

- <sup>2</sup>Cade, T. J. 1960. Ecology of the peregrine and gyrfalcon populations in Alaska. *University of California Publications in Zoology*, 63: 151-290.
- <sup>3</sup>Hickey, J. J. (Ed.) 1969. *Peregrine Falcon Populations; Their Biology and Decline*. Madison: University of Wisconsin Press. 596 pp.
- <sup>4</sup>Anderson, J. H. and D. D. Berger. 1968. Chlorinated hydrocarbon residues in peregrines and their prey species from Northern Canada. *Condor*, 70(2): 149-53.
- <sup>5</sup>Cade, T. J., C. M. White and J. R. Haugh. 1968. Peregrines and pesticides in Alaska. *Condor*, 70(2): 170-78.
- <sup>6</sup>Cade, T. J., J. L. Lincer, C. M. White, D. G. Roseneau and L. G. Swartz. 1971. DDE residues and eggshell changes in Alaska falcons and hawks. *Science*, 172: 955-57.
- <sup>7</sup>Cade, T. J. and R. Fyfe. 1970. The North American peregrine survey, 1970. *Canadian Field-Naturalist*, 84(3): 231-45.
- <sup>8</sup>White, C. M. and T. J. Cade. 1971. Cliff-nesting raptors and ravens along the Colville River in Arctic Alaska. *The Living Bird*, 10: 107-50.
- <sup>9</sup>Berger, D. D., D. W. Anderson, J. D. Weaver and R. W. Risebrough. 1970. Shell thinning in eggs of *Ungava* peregrines. *Canadian Field-Naturalist*, 84(3): 265-67.
- <sup>10</sup>Anderson, D. W. and J. J. Hickey. 1972. Eggshell changes in certain North American birds. *Proceedings of the XVth International Ornithological Congress, The Hague, 1970*. pp. 514-40.
- <sup>11</sup>Hickey, J. J. and D. W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. *Science*, 162: 271-73.
- <sup>12</sup>Bowes, G. W. and C. J. Jonkel. 1972. Polychlorinated biphenyls (PCB): Identification in marine arctic and sub-arctic food chains. Presented at the 164th National Meeting, American Chemical Society, August 27 to September 1, 1972, New York.
- <sup>13</sup>Lincer, J. L., T. J. Cade and J. M. Devine. 1970. Organochlorine residues in Alaskan peregrine falcons (*Falco peregrinus* Tunstall), Rough-legged Hawks (*Buteo lagopus* Pontoppidan) and their prey. *Canadian Field-Naturalist*, 84(3): 255-63.
- <sup>14</sup>Walker, W. E., R. W. Risebrough, J. T. Mendola and G. W. Bowes. In press. South American studies of the peregrine, an indicator species for persistent pollutants. *Antarctic Journal of the United States*.

## The Icefield Ranges Research Project, 1972

The Icefield Ranges Research Project (IRRP) base camp (61°N., 138°30'W.) opened its doors on 3 June. (For map of the area see paper on long-tailed jaegers, p. 000). Four programs, supported in whole or in part by the project, were in the field before the official opening of Kluane base camp, and two research teams remained in the field through early September. From 3 June until 29 August base camp was in full operation. A total of 86 persons representing 23 colleges, universities, and institutions (12 Canadian; 11 U.S.) made use of IRRP facilities during that time. One student from the United States and 6 Canadian students were involved in field work leading to postgraduate degrees: 4 toward an M.Sc. and 3 toward a Ph.D. Peak occupancy was in the last two weeks of July and the first week of August when over 50 people were at Kluane and the 15 long- and short-term field camps.

The February 1972 announcement of a Kluane National Park has generated interest in a number of multi-year programs concerned with resource inventory and planning processes.

In July and August representatives from the National and Historic Parks Branch, Ottawa, visited Kluane and a number of informal and interesting discussions relating to the park took place. In addition, they worked with a team from KEG Productions Ltd., Toronto, to produce a TV documentary about Kluane National Park.

Under the auspices of the Arctic Institute's Visiting Scientists program two professors from the Departments of Geography at the University of Glasgow, Scotland, and Western Michigan University, Kalamazoo, took part in IRRP during the last week in July and first week in August. Students benefited from having these senior researchers accompany them in the field and from their being available for consultation. A highlight of their visit was a round-table discussion of the past, present, and future research programs of IRRP.

Air support for IRRP, including support for the television team and climbing expeditions, was provided by the Arctic Institute's supercharged, ski-wheel-equipped Helio Courier; by a Canadian Forces DeHavilland Buffalo; and by a chartered Bell Ranger helicopter. A total of approximately 215 hours were flown in support of all programs in 1972.

The twenty-foot long, wide-beam life boat was in greater demand this past summer than

in any summer since 1968. It was used by separate programs in physical limnology and geomorphology, geology, and archaeology.

#### GLACIER STUDIES

##### *Geophysical Measurements — Trapridge and Rusty glaciers*

A team from the University of British Columbia continued geophysical studies on Trapridge and Rusty glaciers and began studies of Steele Glacier. Radio echo soundings, thermal drilling, englacial temperatures and glacier flow measurements were carried out on Trapridge Glacier. From soundings taken at 28 sites a maximum depth of 130 m. was recorded. Twenty-four soundings were taken of the Rusty Glacier and the results indicate that the glacier is thicker than the depths interpreted from a gravity survey in 1968<sup>1</sup>.

Thermal drilling was performed at 7 sites on Trapridge Glacier and the measured temperature profiles were similar in character to those obtained from Rusty Glacier<sup>2</sup> during 1969 to 1971. Both glaciers at the present time are in a quiescent state, but a surge of the Trapridge in the near future seems probable. From data recorded since 1967, a theoretical model of the thermal instability mechanism which gives realistic results and fits observations reasonably well has been developed<sup>3</sup>.

##### *Thermal Drilling — Steele Glacier*

Thermal drilling on Steele Glacier at a site between Hazard Lake and the Hodgson confluence was started near the end of the field season. Although the bed of the glacier was not reached, a hole was drilled to a depth of 115 m. and plans are to return in 1973. Owing to time limitations equilibrium temperatures were not measured; yet the non-equilibrium temperature at 115 m. was  $-6.5^{\circ}\text{C}$ .

##### *Tapridge Glacier — Survey*

Twenty-three of the 26 marker poles placed in the Tapridge Glacier in 1970 were resurveyed in 1972; 3 had disappeared. Five markers were added to the array wherever they were necessary; so, in all, 28 markers were located three-dimensionally with an estimated accuracy of  $\pm 0.3$  m.

The 65-marker array on the Rusty Glacier originally placed in 1967 and 1968 and resurveyed each year through 1971 was not surveyed in 1972. A resurvey of the array every two years will serve to monitor the state of the glacier until such time as its activity increases. It is planned to resurvey in 1973.

##### *Glacier Inventory*

Early in 1972 funds were awarded AINA/IRRP by the Glaciology Division, Department of the Environment, Ottawa, to begin an inventory of Canadian glaciers in the St. Elias Mountains. By the end of March a pilot study had been completed of the glaciers in the Steele Creek drainage basin, and in late April studies were started of the glacier basins in the Donjek River Hydrologic Basin.

During the field season, conclusions drawn from studies of aerial photographs of the Steele Creek basin were checked by direct examination of specific glacier areas from the air. Only insignificant differences were noted between conclusions drawn from direct observation and those made after stereoscopic examination of good aerial photographs.

The inventory will continue throughout March 1973.

##### *Kaskawulsh Glacier*

Investigations were concentrated on the 2-mile wide northwest lobe of the terminus of the glacier. The objectives of this long-term program are to determine what ice motion exists in the terminal zone, to measure ablation rates, and to observe the evolution of ice-cored ablation drift topography and the mass movement of drift material. Poles were positioned in different topographical locations so that there would be variation of slope angle, aspect, and drift cover. Their positions were surveyed and the height above the ice surface of the tops of each pole was recorded in order to measure daily ablation and so that daily and annual rates could be computed. In addition, a number of fragments of drift were painted and distance to the marker poles measured for future determination of mass movement of ablation debris.

#### GLACIAL GEOLOGY, GEOMORPHOLOGY AND HYDROLOGY

##### *Donjek Glacier — Ice-cored Moraines*

Data on the slope form and slope processes on ice-cored moraine features as a response to microclimate input are at present undergoing analysis. Initial analysis indicates that the thermal regimes in the till on different parts of the moraine are controlled by the local wind which is dominantly a shallow katabatic wind off the Donjek Glacier. Variations in the solar radiation input alone cannot account for the variation in process and the rate of individual processes across the moraine. Exposure of the ice core when the glacier ploughed forward into the moraine in 1969 provides a control on the

faster rate of erosion which could be expected to occur on the feature.

*Donjek and Kaskawulsh Glacier Termini — Load Distribution Variation and Source*

Glacier load varies in mineralogical composition and size of material between crevasse zones, shear zones, lateral areas, and englacially. This indicates different areas of pick up and incorporation of material into the glacier ice. Basal load of the Kaskawulsh Glacier derived from the upper part of the catchment shows little contamination by material from the lower part of the catchment area; englacial materials are materials primarily derived from the lower parts of that area. Shear zones occur on both glaciers but are different in character. On the Kaskawulsh Glacier they are well spaced back to one mile from the terminus, but on the Donjek Glacier they are closely spaced and confined to the terminal 100 yards of the glacier. The material in both glacier shear zones appears to be basal load.

*Slims River Valley — Loess Transport*

Investigations into the mechanics and amount of loess transport in and out of the Slims River valley continued as well as those aimed at findings relating to surface soil moisture and temperature conditions, surface salt concentrations, surface configuration and wind velocity in the delta area.

Studies concentrated primarily on sampling and determining dust concentrations in the atmosphere up to 15 metres under varying soil moisture conditions and wind velocities. But too frequent rain and early flooding of the river valley resulted in infrequent dust storms, and not all the sample runs planned for could be made. Standard meteorological observations plus detailed wind profiles were taken in the valley from 17 June to 6 August. During that period two 24-hour and one 48-hour meteorological run which called for readings at one-half hour intervals were completed. Undisturbed surface soil samples were collected at the 100 metre grid intersections of a 1,500 metre by 800 metre plot surveyed in on the delta.

*Donjek Valley — Spring Creek Alluvial Fan*

Research was in the disciplines of fluvial sedimentology, fluvial hydrolics, hydrology, and Pleistocene geology. All aspects of the project were investigated in varying degree from late May through July. The Spring Creek fan's braided system was studied in detail for facies and bedform distribution, indices of transport, vectorial properties on all scales, and the changes in character of braiding with the passage of seasonal peak

discharge. At the fan head continuous stream gauging and current metering was undertaken in order to study hydrolic geometry in the field. The interaction of the tributary fan and trunk valley drainage, involving a lateral constriction of the latter, is also under consideration.

*Ruby Range — Mass Wasting Program*

At a site in the Ruby Range about 50 km. north of Kluane base camp a long-term mass wasting study on solifluction lobes, first initiated in 1967 and 1968<sup>4</sup>, was resumed in August 1972. Results for the 5-year period (1967 to 1972) indicate that surface movement on these solifluction slopes is on the order of 1 to 3 cm. yr.<sup>-1</sup>, and under certain conditions subsurface movement may exceed surface movement. This is particularly true on slopes having well-developed vegetation and dense organic turf surface.

In order to determine past rates of mass wasting, several solifluction lobes were excavated back upslope a distance of 15 m. during the 3 field seasons, and samples taken for radio-carbon dating. Dates on 15 samples have been received and 10 samples are currently being processed. It is hoped that the information will aid in reconstructing and interpreting the manner and rates of past lobe movement as well as providing an indication of past environmental conditions in the area.

In support of the mass wasting program, micro-climatic measurements were taken of solar radiation, surface albedo, surface radiant temperature, soil temperature and air temperature. The measurements were made for various topographic settings. These and other variables will be used in the construction and testing of a numerical simulation model of solifluction. In addition, the radiation measurements will be used to test the development of solar radiation climatology maps of the Ruby Range. The maps will include the effect of topographic aspect and slope which has great influence on the solar radiation receipt in as complex a setting as the Ruby Range. It is hoped that these maps will be of service to both the geomorphologists and the plant ecologists who may work in this area.

KLUANE LAKE STUDIES

*Raised Beaches; Drowned Forest*

Investigations involved examining, measuring, and cataloguing all beaches around the 230 km. shoreline. Though sometimes difficult to recognize, remnants of beaches are virtually found all around the lake except in

areas of steep topography that are rock-defended. Brooks and Talbot arms in particular have few preserved beaches. However, at the entrance to the arms there appear to be remnant spits at the  $\pm 3$  m. and  $\pm 13$  m. levels<sup>5,6</sup>.

The region of the present outlet in the northwest corner of the lake was examined quite extensively and yielded a possible explanation for the  $\pm 3$  m. raised-beach level. Additional fathometer soundings were recorded across the shallow north end of the lake which now is an extensive drowned forest defining what is believed to be a large area of coalesced alluvial fans of the Duke River. Finally, a number of transects were made in the Brooks and Talbot arms, and this work in conjunction with soundings taken in the northern end of the lake during 1969 to 1971 and the soundings at the south end has permitted the preliminary draft of a "lowest" lake level map.

#### *Drainage of Glacial Lake Kloo — a Reconnaissance*

Interest in the history of Christmas Creek which now occupies a misfit valley entering the southeast corner of Kluane Lake led to a survey of the present Kloo Lake area to learn if at some time a larger lake drained northward into Kluane. A reconnaissance was made of the basin now occupied by Sulphur Lake (elevation c. 825 m.) and Kloo Lake (elevation c. 860 m.). At the present time this area is drained by the Jarvis River, a tributary of the Alsek River basin which drains into the Gulf of Alaska. The two most apparent divides separating the Kloo and Kluane lake basins are at approximately 915 m. and are flat and wide. Three old beaches were identified near the 3,000-foot contour (c. 915 m.). Samples of the material were collected for analysis, and further studies are planned.

#### *Zooplankton Studies*

In late August a preliminary survey was made of planktonic organisms and the water chemistry and temperature with depth of Kluane Lake. Shallow and deep portions of upper and lower areas of the lake were sampled to learn differences in zooplankton and net phytoplankton species and the composition and relative differences in biomass in the aquatic ecosystem of this lake type. This investigation was undertaken as part of a larger survey of lakes and ponds in southern Yukon in cooperation with the Department of Fisheries and Forestry, and is an extension of studies in progress in northern Alberta.

#### BIOLOGY AND ENVIRONMENTAL STUDIES

##### *Studies of *Boschniakia rossica**

The program was conducted near the south margin of the Slims River delta. Various physical and biotic factors of the study area were recorded such as soil and atmospheric conditions and characteristics, the plants present, and animals observed. Plants were mapped in a 12 sq.m. plot, and growth of several selected plants was measured every 5 days to calculate growth rate. Symbiosis was investigated by using various methods of separating the parasitic plant from its host and periodically observing results. Sketches were drawn to show macroscopic details of the structure of the root, leaves, stem, flower, and fruit. The number of fruit on many adult plants of various height were counted and seed production figures calculated. Finally, several of these non-green plants were selected to be covered by ventilated boxes with coloured glass windows — green, blue, red, and white. Observations were made relating light dependency of the plants.

##### *Plant Succession on three Kaskawulsh Glacier Terminal Moraines*

A study was undertaken in the hope of correlating selected edaphologic parameters with bryophytic community development. On-site inspection, however, revealed a paucity of Bryophyta and emphasis was shifted to conspicuous vascular plant communities of the three moraines.

Vascular plant succession was specifically examined on the moraines while observation and collection of bryophytes were extended to include the Slims River valley and the ice of the Kaskawulsh Glacier. Specimens of tracheophytes and bryophytes were collected for later identification, and soil samples were taken from selected sites on each moraine for analysis. Numerous moss polsters or "glacier-mice" were observed on the ice and samples were obtained for identification of constituent Musci.

##### *Canid Predator — Prey Relationships in Kluane National Park*

A field study was started in 1972 to investigate the significance of relationships between the canids (wolves, foxes and coyotes) and their important food species. No previous work had been done on canids in the region; therefore, reconnaissance was made of the major river valleys and lake basins in the Kluane Game Sanctuary and National Park. Trips into the bush were made varying in length from 1 to 8 days over distances of up to 50 km. from the Haines and Alaska highways. One occupied wolf den was discovered

and observations and descriptions noted on 4 pups and 2 adults, with perhaps a third adult present. One single wolf was seen but in a different location. Nearly 1,800 scats were collected. Of these about 600 are from the area around the active wolf den and 300 are from one of three active fox dens. Coyotes proved difficult to locate and observe. Only one animal was seen during the summer.

#### *Ecological Studies — Kluane National Park*

Under the joint auspices of the Canadian Wildlife Service and AINA, investigations involved the preparation of an annotated list of small mammals in the park; assessing the occurrence of fire, its significance to the functioning of Kluane's forest biomes, and recommending a fire management policy for the park — not necessarily a strict control; mapping all evidence and effects of man (i.e. trails, cabins, camp and mine sites, etc.); and providing data on large mammal and bird resources. Most significant is the extent to which the forests have burned in the southern parts of Kluane National Park. Spruce stands are rare where fire has not occurred for 150 years.

#### ARCHAEOLOGY

##### *Ethnohistoric Archaeology — Tatshenshini River Basin*

Research concerned reconstruction of the various Indian groups, their cultures, territorial distributions, and trade relationships. Special focus was directed on the interrelationships of the interior Indians and the coastal Tlingit.

Fieldwork was divided into 3 parts: 1) the region between Dalton Post/Nesketahin and Debris Creek on the Tatshenshini River was investigated by horseback; 2) the abandoned sites of Nesketahin and Dalton Post were investigated with primary concern and Klukshu village with somewhat less; these sites were photographed and mapped, and four test excavations were conducted at Nesketahin; 3) extensive archival research was accomplished in the Public Library and McBride Museum, Whitehorse, where important information from old documents and books were found and some photographs obtained. Time also was spent on archival research at the National Archives of Canada, Ottawa.

##### *Kluane Lake — Long Point Site*

On the return trip by boat from a visit in late August to the archaeological sites at the mouth of Gladstone Creek and Talbot Arm, weather forced the team to put in behind

Long Point where they spent the next four days waiting for the lake to calm down enough for them to return to Kluane base camp. Short excursions were taken along the shore and somewhat inland, and on one of these an early archaeological site was discovered on the exposed bottom of a "fossil" pond. The site was investigated in a reconnaissance manner and a number of projectile points and other bifaces were found. The importance of the find has yet to be determined. Plans are to revisit the site in 1973.

#### HIGH ALTITUDE PHYSIOLOGY STUDIES (HAPS)

The decision not to return to the field in 1972 was made, however reluctantly, at the end of the 1971 summer season. It was felt by all concerned with HAPS that data accumulated from past seasons needed to be further inspected and analysed, assimilated, recorded, and reported. In short an interlude was required. It had been decided also that Divide Camp (elevation c. 2,630 m.) should be moved to a new site at a higher elevation to serve as a staging camp for physicians and subjects in 1973. In July, therefore, a team of 6 persons, three of whom were veterans of the HAPS program, were flown to a location north-northwest of the old Divide Camp. Eclipse Camp, as it became known, was situated at an elevation of about 3,100 m. below the southeast flank of Mount Badham and with a clear view of Mount Logan 45 kilometres to the southwest. Soon after establishing Eclipse Camp, the cache at divide was moved by Helio Courier the 15 kilometres separating the two camps to be used during the summer and succeeding years.

#### MOUNTAINEERING EQUIPMENT EVALUATION PROGRAM

Tests and evaluations were made for the U.S. Army Natick Laboratories of certain selected mountaineering equipment considered to be the best available on the commercial market today. The equipment was tested under varying climatic conditions and extremes in the low elevation (c. 850 m.) forested region near Kluane Lake, in the medium elevation (c. 3,100 m.) alpine environment of the Icefield Ranges, and in the severe high elevation (up to c. 6,050 m.) polar environment of Mount Logan, Canada's highest mountain.

The tests were mostly carried out during July 1972, although use was made of extensive experience from previous years. Equipment was tested and evaluated in the process of glacier exploration and high mountain climbing of varying degrees of technical difficulty.

## METEOROLOGY

A minimum meteorology program was carried out at Kluane base camp, and for most of the month of July at Eclipse camp. Standard synoptic observations were taken at 3-hour intervals from 0700 to 2200 hours. Twice daily compilations were transmitted to the Forecast Office in Whitehorse via telephone to the radio range station at Burwash Landing. Both base camp weather observers were given a brief familiarization course on weather observing and reporting by the staff at the Weather Office in Whitehorse. This opportunity was initiated in 1965 by the Chief Forecaster and is welcomed each year by the students who man the observing stations in the Icefield Ranges. Regular weather observations have been taken and records are on file for every IRRP field season for 10 consecutive years.

*Richard H. Ragle*  
Arctic Institute of North America

## REFERENCES

- <sup>1</sup>Crossley, D. J. and G. K. C. Clarke. 1970. Gravity measurements on "Fox Glacier", Yukon Territory, Canada. *Journal of Glaciology*, 9(57): 363-74.
- <sup>2</sup>Classen, D. F. and G. K. C. Clarke. 1972. Thermal drilling and ice-temperature measurements in the Rusty Glacier. In: *Icefield Ranges Research Project Scientific Results*, 3: 103-16.
- <sup>3</sup>Hoffmann, J. W. and G. K. C. Clarke. In press. Periodic temperature instabilities in subpolar glaciers. IUGG/IASH publ. Symposium on the role of snow and ice in hydrology, Banff, 6-20th Sept. 1972. Sponsored by the Canadian National Committee for IHD.
- <sup>4</sup>Price, L. W. 1970. Morphology and ecology of solifluction lobe development — Ruby Range, Yukon Territory. Ph.D. dissertation, University of Illinois, Urbana. 325 pp.
- <sup>5</sup>Bostock, H. S. 1969. Kluane Lake, Yukon Territory, its drainage and allied problems. *Geological Survey of Canada*, Paper 69-28. 19 pp.
- <sup>6</sup>Ragle, R. H. and C. S. Houston. 1972. The Icefield Ranges Research Project, 1971. *Arctic*, 1(25): 60-64.