distance and lack of communication always managed to provide what was required, and also his opposite number in Edmonton, Mr. John Owen; Mr. René Toms of Bradley Air Services; and last but not least Mrs. Walker who acted as camp cook during the summer — certainly not always the easiest of jobs.

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IBP High Arctic Ecosystem Study, Devon Island

The research in 1971 continued to emphasize the physical environment and the biological response of organisms on meadows (*c.* 49 per cent of the lowland) and raised beach ridges (*c.* 15 percent of the lowland) in the Truelove Lowland. The lakes (22 percent) were not included in the studies and all data are expressed on the basis of a 3,300 ha. land area. As in 1970, the research was concentrated on a typical mesic meadow (soils, meteorology, primary production, nitrogen fixation, invertebrates, decomposition) with additional data gathered in 2 to 5 other meadows (extensive sites), depending upon the research unit. The intensive beach ridge site, approximately 7,500 years old, was studied with the same components of research as the master meadow site. In addition, 2 to 11 other beach ridges (extensive sites), and a site on the plateau (*c.* 300 m. above sea level) were studied in varying detail (soils, meteorology, primary production, and invertebrates). In all, 22 separate research projects were conducted in 1971.

Two flights for aerial photography of the Truelove Lowland were made. The Atmospheric Environmental Service of the Department of Transport photographed black and white and an infrared scan in late July, and the Inland Waters Branch photographed black and white imagery at 3,330 and 830 m. and infrared false colour at 1,660 m. in mid-August. The 1:20,000 scale photography will be used to produce a photographic map devoid of horizontal and vertical distortions and will be able to resolve height differences of 1 m. The 1:5,000 scale photography will be used for detailed mapping of land and vegetation features, enabling the interpretation of features 1 m. in diameter.

Eleven holes were drilled in the major terrain units of the lowland and one on the plateau. The holes varied in depth from 1 to 9 m. and each contained a series of 12 thermocouples. July temperature data of the permafrost ranged from −9°C. to −15.6°C. at depths of 3 to 9 m. From the summer and winter data, and determinations of thermal conductivity of the granite gneiss, limestone, dolomite, and sandstone, estimates will be made of permafrost thickness in the lowland and on the plateau.

Soils of the intensive beach ridge and mesic sedge meadow were mapped, based upon a total of 111 and 137 small pits respectively. Profile samples from 9 pits were collected for physical and chemical analyses. The extensive sampling program included descriptions and soil collections from an additional 14 profiles from meadow, beach ridge and outcrop sites scattered over the lowland.

The microclimatic studies initiated in 1970 at the 2 intensive sites and the 3 extensive ones (rock outcrop, cliff base, and Base Camp) were continued. Additional stations were set up on the plateau and near the sea (Rocky Point). An additional "roving" station was placed for 2-week periods each on Beschel Hill, a hydric sedge meadow, and a coastal sedge meadow.

In general the microclimate of the Truelove Lowland in 1971 was very different from that of 1970. Lake ice was thinner (1.5 *v.* 2.3 m.) and average snow cover was greater in 1971. Both June and July were sunnier in 1971. The lakes were free of ice for 2 days in late August 1970, but from late July until late August in 1971. August 1971 was cloudy and cool. The lowland experienced 2 Chinooks (26 June, 29 to 31 August) in 1970 and 3 in 1971 (August, September, October). The week of maximum temperatures lagged the solar high by 3 weeks in 1970 and by 4 weeks in 1971. In mid-June warming was greatest in the areas of more massive rock outcrop away from the coast. From the end of June and through mid-July there were three areas of local heating (plateau edge, Beschel Hill and near intensive study sites).

Water flux studies using both lysimeters and sod blocks were conducted on the 2 intensive study sites. While temperature at 1.5 m. was very similar in the 2 sites, microclimatic conditions (temperature, wind, vapour pressure deficit and soil moisture) were very different. Foliose and fruticose lichens nearly doubled the rates of evaporation com-

pared with bare soil, whereas there was little difference in evaporation comparing a crustose lichen surface with bare ground. Evaporation rates from lichen covers were much greater than those with flowering plants. At the meadow site evaporation from a moss surface was greater than from open water. In both sites it appears that lichens and mosses provide little if any resistance to water loss in contrast with vascular plants.

The 1970 above ground annual production of vascular plants averaged 87 g./m.^{2} on the intensive beach ridge site with a standing crop of 597, 97 and 10 g./m.^{2} for vascular plants, mosses and lichens respectively. Much of the annual production is the annual increment of woody or semi-woody shoots of *Dryas integrifolia* and *Saxifraga oppositifolia*. On the plateau the estimates are an annual production of less than 10 g./m.^{2} and a standing crop of 20 and 265 g./m.^{2} for vascular plants and mosses respectively. While the 1971 production data are not yet available, plant cover has been estimated on 12 beach ridges and the plateau and standing crop on 6 beach ridges and the plateau. The beach ridges were selected to show changes in cover and standing crop in relation to age. Younger beach ridges (3 to 5,000 years) had less cover and standing crop than older ones (6 to 10,000 years).

Carbohydrate data showed a stable system with little depletion of root reserves in early season, yet shoots showed a significant increase in carbohydrates in the first 14 days after snow melt. Oligosaccharides constituted a high proportion of the sugars, especially in roots.

Twelve sedge dominated communities were sampled for community composition and 6 of these for primary production in 1971. The data indicated that there were 3 meadow types (dry mesic with frost boils, mesic often with sedge hummocks and hydric meadows often with flowing water). In 1970 annual above-ground production averaged about 90 g./m.^{2} with mosses accounting for 45 g./m.^{2}. In mid to late July chlorophyll reached a peak in mesic and hydric meadows of about 210 and 270 mg./m.^{2} respectively. Roots and rhizomes became partially depleted of sugars in late June — early July, and sugar increased in shoots in late July until mid-August. As with the beach ridges oligosaccharides predominated.

The gas analysis data for *Dryas integrifolia* showed that plants became active within a few days of snow melt. On clear days leaf temperatures might reach 30°C. to 35°C. indicating that leaves were not closely coupled with the environment. Under such conditions, respiration predominated over photosynthesis and the plants thus carried on more net assimilation at "night" than during the "day" or under cloudy conditions. The rates of photosynthesis in *Dryas* were comparable to temperate region grasses and tree seedlings showing that this arctic species was capable of producing as much biomass under favourable environmental conditions as were temperate region plants. *Dryas* appeared to be best adapted to cool temperatures, cloudy days, and clear nights. Data were also gathered on *Carex stans*, mosses, and lichens.

Initial work on lichens consisted of estimates of species composition and standing crop for the intensive beach ridge, the adjacent rock outcrop area, and an extensive beach ridge site. Estimates of annual production will be based upon photographic colour slides, ^{14}C, gas analysis, and soluble carbohydrate analyses.

Studies of mosses and hepatics were initiated in the intensive meadow site and at an additional 10 sites. Data were gathered on community composition, annual production, standing crop, and vertical profiles of moss stands to determine caloric, chlorophyll, and nutrient contents. There was a greater bryophyte diversity in mesic meadows than in hydric (13 *v.* 5 species/dm.^{2}). Production was greatest along streams and in hydric meadows. The rate of length-growth in mosses growing in meadows was highest in early season. Preliminary nutrient analyses indicated that water quality in these meadows and streams was similar to some calcareous fens in the boreal forest zone.

Preliminary data showed considerable nitrogen fixation in mesic meadow soils with decreasing amounts in hydric meadows and the intensive beach ridge site. Relatively dry soils in the beach ridge and cold soils in the hydric meadow may be important limiting factors. Whereas mats of *Nostoc commune* were common in mesic meadows (1.5 per cent cover) and smaller amounts were seen in the other meadow types and beach ridges (0.1 per cent), the species appeared to fix relatively little nitrogen. Soil microorganisms appeared to be the principal nitrogen fixers. Laboratory studies showed that the rate of fixation was very sensitive to exogenous nitrogen supplies and to temperature. Of the 42 species examined for mycorrhizae, 13 were found to contain them.

Carbon dioxide flux was measured at both intensive sites. Higher total CO_2 flux occurred in the meadow than in beach ridge soil and in both sites nearly 50 per cent of the total release was in the upper 8 cm. When temperature was varied at field moisture level, the CO_2 flux increased with a temperature

increase, the response being much greater in the beach ridge soils. Changing both moisture and temperature showed the following: decreasing moisture in beach ridge soils gave a decrease in CO_2 flux irrespective of temperature while in the meadow soils a decrease in moisture resulted in a substantial increase in CO_2 release.

It was estimated that 125 to 150 species of insects occurred in the lowland, of which the Chironomidae (Diptera) were the most abundant. Preliminary soil data showed that there was a greater species diversity and standing crop of invertebrates in the sedge meadow than in the beach ridge. The major groups in the meadow soils were protozoans, nematodes, enchytraeids, tardigrades, acari, Collembola, Chironomidae larvae and copepods. In the beach ridge soils nematodes, enchytraeids, acari, Collembola and Chironomidae larvae predominated. The bioenergetics of larvae of several species of Lepidoptera is being studied.

Dicrostonyx groenlandicus remained at about the same population level for 2 summers. As in 1970 lemming were mostly confined to the drier habitats in the summer, averaging 1.1/ha. on beach ridges, 0.8/ha. in granitic outcrops, and 0.6/ha. in raised-centre polygons. Winter nests predominated on beach ridge fore-slopes and back-slopes with lesser numbers in mesic meadows, granite, and calcareous outcrops. These lemming appeared to be small, averaging only 28 g., and contained little fat reserve. The estimated standing crop of lemming was 4.6 g./ha. in late August, about 2,000 in the lowland.

Summer feeding experiments were conducted using *Salix arctica* and commercial rat chow. Growth rates will be calculated from these studies. Fall observations indicated that the preferred food species were *Dryas integrifolia, Saxifraga oppositifolia, Salix arctica,* and *Pedicularis sp.*

Although *Lepus arcticus* are seldom seen in summer, they are observed when there is a snow cover. The most commonly selected plants are *Salix arctica* and *Pedicularis lanata.* Standing crop in the lowland is estimated to be 4.0 g./ha. Feeding experiments and radio tagging are planned for the spring of 1972.

Ovibos moschatus is the only large herbivore that utilizes the lowland. Calf production in 1971 was significantly above the 1970 figure. This increase was consistent with good calf crops in other High Arctic muskox populations in 1971. Sedges and grasses are the principal plants utilized. The estimate of herbage removal for the summer months is about 1.5 per cent of the standing crop. The standing crop of muskox averaged *c.* 250 g./ha. for the 3 summer months. Although the sedge meadows were used more heavily in August 1971 than in previous years, it appeared that the lowland received more intensive winter and spring grazing when the ground was snow-covered than it did in summer. Bioenergetic studies are planned this winter on penned animals in Alaska.

The bioenergetic studies of birds were continued with the emphasis again on snow bunting *(Plectrophenax nivalis).* Two nestling birds were raised in the laboratory. Predators destroyed 69 per cent of the nests found in 1971 compared with 25 per cent in 1970. Foxes accounted for most of the predation. The 1970 cencus of the lowland recorded 17 species and the two in 1971 averaged 18 species. Of these, red throated loons, Oldsquaw, Baird's sandpiper, arctic tern, Lapland longspurs, and snow bunting were the most abundant.

Arctic fox *(Alopex lagopus)* averaged 4 from May through July and 6 in August and September, an average of 1.5 g./ha. The winter and summer study indicated that foxes spend most of the year on the ice pack feeding on seal and return to the land for denning activity (May to October).

Short-tailed weasel *(Mustela erminea)* occurred mostly in the rock outcrops in the lowland. From May through September the weasel population averaged 10, a standing crop of 0.14 g./ha. Bioenergetic studies were run on caged fox and weasel in the summer of 1971 on Devon and the research was continued during the winter under controlled laboratory conditions.

Both fungal and bacterial biomass were determined in the 2 intensive sites. The data clearly showed that the standing crop of fungi was much greater than bacteria and that the biomass of both groups was 10 to 15X greater in the meadow soils. Both natural plant materials *(Carex* and *Dryas* litter and *Saxifraga* and *Dryas* roots) and cellulose have been placed in the field to enable calculations of decomposition rates. Microbial succession on decomposing *Dryas* and *Carex stans* leaves is also being studied.

Initial studies indicated that moisture was more important than other factors in the decomposition of muskox dung. There appeared to be a seasonal progression of fungi active in dung decomposition.

The manipulatory studies showed that with the addition of fertilizer, some species responded more rapidly than others *(Salix arctica, Alopecurus alpinus* and *Arctagrostis latifolia).* Nitrogen was more effective than phosphorus or potassium, but a combination of the three might have a greater effect.

Depth of the active layer measurements showed that with surface disturbance the active layer seldom increased more than 10 to 15 per cent and in many places no significant increase resulted. With surface scraping, thaw of ice-rich lenses was initiated but relatively few sites of slope slumpage or surface subsidence were observed in the other islands.

Using the incomplete standing crop, caloric, and bioenergetic data of 1970 and early season data for 1971, preliminary energy flow and nitrogen flow models were calculated for the Truelove Lowland. It is important to stress that the data are preliminary and that refinement of these models will continue throughout the life of the Project, but the orders of magnitude are probably correct. The models showed that the main components of the system were the plant-soil organic-decomposer cycle with herbivores and carnivores a small component. The role of invertebrates in the system and the importance of muskox in returning nutrients via dung over the lowland are not known, and along with various other aspects give new impetus to the 1972 studies.

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Further information on the project and the individual researchers can be obtained by writing the author and Director of the project:

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Recherches Amérindiennes au Québec

This information bulletin, published six times a year, is an outlet for researchers in all branches of anthropology who are working in the Quebec and Labrador regions.

Of particularly timely interest is the special issue (Vol. I, nos. 4-5) devoted to the plight of the Indians of the James Bay region whose hunting territories and way of life are being menaced by industrial development (electric power project). The papers assembled in this special number have been written by a team of anthropologists and ecologists familiar with that area.

English translations of the titles of the main chapters follow. 1) The James Bay Project: Disquiet of the Non-initiated; 2) Problem #1: Territorial Rights; 3) The Culture Crisis facing the Project: Northern Experience and Science; 4) . . . And Anthropologists.

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