plain, begun in 1958, were continued. Above the alluvial terraces there are at least two other distinct terraces formed by the ancient Mackenzie River, the most extensive is the 200-foot terrace, and on this we examined several eskers which indicate that the formation of this terrace preceded the glaciation which deposited the eskers. Glacial till found on the east bank of the Mackenzie on the 60-foot terrace, eight miles north of Arctic Red River, indicates that the relief of the Mackenzie valley was completed at least to the level of this terrace before the till was deposited.

On the 10th a successful flight was made and caches were deposited at Martin House, Bernard House, and at the mouth of Weldon Creek. From there we continued on a reconnaissance flight along Snake River to Peel River, turning west to the foot of Richardson Mountains and north along them, thence east to Fort McPherson and back to Arctic Red River. During this flight three distinct levels of the Peel Plateau were recognized. Further observations of the maximum extent of the continental ice sheet, the direction of ice movement, and the mode of its retreat were made.

We finally left the settlement of Arctic Red River on July 14 with our guide André and arrived at the mouth of Cranswick River on the evening of the 19th. Only on the 16th was the river too rough for travelling. Measurements of terraces, study of mass movements on the slopes, and inspection of the glacial channel on the plateau, occupied us on the 20th. On that afternoon our tents were blown down by a sudden storm. These late afternoon storms are typical of the upper reaches of the Arctic Red River. The proximity of the Mackenzie Mountains suggests that they are orographically controlled convection currents which are channelled by the deep valleys of the Arctic Red River and the Cranswick River. These storms contribute to sudden floods during which the water-level may rise twenty feet or more in a matter of a few hours.

On the 21st we navigated the Arctic Red River past Cranswick River. The current was so swift that we covered only about 14 miles in nine hours. As progress was growing progressively slower we turned back on the 22nd and began our journey to the settlement. The weather deteriorated rapidly; by the 24th it was raining most of the day and night.

More time was devoted to the study of the development of the slopes with special attention to many spectacular mass movements, especially on the east side of the valley. The intense red colour of the clay in the lower part of the slopes is apparently the result of spontaneous combustion of the very thin layers of coal in the shale, caused by friction of the great volume of material involved in the mass movements. Smoke lingers over the east slope of the river valley in a number of places above and below its confluence with Cranswick River. Well-preserved terraces of 85 and 205 feet in height were surveyed on the left bank of Arctic Red River three miles downstream from Weldon Creek. The latter terrace can be traced in the tributary valleys.

We benefited by the rain and the resulting high water by being able to canoe 14 miles up Sainville River, much farther than local inhabitants had believed was possible. A chance meeting with a party of geologists of Western Minerals on Sainville River provided an opportunity to extend our survey 15 to 20 miles upriver by helicopter. During the flight we reconnoitred glacial channels on both sides of the river.

On the 27th a 60-foot high terrace on the left bank of the Arctic Red River was examined about seven miles downstream from the mouth of the Sainville River. The fluvioglacial channel found on this terrace indicates that the 60-foot terrace was formed before continental ice occupied the valley. We travelled about five miles up the meandering course of Upper Beaver River where alluvial processes were studied and a traverse made on the 27th on the plateau to the west. The concentric pattern of lakes of a diameter of about one mile proved to be a 'nest' of palsa bog which has not been reported from this area before. The crescentic arrangement of lakes between this palsa bog and Martin House suggests the temporary pause of a glacial lobe of the waning continental ice sheet in this area. In the afternoon we followed the meanders of Jackfish Creek in the canoe for about 11 miles.

On the 29th we made a one-day overland trip along the valley of the river which flows into Arctic Red River on its east bank about 1 1/2 miles north of Jackfish Creek. A perfectly preserved braided esker was found on the plateau about five miles from the mouth of the river. Many small ponds behind the moraine-like swells of the slumps are characteristic of this valley. The valley abounds in berries and several varieties of edible fungi: e.g., Boletus edulis, Lactarius deliciosus, and Agaricus campestris.

On August 1 we made a trip to investigate the natural causes of the legend of the monster Bluefish in Swan Lake. The area where the Indians indicated a turbulence which they described in various ways coincided with openings in the lake ice visible on winter air photographs, indicating that the story is not entirely a product of imagination. We portaged a light canoe and paddled across three lakes before reaching Swan Lake, which was so rough that Blasko and our guide remained ashore. Having paddled the canoe across, I found an underwater spring emitting water and gas with such force that it was difficult to approach closer than 10-15 feet to the centre of the spring. Water

samples were taken from about this distance. The air temperature was 65°F, water temperature 59°F; the depth of the lake about 10 feet from the centre of the spring was 9 feet, and from the middle of the lake 6 to 8 feet. The floor appears to be sandy-clay with many boulders. Unlike smaller lakes it is comparatively free of water plants.

The following day, August 2, we made other observations and took measurements of terraces before reaching Arctic Red River settlement. The water-level had dropped about 6 feet compared with that during the upstream journey. About 12 miles from Arctic Red River there are shallows, which are an obstacle to navigation in the summer. At break-up, if ice jams form on the Mackenzie, the reverse flow of the flood waters backing up Arctic Red River may reach a speed of 12 miles an hour according to the priest at Arctic Red River. Our guide, who has trapped and hunted in the area in springtime, told us that the reverse flow reaches Sainville River by Bernard House, a distance of 77 miles. We saw driftwood at Rock Cove , 48 feet above the August water-level.

We left Arctic Red River settlement on the 6th. In the stretch of the Mackenzie valley between Arctic Red River and the Travaillant River to the west we found, above the alluvial terraces, older terraces, of which the 200 - and 300-foot are the most extensive. Both terraces are covered with glacial till, and, as gravels are exposed in the 200-foot terrace, their preglacial or interglacial origin appears likely.

Much valuable information was obtained from the Loucheux chief, J. André, brother of our guide, who lives in the settlement of his clan at the mouth of Tree River. With one of his canoes we made a 2 1/2-day journey in which we covered 36 miles from near the mouth of Travaillant River to Big Lake and Rat Lake across charred muskeg to the edge of the "Travaillant Uplands". This trip gave us an opportunity to examine the 200-foot terrace and the glacial meltwater channels on the scarp at the edge of the uplands.

The last phase of the summer's work was the reconnaissance of the plateau east of the delta. A flight was made for the Department of Northern Affairs and National Resources on the 24th to investigate sources of sand and gravel. At present the cost of gravel brought by barges from Point Separation to Fort McPherson is $25.00 per ton.

In the absence of eskers in the vicinity of Fort McPherson, the gravel beds of Stony Creek as a source of gravel, and the weathering sandstone strata exposed in the edge of Peel Plateau north of Stony Creek as a probable source of sand were suggested.

Eventually we were flown to Sunny Lake on the 27th, but after this date the bad weather continued and we were frequently enveloped in stratus clouds and drizzle and had frost at night. We had made arrangements for a reconnaissance flight on September 1 and a pick-up on the 10th. However, the first was cancelled and the second delayed till the 11th by bad weather. This part of the season was most rewarding in spite of the weather. Taking advantage of spells of sunshine we were able to make short trips on foot during which we detected erosional levels apparently of preglacial age, and studied kame terraces surrounding the lakes and the influence of glaciation on the development of the present drainage pattern.

We returned to Aklavik on the evening of the 11th, packed up and left on the 14th, staying overnight in Inuvik and leaving for Ottawa by air on September 15.

Proposed new northern territories

The Northwest Territories Council at the 1962 Session recommended to the federal government that the present Northwest Territories should be divided into two new territories. Their recommendations were that one territory, for which the name of the Territory of Mackenzie was suggested, would include all the mainland of the present Northwest Territories and the associated islands west of the 105 meridian of longitude together with Banks and Victoria islands. The other territory, for which the Council suggested that an appropriate name of Eskimo origin was desirable, would consist of the remainder of the present Northwest Territories. In each case there would be a commissioner and council with powers and responsibilities similar to those of the present commissioner and council of the Northwest Territories. Financial agreements between the new territories and the federal government, following the pattern of the present agreement with the Northwest Territories, would also be necessary.

In the case of the Territory of Mackenzie, the council would consist of nine members, initially five being elected residents of the territory and four non-residents appointed by the Governor-General in Council. The seat of government would be in the new territory and the commissioner would be resident there.

In the case of the other territory, a council of seven was proposed, three residents of the area, three non-residents, and a deputy commissioner. Initially all would be appointed and the Council suggested that it would be desirable to include at least one Eskimo. The seat of government would be in Ottawa. The commissioner would be an officer of the Department of Northern Affairs and National Resources.

In making these recommendations, the Council suggested that federal legislation should be introduced so that the new territories could be established during 1964. In the discussion in the Council, Fort Simpson was considered by the majority to be the most promising location for the capital of the Territory of Mackenzie, but no recommendation was made on this point as the Council felt more information was required before a decision could be reached.

Visit of Their Excellencies the Governor-General and Madame Vanier to northern Canada

On 12 June 1961 Their Excellencies the Governor-General and Madame Vanier left Uplands Airport, Ottawa, on a visit to northwest Canada. They were accompanied by Madame Louis Berger, Mr. Esmond Butler, Mr. Guy Robillard, the Hon. Raymond Joliffe, Captain Jean Lajeunesse, Mr. Graham Rowley, Wing-Commander Russell Manson, and Dr. Peter Burton. The first night was spent at Fort Churchill, the second at Beaverlodge. On June 14 Their Excellencies arrived at Fort Smith for a stay of three nights, followed by two nights at Hay River. During their stay at Hay River they visited Alexander and Louise falls, and Riverside Gardens.

On Monday, June 19, the Vice-Regal party flew to Fort Simpson where it had been planned to spend two nights. Here, however, the splendid weather the party had enjoyed since leaving Ottawa broke and heavy rain on the unpaved airstrip made it necessary to postpone departure for twenty-four hours. On Thursday, as the

party was preparing to board the aircraft at Fort Simpson, news was received that the airfield at the next stop, Norman Wells, had also been put out of service by a sudden storm, forcing a rapid change of plans. The result was that the Mayor of Yellowknife received less than an hour's notice that Their Excellencies were arriving that morning instead of Saturday as had been planned. Yellowknife must have become a scene of feverish activity. Clothes and uniforms were at the cleaners and hair appointments had been arranged for Saturday, but the town was ready to give a most memorable greeting to Their Excellencies.

By Saturday, June 25, the airfield at Norman Wells had dried sufficiently for the party to land there. On Sunday they flew from Norman Wells to Bear River Camp where they boarded a barge pushed by the Northern Transportation Vessel Radium Prince. The trip down the Bear River to Fort Norman was made in ideal weather but during the visit to the settlement there was a sudden downpour. This drenched the reception but did not affect the warmth of the welcome. The voyage down the Mackenzie to Norman Wells was enlivened by the rescue of a party in a canoe with a broken-down outboard. The next place on the itinerary was Inuvik. For several days the ceiling here had been below limits but it lifted on Monday to allow the party to land.

After two days at Inuvik the party flew direct to the R.C.A.F. Station at Cold Lake. By good fortune the visit here coincided with the annual payment of Treaty Money to Chipewyan Indians in the area. Arrangements were made for the Vice-Regal party to attend and His Excellency made the payment to the chief and the oldest Indians. This is believed to be the first time that a Governor-General has personally paid Treaty Money. On Thursday, June 30, Their Excellencies returned to Ottawa, completing a tour that will be long remembered in northwest Canada.

Sighting of whales

The Arctic Unit of the Fisheries Research Board is studying the occurrence of whales in the Arctic and Atlantic, and would appreciate information on any sightings in the north. This should include the date, time, position, visibility, wind, together

with the number and size of the whales, and any observations that would help to identify the species. Circular No. 7 of the Arctic Unit, "Whales and dolphins of the Canadian east coast", gives general information on the habits of whales and their distribution in the western North Atlantic and also provides illustrations and other aids for identification of the principal species. It includes a number of record sheets for entering sightings. Copies of the circular can be obtained from the Arctic Unit, Fisheries Research Board of Canada, 505 Pine Avenue West, Montreal 18, P.Q.

Circular No. 32 of the Fisheries Research Board station at Nanaimo, "Guide to the whales, porpoises and dolphins of the northeast Pacific and arctic waters of Canada and Alaska", also provides similar illustrations and information for the west. Information and whale sightings in the Pacific and requests for copies of this circular should be sent to the Biological Station, Fisheries Research Board, Nanaimo, B.C.

Subscriptions for 1962

Members are reminded that their subscriptions for 1962 ($2.00 for Ottawa members, or $3.00 for combined membership for husband and wife, and $1.00 for out-of-town members, other than institutions) are payable to the Treasurer, Mrs. A.H. Macpherson, 258 Powell Avenue, Ottawa.

Change of Address

Members are earnestly requested to advise the Treasurer, Mrs. A.H. Macpherson, 258 Powell Avenue, Ottawa, promptly of any change of address.

Editorial Note

The Editor would welcome contribution from those who are at present in the Arctic or have information about work in the Arctic. All material for the Circular should be sent to

Mrs. G.W. Rowley,
245 Sylvan Road, Rockcliffe,
Ottawa 2, Ontario.

THE ARCTIC CIRCULAR

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One hundred and fourteenth meeting. The one hundred and fourteenth meeting of the Arctic Circle was held in the No. 9 Transport Company Mess, R.C.A.S.C. on April 10.

Mr. J.A. Downes gave an illustrated talk on "Northern insects".

One hundred and fifteenth meeting. The one hundred and fifteenth meeting of the Arctic Circle was held in the No. 9 Transport Company Mess, R.C.A.S.C. on May 8.

Mr. A.H. Macpherson spoke on "Caribou, Caribou Eskimo, and other Eskimo".

Field activities of the Geological Survey of Canada in the Arctic, 1961. By R.G. Blackadar [1]

The Geological Survey of Canada carried out reconnaissance field studies in various parts of the Canadian Arctic in 1961. In the District of Franklin four programmes were undertaken, three in the northern Queen Elizabeth Islands and one in southern Baffin Island. In addition several officers studied marine geology in cooperation with the Polar Continental Shelf Project. In the District of Mackenzie several regional investigations were made and an area in north Yukon and Northwest Territories was examined in preparation for "Operation Porcupine" scheduled for the 1962 field

[1] Published with the permission of the Director, Geological Survey of Canada.

season. Several studies in marine geology were made in cooperation with the Division of Oceanographic Research in the Hudson Bay area.

R. Thorsteinsson, E.T. Tozer, H.P. Trettin, and J.W. Kerr continued reconnaissance studies of the bedrock geology of Axel Heiberg and Ellesmere islands. Eureka weather station was used as a base and the party arrived there by R.C.A.F. aircraft on May 27. Three Piper Super Cub aircraft under contract from Bradley Air Services were used for transportation in the field. Part of the area had been mapped by members of "Operation Franklin" in 1955 and by Thorsteinsson and Tozer in 1956 and 1957 and it is expected that the present programme, to be continued in 1962, will supply data permitting the publication of maps on a scale of 1 inch to 8 miles for the entire area. The weather was poor throughout the season with much low stratus cloud. The party left Eureka on August 31 for the south.

Bedrock within the area investigated ranges in age from Cambrian to Early Tertiary. Extensive biohermal limestone reefs, up to 1,200 feet thick, of Early Permian age, are found between Hare Fiord and Greely Fiord in northern Ellesmere Island. New information was obtained on the extent of volcanism within the Sverdrup Basin. Thick successions of volcanic flows and pyroclastic rocks are present in the Early Cretaceous formations of northern Axel Heiberg Island and two successions, the lower of Middle Pennsylvanian age, outcrop in northwestern Ellesmere Island. Structural evidence from eastern Axel Heiberg Island suggests that here and there at least, two periods of tectonic activity followed the deposition of the Early Cretaceous Christopher formation. Elsewhere Tertiary beds rest concordantly on Upper Cretaceous strata.

J.G. Fyles studied the surficial deposits of western Ellesmere and eastern Axel Heiberg islands. About 250 landings were made by Piper Super Cub to obtain geological information. A brief visit was also made to Meighen Island where marine silt was discovered beneath wood-bearing gravels and sands of the Beaufort formation. Throughout the main area investigated there is abundant evidence that former glacial activity was widespread and it is likely that at some time during the Pleistocene most of the area was overridden by ice although glaciation may not have been simultaneous in all parts. It appears that multiple glaciation took place.

Raised marine features, apparently of recent age, were found up to 500 feet above present sea level around the northern part of Eureka Sound and up to 450 feet around its southern reaches. The level of these features seems to decrease to the east, and at the heads of the fiords of western Ellesmere Island the maximum height is about 250 to 300 feet.

R.L. Christie accompanied by N.E. Haimila continued the geological reconnaissance of eastern Ellesmere Island begun in 1960. The R.C.M. Police post at Alexandra Fiord was used as a base and transport within the area was by aircraft and dog sledge. An Otter aircraft of the Polar Continental Shelf Project brought the party to Alexandra Fiord from Isachsen on April 26 and was used to place a food and fuel cache at Goding Bay near the mouth of Talbot Inlet. It had been previously arranged that two dog teams and drivers from Grise Fiord would meet the geologists at Alexandra Fiord and Paulossie and Ookookoo were already at the post when Christie and Haimila arrived.

A short trip was made from the post to Flagler Bay and thence towards Sverdrup Pass, and then a longer trip was made to the south. The cache at Goding Bay was reached on May 21 and from here numerous short trips were made. On June 1 the two Eskimos and one sledge separated from the geologists and returned to Grise Fiord. Christie and Haimila travelled back to Alexandra Fiord across the ice cap. In the first four days less than 7 miles were covered owing to deep snow but once the summit of the ice cap was reached travelling conditions improved and were good except for a breakable crust in places. The weather was generally fine and cool and the party arrived at Alexandra Fiord post on June 11. Following this a short dog team trip was made with members of the R.C.M. Police detachment at Alexandra Fiord to the former post at Bache Peninsula. This marked the end of the sledging season as far as the survey work was concerned and on June 25 a Beaver aircraft fitted with low-pressure tires arrived at Alexandra Fiord post. Christie and Haimila were flown to the head of Flagler Bay whence they traversed back overland. On July 4 a Piper Super Cub, also equipped with low-pressure tires, arrived at the post and was used during the next week to pick up caches of geological specimens, obtained during the spring sledging trips, to obtain data from selected outcrop areas, and to place a camp on northeast Bache Peninsula.

About the middle of July Haimila was flown north to join J.W. Kerr who at that time was on Darling Peninsula; Christie joined R. Thorsteinsson at Eureka and spent the next two weeks using a Piper Super Cub to examine exposures on the west side of the ice cap between Makinson Inlet and Sverdrup Pass.

The bedrock formations in eastern Ellesmere include: Precambrian gneisses and granites; Proterozoic sandstones, shales, and volcanic rocks; and lower Palaeozoic carbonate rocks. An area of poorly consolidated sandstone and coal beds, possibly of Tertiary age and of limited extent, was discovered. The Proterozoic rocks are similar to exposures near Thule, Greenland, and in northwestern Baffin Island. Occurrences of metallic mineral deposits are limited to copper stain, found particularly along the south coast of Bache Peninsula, and sulphide minerals which are disseminated in certain gneiss bands. Non-metallic mineral occurrences include several seams of soft, flaky coal (one of which is about 15 feet thick) exposed near the head of Bartlett Bay in beds of massive, relatively pure gypsum exposed along the isthmus and northern shores of Bache Peninsula.

R.G. Blackadar assisted by A.J. Jenik mapped Andrew Gordon Bay and Cory Bay map areas in southern Baffin Island. Blackadar reached Cape Dorset from Churchill on April 9 but because of a severe influenza epidemic which caused four deaths in the community it was April 22 before any dog-team drivers were well enough to travel. During the next four weeks an overland trip of about 250 miles was made to the northeast part of Cory Bay map area (near Bowman Bay) to map areas relatively inaccessible in summer except by helicopter.

Jenik arrived at Cape Dorset from Frobisher Bay on May 27 and three days later the party moved by dog-team to a camp-site on the north shore of Andrew Gordon Bay some 40 miles east of Cape Dorset. Geological traversing was begun on June 8 at which time the snow cover was only 25 per cent and rapidly decreasing. Two men from Cape Dorset, Kaka and Liashah, worked with the geologists acting as traversing companions.

The mainland between the head of Andrew Gordon Bay and Chorkbak Inlet was mapped and early in July the party returned by canoe to Cape Dorset where they met the C.G.S. C.D. Howe and received supplies for the balance of the season. At this time Jenik,

thanks to the members of the Dominion Observatory who were carrying out gravity surveys in central and southern Baffin Island, was able to make a helicopter traverse from Hudson Strait to Foxe Basin through the western part of the area.

The party left Cape Dorset on July 21 aboard the Aivik, a peterhead boat owned and operated by Paulassie Pootogook, and for the next eight weeks this boat was used as a floating base to support the traversing programme. Jenik made several canoe trips through the interior, the longest of which was from the head of Chorkbak Inlet through Tessik and Kinguk lakes to Andrew Gordon Bay and involved twenty-three portages.

Jenik returned to Ottawa by way of Frobisher Bay in early September and Blackadar, after further field work, flew south to Moosonee on September 22. It is expected that preliminary maps of the areas examined will be published shortly. The area is underlain by Grenville-type rocks and contains deposits of magnetite which were staked by Ultra-Shawkey Mines Ltd. and were examined by geologists of that company in 1957 and 1958. At present there is no prospecting in the area.

B.R. Pelletier was attached to the Polar Continental Shelf Project during April and early May to continue a study begun in 1960 on the submarine geology of the continental shelf adjacent to the western Queen Elizabeth Islands. He left Ottawa on April 13 and proceeded to Isachsen via Churchill. Reconnaissance traverses using an Otter aircraft were made across parts of the shelf between Meighen and Ellef Ringnes islands, landing at pre-selected sites to obtain bottom samples through holes drilled through the ice. Pelletier left in May to continue stratigraphic studies in northeastern British Columbia. Results of this work indicate that glaciation of the inter-island areas took place when the land was at a higher elevation relative to sea level than at present, and that this event was followed by submergence.

D.R. Horn was attached to the Polar Continental Shelf Project from March to August. He initiated a detailed study of bottom sediments and submarine topography in the inshore areas and channels lying between Ellef Ringnes and Axel Heiberg islands and the coasts of Amund Ringnes and Cornwall islands. Horn used dog teams to carry his equipment and camp supplies while traversing

Louise and Haakon fiords, and an S-55 helicopter to sample the channel areas east of Ellef Ringnes Island. This study of the distribution of sediments should make it possible to interpret the geological and physiographic history of the island channels and inshore areas.

R. Kretz continued a study of pegmatites in relation to the surrounding rocks in the Yellowknife-Beaulieu area. In places mapping was done in great detail and material was collected to study the regional distribution of certain elements, some of considerable economic importance, such as beryllium, lithium, tantalum, and niobium.

J.C. McGlynn continued a regional study of mapped Precambrian rocks in the District of Mackenzie. This information has a bearing on mineral exploration in that it will permit more accurate correlation of rock units.

Several officers were attached to the Division of Oceanographic Research, Surveys and Mapping Branch, and carried out studies in Hudson Bay.

P.S. Hood conducted the first saltwater testing of a sub-bottom depth recorder developed by Hunting Survey Corporation and the University of Toronto. This survey has provided data from the southern part of Hudson Bay and from Omarolluk Sound in the Belcher Islands and permits an estimate to be made of the depth of unconsolidated sediments covering the bedrock.

R.J. Leslie aboard the M.V. Theta initiated a submarine geology programme in Hudson Bay including studies on physiography, bottom sediments, and fauna. Traverses were made on east-west lines around the shores of Hudson Bay. B.R. Pelletier joined Leslie in September. This work will form the basis for future detailed oceanographic studies of Hudson Bay.

A sea magnetometer, constructed by L.S. Collett and P. Sawatzky, was installed in M.V. Theta and 9,000 line miles of data were obtained which will be useful in determining the depth of the sedimentary rock layer beneath Hudson Bay and also in tracing major rock trends.

An aeromagnetic survey of the Muskox Complex, near Coppermine River, was carried out by members of the Geophysics Division under the direction of K.H. Owens. This ultrabasic body is one of several that will be studied in detail during the international study of the Upper Mantle and the geophysical work carried out will help delineate the Muskox Complex and assist the proposed research drilling.

The Northern Insect Survey, 1957-61. By D.R. Oliver[1].

The Northern Insect Survey began in 1947 as a joint project of the Divisions of Entomology, Botany, and Plant Pathology of the Department of Agriculture and the Defence Research Board of the Department of National Defence. The Survey has been continued since 1952 by the Division of Entomology (now the Entomology Research Institute) in cooperation with the Defence Research Board. The primary aims are to investigate the systematics, distribution, and ecology of the biting flies and other insects in the arctic and subarctic regions. Seventy-two field parties consisting of one or two men have visited 71 localities. Dr. T.N. Freeman has reviewed the activities of the Survey until 1956 in the Arctic Circular (see Volumes 3 (1950) p. 55, 4 (1951) p. 85, 6 (1953) p. 30, and 10 (1957) p. 10). The following continues the chronological list of the field parties and localities since 1957:

1957: Queen Charlotte Islands, B.C.; E.B. MacDougall.
Fort McPherson, N.W.T.; S.D. Hicks and R. Hurley.

1958: Clyde Inlet, Baffin Island, N.W.T.; G.E. Shewell and J.E.H. Martin.
Payne Bay, Que.; W.R.M. Mason and E.B. MacDougall.

1959: Umiat, Alaska; J.E.H. Martin and R.B. Madge.
Summit Lake, B.C.; E.B. MacDougall and R.L. Leech.
Alaska Highway between Fort St. John, B.C. and Chicken, Alaska; G.P. Holland and J.E.H. Martin.

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1. National Research Council Postdoctorate Fellow, Entomology Research Institute, Canada Department of Agriculture.

1960: Ross River, Yukon; J.E.H. Martin and E.W. Rockburne.
Telegraph Creek, B.C.; W.W. Moss and R.J. Pifrey.
Isachsen, Ellef Ringnes Island, N.W.T.; J.F. McAlpine (see McAlpine, this issue).

1961: Unalakleet and Cape Thompson, Alaska; B.S. Hemming and R.B. Madge.
Hazen Camp, Ellesmere Island, N.W.T.; D.R. Oliver (see Oliver, this issue).

The insects of the Lake Hazen area, Ellesmere Island, 1961. By D.R. Oliver

Collections of insects were made between July 8 and August 20 at the Hazen Camp (81° 49N, 71° 18W.) of the Defence Research Board on the north shore of Lake Hazen. Members of the Hazen party who had been at the camp since May reported that insects were common during the last week of June and a few "flies" were seen throughout that month. The number and variety of insects increased notably during the second week of July. The first mosquito bites were suffered by the party on July 8. Repellent was necessary during the remainder of July and the first week of August. On August 1, a member of the party, S. Windisch, stood in one spot and swept at random with an aerial net for five minutes and captured approximately 1,100 mosquitoes. Diptera were the commonest insects throughout the collecting period, especially during the last part of July and the first part of August, when the lake chironomids emerged in large numbers. The Lepidoptera and Hymenoptera attained their maximum numbers early in August. By the second week of August most groups were becoming less common, although the chironomids were numerous along the margins of aquatic bodies. By the time of departure, August 20, the few insects seen flying were mainly Diptera.

The field work was divided into two parts: general insect collecting and a detailed study of the Chironomidae, including life history and ecological observations. Some 204 species of insects (including Collembola) were collected. This doubles the number of species known from the Queen Elizabeth Islands. General collecting

was secondary to the chironomid investigations and further collecting will undoubtedly reveal more species, especially since about 30 species known to occur in the Queen Elizabeth Islands (Bruggemann, 1958[1]) were not collected at Hazen Camp. The number of species is very much larger than that occurring in the Isachen area (see McAlpine, this issue). McLachlan (1878[2]), after examining the insects collected by the Nares Expedition, wrote "Thus we see that Grinnell Land, ice-bound and ice-covered as it is for all but a short period in each year, possesses an insect fauna that cannot be styled otherwise than remarkable...". This expedition collected some 45 species of insects and 16 arachnids.

The following is a summary of the number of species in each family of insects collected:

Collembola		Trichoptera	
Poduridae	5	Limnophilidae	1
Isotomidae	6	Lepidoptera	
Onychiuridae	1	Olethreutidae	2
Neelidae	1	Geometridae	2
Sminthuridae	1	Liparidae	1
Homoptera		Noctuidae	5
Pseudococcidae	1	Arctiidae	1
Coleoptera		Pieridae	1
Staphylinidae	1	Nymphalidae	2
Dystiscidae	1	Lycaenidae	2

[1] Bruggemann, P.F. 1958. "Insects and environments of the High Arctic". Proc. Tenth Int. Congr. Ent., 1956, Vol. 1, pp. 695-702.

[2] McLachlan, R. 1878. "Insecta and Arachnida" in Nares, G.S., 'Narrative of a voyage to the Polar Sea during 1875-6 in H.M. Ships Alert and Discovery', Vol. 2, pp. 234-9.

Diptera		Sapromyzidae	1
Trichoceridae	2	Piophilidae	2
Tipulidae	5	Agromyzidae	1
Chironomidae	54	Tachinidae	2
Ceratopogonidae	6	Calliphoridae	3
Culicidae	2	Muscidae	22
Mycetophilidae	5	Hymenoptera	
Sciaridae	10	Tenthredinidae	1
Cecidomyiidae	2	Braconidae	5
Dolichopodidae	2	Ichneumonidae	34
Empididae	3	Chalcididae	1
Phoridae	1	Apidae	2
Syrphidae	4		

I am indebted to the Defence Research Board and Dr. G. Hattersley-Smith, the leader of Operation Hazen, for making available the facilities at Hazen Camp.

Preliminary report on the insects of the Isachsen area, Ellef Ringnes Island, 1960.

By J.F. McAlpine[1]

A general survey of the insects, spiders, and mites of the Isachsen area of Ellef Ringnes Island, carried out by myself in 1960, showed that the fauna is extremely restricted and very simple. Collections made between July 7 and August 5, the warmest period of the year, contained a total of some 28 different kinds of insects;

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1. Entomology Research Institute, Canada Department of Agriculture.

all were taken in the relatively fertile area within a radius of about three miles of Isachsen.

The following groups were represented; the exact numbers of species indicated may change somewhat when the groups are studied in more detail:

Diptera

- Chironomidae, 18 species
- Sciaridae, 2 species
- Trichoceridae, 2 species
- Muscidae, 2 species
- Calliphoridae, 1 species

Lepidoptera

- Geometridae, 1 species

Hymenoptera

- Ichneumonidae, 1 species

Anoplura 1 species

In addition to the insects, two species of spider (Aranaea), several species of mites (Acarina), and at least three species of springtails (Collembola) were found in the area. One species of earthworm (Microdrili) was also collected.

Observations made at other localities on Ellef Ringnes Island, and on Meighen and Borden islands, indicated that, entomologically speaking, the Isachsen area is very probably the richest locality in the Sverdrup group, excluding Axel Heiberg Island. The collection obtained at Isachsen, now in the Canadian National Collection of Insects, Ottawa, is thought to contain representatives of approximately 90-95 per cent of all the insect species that are able to survive on these low, exposed, arctic islands.

The accommodations and facilities provided by the Polar Continental Shelf Project, Department of Mines and Technical Surveys, is gratefully acknowledged.

A case of osteological thievery. By Charles F. Merbs

Archaeologists, from the destruction observed at their sites, are only too familiar with certain habits of animals, particularly rodents. Gopher holes at first appearance may be mistaken for post moulds, artifacts may be partially destroyed or spirited away by pack rats, and human bones may be gnawed beyond recognition by porcupines. Unfortunately the Canadian Arctic does not lack a counterpart.

During the summer of 1959, a field party from the University of Wisconsin, under the direction of W.S. Laughlin, excavated human burials of the Sadlermiut Eskimos on Southampton Island, Northwest Territories. The burials, for the most part, consisted of vault-like graves constructed of selected but unprepared stones. Many of these graves appeared to be completely undisturbed at first inspection. When opened, however, teeth and smaller bones were found to be in disarray or absent. Some of the lost items were subsequently recovered from between rocks which formed the lower portions of the walls or the floors of the graves, but a thorough examination of the burial area failed to disclose the whereabouts of the remainder. Some of the disarray could be attributed to rapid runoff of water from heavy downpours or quick thaws, and in the case of disturbed graves to foxes, but another agency had obviously been at work.

This agency was soon discovered to be the brown lemming (Lemmus trimucronatus) to whom the graves represented ideal homes. The human skulls were used as nests, as the foramen magnum proved to be just large enough for the lemmings to enter and leave. One of the first steps in the excavation of a burial consisted of removing the flat cover slabs so that the contents could be photographed. The lemmings seemed quickly to sense that their nests were in danger, and so used the photographing time to remove their infants, one by one, from the skull and deposit them out of harm's way among the neighbouring rocks. In only one case did the lemmings have to be forcibly evicted. Examination of the interiors of the skulls occasionally disclosed human teeth and small phalanges along with the usual nesting debris brought in by the lemmings.

Skeletal items most frequently missing were teeth, the hyoid, cervical and coccygeal vertebrae, phalanges, carpals, and the smaller tarsals. Although the size of the object appears to have been the primary factor determining its removal, the anatomical position of the bone, and its position in the grave were also important. The bones in exposed positions were those most frequently missing. A specific example of this osteological thievery may be taken from the cervical region of the vertebral column. The skeletons of 15 adolescents and children, and 63 adults had practically all of the larger bones present. Of these, however, only three of the subadults and 33 of the adult columns contained all seven cervical vertebrae. The vertebrae missing with greatest frequency were C-3 (31 per cent), C-4 (23 per cent), and C-5 (26 per cent) as compared with C-1 (15 per cent), C-2 (14 per cent), C-6 (14 per cent), and C-7 (10 per cent). Only about 4 per cent of the adult thoracic vertebrae were not recovered with T-1 missing most frequently. Vertebrae of course are too large to be taken into a skull, but were instead cached among nearby rocks or in hiding places known only to the lemmings.

Archaeological discoveries in the Chukotsk Peninsula

The Soviet News Bulletin No. 17 (1730), dated 30 January 1962 and published by the U.S.S.R. Embassy in Ottawa, carries a report on archaeological discoveries in the Chukotsk Peninsula. In 1955 D.A. Sergeyev, a teacher in one of the Chukotsk schools, helped to discover an ancient Eskimo burial ground. In 1961, as a member of an expedition from the Ethnography Institute of the U.S.S.R. Academy of Sciences, he found another old Eskimo burial ground. It was about 30 kilometres south of Wellen, near the deserted village of Ekwen. The report ascribes the find to the Old Bering Sea culture, and mentions harpoon heads and knife hafts covered with fine designs, ivory carvings of animals and people, and tiny chains also of walrus ivory. The carving is said to show high artistic skill and to include representations of mountain sheep, walrus, polar bear, and weasels. A particularly interesting find was an iron instrument for engraving. This is said to indicate that iron had penetrated to the north as far back as the first century A.D. and that the Eskimos even then had contacts with other peoples living farther south. The collection is now in Moscow.

The biology and hunting of white whales

Circular No. 8 of the Arctic Unit, Fisheries Research Board, "The biology and hunting of beluga or white whales in the Canadian Arctic" by D.E. Sergeant summarizes what is known of white whales in northern Canadian waters. Their movements are outlined, a table shows the numbers killed in recent years, and maps indicate the places where they have been reported. The publication also describes hunting methods and processing plants such as that which operated at Churchill from 1948 to 1960. The report concludes that in future beluga fishing will be for local use only and not for export, and suggests the most suitable locations for local fisheries.

Editorial Note

The Editor would welcome contributions from those who are at present in the Arctic or have information about work in the Arctic. All material for the Circular should be sent to

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