geomorphic processes, and a considerable extension of this investigation is to be undertaken in succeeding years.

About 5 miles north of the Resolute Air Base, there is an area of surprisingly good, fine sandy loam which is closely interbedded with layers of humus, and this was the area selected for the modification experiments. Eight plots each 10 feet square were marked out, and a rod carrying 14 thermocouples was drilled down into the centre of each. The thermocouple wires from each rod were then led to a centrally placed instrument tent which housed the switching gear and a battery-operated potentiometer, by means of which temperatures could be determined to the nearest 0.2°F. One of the plots was left completely undisturbed to act as a control, but the surfaces of the other 7 were variously treated in an attempt to induce changes in the subsurface temperatures. For example, to investigate such changes as might be induced by altering the thermal conductivity of the soil, the surface of one plot was flattened and compacted by heavy treading, while that of another was dug to a depth of about 9 inches and broken into a reasonably fine tilth. To induce changes in subsurface temperatures by altering the albedo or reflective power of the surface, a third plot was dusted with a thin layer of white talc powder, while a fourth was similarly treated with carbon black. In an effort to increase surface and subsurface temperatures by reducing wind speed and evaporation rates, a fifth plot was dug, dusted with carbon black and then covered by a polyethylene cloche whose dimensions were such as to enclose 100 cubic feet of air. Temperature profiles in each plot were measured at about 2:30 P.M. on most days, which time coincided with the attainment of maximum temperatures at the ½-inch depth, and moisture values were determined by the gravimetric method. During one 24-hour period, readings were taken every 2 hours to provide information concerning the diurnal range of temperature at each of the 14 depths on all plots.

Several of the surface treatments produced very significant changes in both subsurface temperature and moisture values; as visual integrators of such changes, small cabbage plants and sprouted potato chits were planted on selected plots. Those planted on each of the unprotected plots died within the course of a few days, which was no surprise, particularly in view of the weather conditions. However, those planted beneath the polyethylene cloche flourished quite remarkably, due to uninterrupted photosynthesis and to the fact that they were subjected to a much more favourable microclimate. Thus, on the afternoon of 30 July, the temperature of the soil surface beneath the cloche rose to no less than 79°F., a figure 26 deg. in excess of the corresponding value for the control plot. At depths of 4, 8, and 12 inches, the excess was 13 deg., 11 deg., and 8 deg. respectively, and it was only at depths below 16 inches that it fell to about 1.5°F., becoming zero at 32 inches. So favourable were its effects that the cloche drove the permafrost down an additional 4 inches in only 16 days, and future experiments with polyethylene greenhouses are to be undertaken to show that when the eventual development of the Canadian Arctic necessitates a certain measure of horticultural self-sufficiency, this can be attained at low cost. The party's 2 microclimatologists agree that "a prerequisite to the solution of the problem of arctic agriculture is the inexpensive raising of the summer ground temperature by a few degrees,"[2] and they wholeheartedly support the view that "we should begin with the scientific groundwork without delay."[2] Moreover, they see no reason why such efforts should be restricted to Canada's western Arctic.

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[1]*Arctic Miscellanies, A Souvenir of the Late Polar Search,* by the officers and seamen of the expedition, 1852. London: Colburn and Co. p. 319.

[2]John C. Reed, 1962. Scientific research and northern development. *Arctic,* 15: 3-8.

Devon Island Programs, 1967

INTRODUCTION

The Arctic Institute's facilities on Devon Island were again used during the summer of 1967 by field parties studying glaciology, glacio-isostatic geomorphology, periglacial geomorphology, ornithology, and botany. In addition, an expedition photographer recorded the summer's activities with still photographs and on 16 mm. colour film. Field camps were established at various locations and the studies were pursued from these as well as from the Base Camp close to Cape Sparbo. Each investigator worked with one assistant; in W. Barr's case, one of the 3 members of the camp staff worked with him, as the assistant originally recruited was unable to join the group.

Local transportation was provided in the early part of the summer by a vessel, later by two Massey Ferguson diesel tractors in the Base Camp lowlands area, and by a Polaris motor toboggan on the ice cap. After

break-up, a 20-foot freight canoe powered by a 10 h.p. outboard motor was used on several occasions. During July and early August, the Institute was able to assist a Dominion Observatory gravity survey team who made their headquarters at the Base Camp, and were able to afford some helicopter support, mainly to the glacio-isostatic geomorphology party; this however was limited owing to the gravity team's own program being delayed by poor flying weather.

Once again, thanks are due to Dr. F. Roots of the Polar Continental Shelf Project for valuable air support in moving personnel and equipment between Resolute and Devon Island. On one of these flights, when the first group of Institute personnel to return south were among the passengers, the Otter crashed on take-off and received considerable damage, mainly to the undercarriage. No one was hurt, and the party was flown out some days later. On 29 August, when the remainder of the Devon Island party were leaving on the C.C.G.S. *John A. Macdonald*, a salvage crew arrived to work on the aircraft and were left in possession of the Base Camp.

The Arctic Institute also gratefully acknowledges the generosity of the following companies in donating food and equipment and giving financial support to the Devon Island Project: Atlantic Sugar Refineries, Canada Freeze-Dry Foods Ltd., Canada Packers Ltd., Catelli-Habitant Ltd., Cel-Cil Fibres Ltd., Fry-Cadbury Ltd., Johnson & Johnson Ltd., Thomas J. Lipton Ltd., Massey-Ferguson Ltd., Mount-Royal Rice Mills Ltd., Nordair Ltd., The Pascal Hardware Co. Ltd., and Pedigree Manufacturing Co. Ltd.

GLACIOLOGY

The glaciology program was supported by funds from the Arctic Institute of North America and the Institute of Polar Studies, Ohio State University. Logistic support in the field was provided by the Arctic Institute of North America. R. M. Koerner and A. E. Koerner were landed on Sverdrup Glacier on 10 June 1967 by a Polar Continental Shelf Project Otter. They conducted field investigations on the ice cap before returning to the base camp on 17 July. They were flown to Resolute Bay on 29 July.

The glaciology program included setting up a recording meteorological station on the ice cap, measuring the August 1966 to June 1967 accumulation on the ice cap, and measuring the 1965-66 mass balance on the south side of the ice cap.

A meteorological station was set up at the abandoned ice-cap station on the northwest side at an altitude of 1,317 m. An anemometer connected to a Rustrak miniaturized automatic chart recorder, driven by a 12-volt battery, began recording on 16 June. This instrument is capable of recording for 3 months and, as the charts were changed on 17 July, a 4-month record of wind speed should be obtained. A thermo-hydrograph was adapted to carry 2 battery-driven recording drums. A continuous chart runs from one drum to the other and in this way the instrument is capable of recording temperature and humidity for a 6-month period. Using these 2 instruments, the weather of the entire melt season will be recorded, thus allowing climate/mass balance relationships to be studied during very short field seasons. In addition, wind speed, direction, sunshine, temperature, and humidity were recorded at the base camp during the 1967 summer. These data will afford interesting comparisons with the ice-cap records.

After the instruments were calibrated and installed at the meteorological station, the glaciological party travelled over the northwest, southeast, and southwest parts of the ice cap using a Polaris motor toboggan. R. M. Koerner again recorded the pattern of high accumulation in the southeast, and low accumulation in the northwest.[1] Density of the August 1966 to June 1967 snow was the lowest on record. The mean density of the previous 6 years' autumn-spring snow cover was 0.344 g. cm.$^{-3}$ compared to 0.291 g. cm.$^{-3}$ in June 1967.

The June 1967 snow profile was unusual as it lacked the hard, dense surface layer common in previous years. The snow profile in June 1967 indicated that there had been average accumulation in the autumn of 1966, low accumulation during the winter, and high accumulation during the 1967 spring. Two periods of very high snowfall in early July added 8 g. cm.$^{-2}$ on the south side of the ice cap and 5 g. cm.$^{-2}$ on the north side. This gave the highest August to early July snow accumulation on record. For this period, the northwest side of the ice cap had a mean accumulation of 18 g. cm.$^{-2}$, the southwest side had 25 g. cm.$^{-2}$, and the southeast side 34 g. cm.$^{-2}$ The very high accumulation area in the southeast corner of the ice cap had a mean accumulation of 51 g. cm.$^{-2}$ for the same period.

On the southeast and southwest traverses, most of the stakes and percolation trays were replaced, so that mass-balance measurements could be made there again in 3 years' time. It is intended to measure the mass balance of the northwest part of the ice cap every spring and on the south side of the ice cap once every 3 years. Thus, a study of the climate/mass balance relationship will be restricted to the northwest side, but a reasonable measure of the mass balance of the

whole ice cap will be gained once every 3 years in the future.

The 1966-67 mass balance of the northwest side of the ice cap will be measured next May and June when the 1967 summer meteorological records have been collected and the instruments have started to record the 1968 weather. It is hoped to include a shortwave radiation recorder in a future program.

GLACIO-ISOSTATIC GEOMORPHOLOGY

The work undertaken during the 1967 field season was a direct continuation and extension of that pursued during the 2 previous seasons. The field work was carried out by W. Barr, assisted by W. Elcock. Attention was again focussed on the raised marine features of the coastal zones of northeast Devon Island, and the field area extended to Cape Parker on the east coast of the island.

Compared to previous years, much less attention was paid to high-level marine molluscs, as an aid to deciphering the glacio-isostatic history of the area. The possible dangers and sources of error resulting from the use of such molluscs for dating raised marine features by C-14 analysis are well known; that they apply just as much on Devon Island as elsewhere has been confirmed by anomalously old dates, and anomalous sequences of dates when related to altitude, for samples of shells already dated.

In lieu of shells, attention was focussed on other organic materials such as peat. Peat deposits occur fairly frequently in the Base Camp Lowlands at heights of up to 27 m., and reaching depths of up to 2.4 m. On the assumption that peat accumulation began reasonably soon after the postglacial isostatic emergence of the land, the basal peat layers should provide a fairly accurate minimum date for this emergence. On the basis of this assumption, a SIPRE ice-corer was used to extract cores from 4 peat bogs at elevations of 5.2, 10.3, 14.6, and 26.7 m. In all, 15 samples of basal peat were extracted from depths of up to 2.4 m. In many cases, the cores contained sizeable veins and lenses of pure ice.

From the peat deposit at 5.2 m., an entire core, 2.3 m. in length, was extracted for pollen analysis. It is hoped that this may throw some light on postglacial climatic fluctuations in northern Devon Island.

Another major line of attack in the Base Camp Lowlands, was the collection of samples of whalebone from as wide an altitudinal range as possible. Pieces of whalebone occur fairly commonly throughout the area of raised marine deposits. The remains are mostly those of the Greenland whale *(Balaena mysticetus* L.*)*, and the skull, being the most durable part, has survived most frequently; it is generally easily identifiable by the presence of the blowhole. The skulls are commonly embedded in the slopes or crests of raised-beach ridges, often being absolutely flush with the surface, and only identifiable from any distance by a slightly more luxuriant vegetation. In every case, the skulls are undoubtedly contemporaneous with the deposits in which they are embedded, and thus provide a true indication of contemporary sea level. Samples for C-14 dating were collected from 14 skulls at heights ranging up to 49.0 m. above sea level. Wherever possible, the samples collected were taken from the ear bones, which are composed of dense, solid, ivory-like bone, little susceptible to penetration by roots of vegetation, thus lessening the danger of contamination.

While, in general, marine molluscs were avoided for purposes of dating, samples were collected from 2 exposures that were of particular interest, and where stratigraphic relationships would suggest that the shells were still in situ where they lived and died. One of these exposures, at the mouth of the Gill River, west of Cape Newman-Smith, was described in some detail in last year's field report; in brief, this exposure would appear to indicate, from the nature of the deposits and their included fossils, a marine transgression, as sea level rose eustatically, as far as the marine limit (in this area at about 66 m.), followed by re-emergence, resulting from isostatic uplift. Three major stratigraphic layers can be distinguished, tentatively identified as littoral, deep water, and again littoral deposits, on the basis of their fossils and other characteristics. C-14 dating of material from all 3 layers should easily corroborate or refute the hypothesis.

The samples collected here and elsewhere throughout the field area represent a marine faunal assemblage quite limited in its number of species. Among the 14 samples collected primariy for C-14 analysis, only the following species were represented, in varying proportions at different sites: *Mya Truncata* (Linné), *Hiatella arctica* (Linné), *Serripes groenlandicus* (Bruguière), *Macoma calcarea* (Gmelin), and *Balanus balanus* (Linné).

Of particular interest in another exposure, produced by marine erosion to produce bluffs 11 m. in height, southeast of the eastern tip of Cape Hardy, is the occurrence of extensive deposits of seaweed. Beneath a thickness of 6 m. of marine sands, and at a height of 3.5 to 4.5 m. above sea level, are a series of interbedded layers of fine yellowish sand, and of seaweed, individual layers being up to 5 cm. in depth. Stems and fronds of the

seaweed are still clearly distinguishable; large samples were collected, since apart from being ideal material for C-14 dating, identification of the species may throw useful light on contemporary marine environmental conditions.

During investigations of the littoral in the neighbourhood of Cape Parker, on the east coast of Devon Island, a strong contrast was observed between the marine limit in this latter area, and that of the Base Camp area. While the upper marine limit in the Base Camp and Sparbo/Hardy Lowlands lies between 65 and 75 m., conspicuous raised marine features attain heights of only 4.5 to 6.0 m. in the vicinity of Cape Parker, gradually giving way to completely undisturbed felsenmeer by a height of 20 m. at the maximum. Thus, there is clear evidence of a west-east tilt in the isostatic recovery of Devon Island.

There is also evidence that eustatic sea-level rise is at present resulting in submergence of the east coast of Devon Island. Study of the aerial photographs of the ice-free areas, together with an aerial reconnaissance of the coast as far south as Philpotts Island, revealed extensive bar development, the bars running between the headlands, and backing up small lagoons. Investigation on the ground in the Cape Parker area showed the bars to consist of well-developed ridges up to 3 m. in height, composed of large rounded boulders, and resulting partly from wave action, and partly from ice push. Back of these ridges, the ground rises gradually in sandy, cobble-strewn raised beaches, characterized by a yellowish-brown colour resulting from surficial chemical weathering. This is in strong contrast to the fresh, grey appearance of the boulders of the storm-beach ridges, and the line between the two is invariably very sharply demarcated. Thus, there is every indication that these ridges are gradually moving inland as a result of sea-level rise.

PERIGLACIAL GEOMORPHOLOGY

The field research undertaken by Roger H. King, assisted by G. R. Douglas and A. Morton, during the summer of 1967 was a continuation of the research program initiated in the summer of 1966. The program consisted of a detailed study of the predominant geomorphological processes and resultant landscape features found in such an active periglacial environment as occurs on the north coast of Devon Island.

The study included a detailed examination of the periglacial phenomena that were considered to be significant within the area; a comprehensive study of slope morphology and rates of slope development together with the determination of the major factors of soil formation, and a study of the morphological expressions of these factors in terms of their spatial distribution and rates of development were also undertaken.

The field work was again largely carried out within the coastal lowlands adjacent to the Institute's Base Camp, but the area under investigation was extended to include the upper reaches of the Truelove River and the surface of the interior plateau as far east as the margins of the ice cap and the Sverdrup Glacier.

Field work started on 3 June with the installation of the base meteorological station. The meteorological program consisted of the standard synoptic observations of cloud, weather, visibility, pressure, precipitation, dry- and wet-bulb temperatures, and wind speed and direction. A continuous record of air temperature and relative humidity was provided by a hygrothermograph positioned in the Stevenson screen, and sunshine duration was measured by a modified set of Campbell-Stokes sunshine recorders. Observations were carried out at 0000, 0900, 1200, 1800, and 2100 hours LST (6 hours after GMT). Additional hourly observations were made during the local occurrence of warm, dry foehn winds.

In addition to the base meteorological program, micrometeorological studies were undertaken and to this end 3 stations were established in the field, and ground temperature measurements were obtained at the Base Camp. Each of the micrometeorological stations was established adjacent to a particular field experiment. These field experiments were concerned with the determination of the processes involved and the rate of development of slopes of different aspect and inclination. One station was established on the surface of the interior plateau, another was established in Truelove Valley, whereas the third was positioned in an area of local high relief in the coastal lowlands. Soil temperatures and a continuous record of air temperature and relative humidity were obtained for these sites during the field season and readings ended on 6 August. The synoptic observations at the Base Camp station, on the other hand, were continued until the evacuation of the remainder of the field parties by icebreaker.

The above micrometeorological stations facilitated a comparative study of the micro-environments of the coastal lowlands, the surface of the interior plateau, and Truelove Valley, and the results have further strengthened the belief in the occurrence of a distinct dichotomy in terms of geomorphological process and periglacial phenomena between each of the major terrain units.

As in the previous field season, the detailed surveys made were aimed at determining the exact nature and mode of occurrence of patterned ground in the area. Dimensional measurements were made of various types of patterned ground, and vertical sections were exposed prior to sampling. There appeared to be no direct correlation between the dimensions of sorted and nonsorted polygons, nets, and circles and the depth of the parent material. The role of solifluction and frost heaving in the formation of the various types of patterned ground were also examined. Wooden and metal stakes of differing length were inserted in solifluction lobes and in sorted and nonsorted stripes, nets, and polygons, and their positions periodically checked by theodolite.

Similar measurements were made of the stakes which had been placed the previous summer. The reduction of the data is at present under way, but preliminary results would appear to indicate significant changes in stake positions even over such a short period of time as a week. The differing lengths of the stakes provided a record of the velocity profile of movement in a vertical section of the soil or regolith. Annual movement in solifluction lobes was found to be considerable, with some stakes having been displaced downslope by as much as 24 cm.

Measurements of the positions of painted stones in lines were also made on the talus slopes of the sedimentary rock escarpment directly east of the base camp in an attempt to determine the annual rate of unsaturated creep. However, despite the overall instability of these slopes (as indicated by fabric analyses), little downslope movement could be discerned among the stones placed in position during the previous field season. On the other hand, impact scars were numerous and in places a considerable amount of fresh detritus had fallen onto these slopes from tors higher up. Rockfalls were very frequent on both the sedimentary and crystalline rock escarpments during the period of investigation, and it is hoped that some correlation can be made between the timing of the observed rockfalls and the incidence of insolation on these slopes.

The previous summer's investigation of slope morphology was expanded to include the north-facing crystalline rock escarpment of Truelove Valley, and a detailed study was made of the lateral moraines in this area with a view to obtaining an assessment of the amount of mechanical weathering and talus development since the deglaciation of the valley. Several talus cones and slopes were surveyed and records made of the size, angularity, lithology, and amount of the detritus.

As in the previous season, numerous levelling traverses were undertaken to determine slope morphology and to establish the height above datum (in this case, the datum point was mean sea level) of many of the rock benches to be found in Truelove Valley in order to ascertain their relationships to well-established marine features. The marine limit in the Base Camp Lowland was established at a height of 75.0 m., and this figure compares favourably with the heights determined by W. Barr in 1965 and 1966. Such a height for the marine limit means that a considerable portion of the Truelove Valley may well have been inundated by the sea some time since deglaciation. Furthermore, the rock benches observed in Truelove Valley were found to be at heights of 55.9 m., 61.0 m., 71.1 m., 86.7 m., 102.7 m., and 105.1 m. It is thus possible that several of these rock benches may have been modified by marine action rather than having had a wholly fluvial or periglacial origin.

The pedological studies were also continued and this year they were extended to include a larger area of the surface of the interior plateau where vegetation is extremely sparse and where so-called "Polar Desert soils" would appear to be dominant. Soil mapping was continued in the coastal lowlands, as well as in Truelove Valley, and was considerably aided by an aerial photographic survey undertaken by means of a helicopter generously provided by the Dominion Observatory. In addition, numerous inspection pits were dug for profile identification and several peat hummocks were cored with a SIPRE ice-corer in order to obtain peat samples for pollen analyses. By this means, it is hoped that a clearer picture of the postglacial climatic sequence in the area can be obtained and correlated with a denudation chronology.

ORNITHOLOGY

Ornithological field work was carried out in the vicinity of the Base Camp by D. J. T. Hussell and G. L. Holroyd from 10 June to 11 August, and was continued by Holroyd until 29 August.

The study of breeding Lapland longspurs *(Calcarius lapponicus)* was continued and was extended to include similar work on snow buntings *(Plectrophenax nivalis)* as time permitted. Thirty-one longspur nests and 22 bunting nests were found. The population of breeding longspurs in the study area was about 50 per cent larger than it had been in 1966, and mean clutch size was about 0.4 eggs larger.

Data on attentiveness during incubation were collected at 4 longspur nests and 2

bunting nests for varying periods of time by means of automatic recorders. The activity of adults feeding their young was similarly recorded at 4 longspur nests and 1 bunting nest. More than 40 samples of food brought to the nestlings were collected at 4 longspur and 5 bunting nests. Adult insects formed a substantial portion of the food brought to the young, and an attempt was made to assess day-to-day changes in the abundance of insects in order to determine whether changes in the available food supply might affect the ability of the adults to find sufficient food for the young. There was no indication of any lack of food, and growth rates of the young appeared to be normal, although the data were rather few because of the high rate of loss of nests due to predation. In only 4 of the 31 longspur nests were young raised to the stage of leaving the nest. The buntings were more successful, a proportion of the nests apparently being inaccessible to predators; young were raised successfully in 9 of the 22 nests.

Long-tailed jaegers *(Stercorarius longicaudus)* were much less abundant in the study area than they had been in 1966, and there was again no evidence of breeding. Parasitic jaegers *(S. parasiticus)* were present in small numbers and at least 2 pairs were breeding. Both species of jaeger may have been responsible for some predation on longspur and bunting nests, but there was evidence that arctic foxes *(Alopex lagopus)* were the principal predators. Lemmings *(Dicrostonyx groenlandicus)* were still scarce, although they were apparently more abundant than they had been during the previous summer.

Twenty-six species of birds were identified in the area this year; 19 were proved to be breeding, 6 of these representing new breeding records for the area.

BOTANY

Botanical investigations were continued by Paul E. Barrett, principally in the Base Camp Lowlands area, bordered on the north by Cape Skogn and on the south by Truelove Inlet and Valley. He was assisted by Christopher Walsh and other members of the expedition.

Thirty-five plant communities on varying hygrotopic and patterned ground features were analyzed. Methods of the Zurich-Montpellier school as modified by Krajina were employed. An extensive collection of bryophytes, lichens, and vascular plants was made, both on and off plots throughout the lowland area. Final identification should yield new information on the phytogeography of the Canadian arctic flora with relation to Devon Island. Synthesis tables of all plots completed will be constructed in an attempt to lay the foundations for a scheme of phytocoenotic classification to be expanded in the following seasons.

In addition to the classification of the principal phytocoenoses, it is hoped that associations may be correlated with varying environmental factors operating in the lowland area. Soil pits were dug at each community, analyzed, and approximately 125 soil and rock samples were brought back to the ecology laboratory at the University of British Columbia for physical and chemical analysis. These included soils from the arctic brown, bog, and wet tundra groups. One raised beach was excavated, and 56 soil samples were taken from 7 profiles in a series through the raised beach. Analysis will be made and correlations sought, with 3 distinctive community types occurring on the beach surface. Field observations in this area tend to support the work of Drury[2] on Bylot Island.

An excellent gradation of soil profile development was noted here corresponding to the amount of vegetation now present on the beach surface. In the case of raised beaches, this seems to be in turn governed by wind exposure or possibly by available water throughout the growing season. The latter, while not mentioned specifically by Drury,[2] is suspected, as numerous plants of *Salix arctica* showed premature chlorosis during the month of August, while the same species growing on more hydric habitats below the beach ridges showed little or no chlorosis. The fact that a number of the lower raised beaches tend to support communities of species-abundance similar to those found on the slopes of some of the higher beaches, also lends some support to this idea. Further investigations may help to clarify this point. I am indebted to David Larder, the expedition photographer, for work done at this site.

A number of metal permafrost probes were placed in various plant communities and similar communities with varying vegetational coverage. These were periodically checked throughout the summer so that rates and depth of thaw under differing vegetational regimes could be established. Preliminary observations indicate that the methods used are adequate for detecting major differences between certain plant-soil groups. This work will be expanded during the 1968 field season and results compared with those of other investigators.

A number of reconnaissance observations, collections, and photographs were made in habitats where detailed phytosociological analysis was postponed pending positive identification of this season's collection.

One extremely interesting habitat was the

late snow patch area found chiefly beneath north-facing rocky overhangs or slopes. These frequently showed extensive communities dominated almost completely by bryophytes. In some areas, it would appear that snow and ice were retained on these sites throughout the entire season, and in many cases outstanding accumulations of surface detritus were observed. The role that these factors play in these communities warrants further attention.

In addition, a limited number of foliar samples were collected, dried, and returned for analysis. These were collected chiefly from species found in a variety of community and soil types (*Salix arctica, Cassiope tetragona, Dryas integrifolia*). Analyses will be conducted to determine if relations occur between the principal exchangeable cations of the substrate and amounts of nutrient uptake on various sites.

Phenological observations were also started for the majority of vascular plants.

W. BARR
PAUL E. BARRETT
D. J. T. HUSSELL
ROGER H. KING
R. M. KOERNER

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[1]R. M. Koerner, 1966. Accumulation on the Devon Island ice cap, Northwest Territories, Canada. *Journal of Glaciology*, 6: 383-92.

[2]W. H. Drury, 1962. *Patterned ground and vegetation on southern Bylot Island, Northwest Territories, Canada.* Cambridge: Gray Herbarium of Harvard University, Contribution No. CXC. 111 pp.

The Icefield Ranges Research Project 1967

The Icefield Ranges Research Project conducted its seventh field program in the St. Elias Mountains between 15 May and 1 September 1967. Under the broad categories of Earth Sciences and Biological Sciences, studies in 18 disciplines were conducted by more than 38 investigators and their assistants. This figure does not include personnel of the supporting Kluane Lake Activity of the Arctic Institute of North America, nor does it include 8 visiting investigators who took the opportunity to conduct short-term studies or to observe field programs in operation.

Noteworthy in 1967 was the absence of a research program in meteorology and climatology. Weather data however, were collected at 4 stations on a 24-hour basis with the objective of extending the sequence of standard observations at Kluane and at Divide Station to 7 field seasons, and of providing synoptic data as a service to investigators in the field and to the Forecast Office of the Department of Transport at Whitehorse. The last-mentioned, in return, provided 12-hour forecasts for the benefit of 10 satellite field stations. The 4 weather stations cited were manned by undergraduate students who received an indoctrination in weather station procedure, field observation, and data collection from the DOT Forecast Office in Whitehorse. Since the meteorological program was of a service nature, details concerning it are presumed to fall within the purview of the Kluane Lake Activity.

As in the past, scientific teams were comprised of senior investigators and their assistants, graduate students working towards advanced degrees, and undergraduates assigned to assist field parties. For the fourth year, under a National Science Foundation Research Participation for College Teachers Grant, 6 college teachers took part in IRRP, either as assistants within one or more active programs or as principal investigators in programs which they had themselves initiated.

EARTH SCIENCES

An intensive study of the internal and external environment of the "Fox" Glacier was begun, in anticipation of the surging of this small ice body in the foreseeable future. Studies leading to an understanding of the mass balance were initiated, and included accumulation, ablation, surface motion, and water discharge. Three-dimensional studies included seismic and gravity profiles and a hot-point drilling program. Conventional and ground stereophotogrammetrical surveying and mapping techniques were applied to the entire glacier surface and to periglacial features. A reconnaissance of the moraine sequences of the "Fox" Valley opened fruitful opportunities for future study. In all, a good beginning was made and it provides an excellent springboard for investigations in 1968 and in later years.

The Steele Glacier continues its advance, though at a rate approximately 50 per cent of that observed in 1966. Ground triangulation in 1967 established a network of control which spanned both the Steele and "Fox" glacier systems and is tied into a formal survey conducted in July by the Canadian Government.

Continuing a program of photo chronology of the Steele Glacier begun in 1935, 15 stations were occupied in 1967 (5 of them more than once) and photo panoramas were exposed.

High oblique aerial coverage of the Steele Glacier, and of the "Fox," was executed on several occasions during the field season by