On the slightly steeper, upper slopes of the Etsho Escarpment which has maximum insolation, the permafrost was thin and discontinuous. It should be noted that there is a vertical exaggeration of 1:250 in Fig. 1. Behind the crest of the Etsho Escarpment the permafrost was about 20 inches (51 cm) thick. A bench at a lower elevation on the northeast-facing slope of the Etsho Escarpment was very wet because of water draining off higher slopes and, presumably, because of northeasterly-dipping shales forming an impermeable layer which guides ground water to springs along the bench. The permafrost in the substrate below the bench was thinner (about 8 inches, or 20 cm) and penetrable with a probe. The thermal conductivity of the water-saturated ground was much greater than that of other ground, and the continuously icy substrate changed into scattered ice crystals through which it was possible to probe. Northeast of Sahdoanah River, on lower land, the permafrost in organic terrain thickened rapidly to about 40 inches (102 cm), and 60 inches (152 cm) within the Northwest Territories. The permafrost occurred in so-called peat plateaus, an extensive Land System further north[3].

CONCLUSIONS

The thickness and hardness of permafrost in northeastern British Columbia decrease with decreasing latitude toward the southwest, with increased insolation on southwest-facing slopes, and with greater thermal conductivity of surficial layers caused by increased wetness.

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Relationships between Temperature and Snowfall in Interior Alaska

At the present time there is some uncertainty as to the role of winter and mean annual temperatures in initiating continental glaciation[1]. Although there is no question that cool summers and snowy winters favour glaciation in high latitudes, the possibility must be considered that excessively snowy winters may be warm enough to raise the mean annual temperature. Thus a higher annual mean temperature could be favourable for glaciation. I wish here to present some observations on the relationship between temperatures and snowfall at one Subarctic station (Fairbanks, Alaska).

Temperature anomalies and snowfall were plotted against each other for three separate groups of data. Initially, seasonal mean temperatures (November through February) were plotted against total July-June snowfall for the period 1914-15 through 1973-74. Monthly mean temperature was also plotted against the monthly snowfall total for each of the months November through February over the same period. Finally, six of the snowiest recent months (November and December 1965, February 1966, January 1968 and November and December 1970) were examined for day-to-day relationships between snowfall and temperature.

The daily data showed a definite tendency for snowy days to be above average in temperature, as was anticipated. On a monthly basis, however, Fig. 1 shows that snowy months, except January, had nearly normal temperatures, with months which were unusually warm or cold (as well as some months with normal temperatures) being generally dry. January, the coldest month, did manifest some tendency for snowy months to be warm. (Note that the transitional months, September, October, April and May are not included in this conclusion.) Seasonal figures showed an even more striking reversal, with excessively snowy winters being most often colder than normal. Fig. 2 shows this seasonal relationship. If the data are split into terciles for both total seasonal snowfall and November-February mean temperature, as shown by the lines on the figures, the sixty winters included twelve each cold/snowy and warm/dry, eleven normal for both temperature and precipitation, six each cold/normal and normal/dry, five warm/snowy, three each normal/snowy and warm/normal and two cold/dry. (Three of the five warm/snowy winters were snowy because of excessive

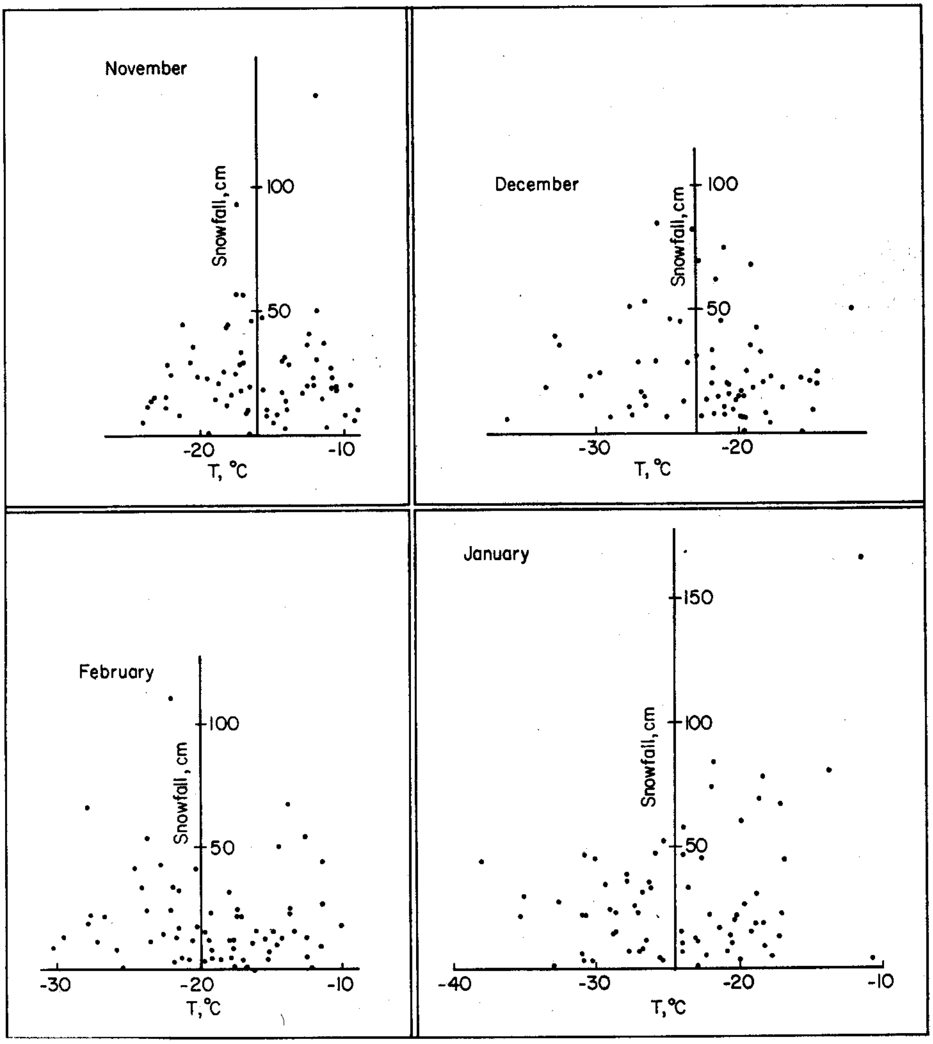

FIG. 1. Monthly mean temperature plotted against snowfall for the four coldest months of the year at Fairbanks, 1917-1976. Note lack of correlation except in January. Vertical axis is on the record mean temperature for each month.

March or April snowfall.) The location at which records were taken did change several times in the 60 years, but shorter uniform sections show the same trend.

Normal monthly snowfall for Fairbanks in winter is around 20 cm. All months since 1904 with snowfall greater than 50 cm were identified, and the temperature differences from the 1930-70 mean monthly temperatures for the preceding, following, and snowy, months were examined. Snowy Octobers, Novembers and Decembers were found to be followed by exceptionally cold months in 13 cases out of 17; by exceptionally snowy months (137, 85 and 47 cm) terminating with low temperatures the first non-snowy month in three cases, and in only one case (December 1914) by a warm, dry month. This was also the warmest December on record, and was the least snowy of the 17 months (51 cm). From January on, no correlation between snowfall and temperature was noted in 20 months of data. In rechecking the original five warm/snowy winters, it was found that all had heavy snow after 1 January.

Examination of monthly mean 700-milli-

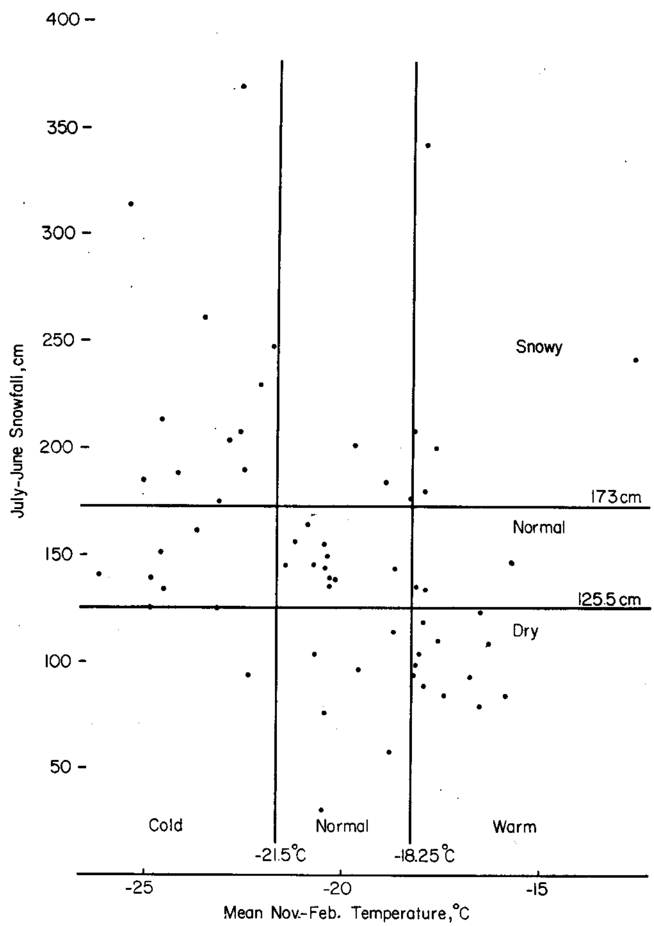

FIG. 2. Mean temperature for the four coldest months of the year plotted against seasonal snowfall totals, 1906-07 to 1975-76. Even though the individual months showed little or no correlation, the seasonal data show a clear tendency for cold winters to have normal or above-normal snowfall, while warm winters are most often normal to dry.

bar maps for the period since 1948 suggests that months with heavy snowfall in Fairbanks are those with zonal (westerly) flow over Alaska, and that this zonal flow, if it occurs early in the winter, has a strong tendency to evolve into meridional types with northerly flow over Alaska. The result is that excessive early-winter snowfall tends to be followed by periods of excessively cold weather.

The phenomenon described above occurs in an unglaciated area, and is probably due in large part to the existence of the Alaska and Coast Ranges to the south, which tend to limit snowfall to westerly situations. Nevertheless, it suggests the importance of checking seasonal correlations for an area, and not merely daily or monthly correlations, before making statements as to whether winter seasonal temperatures required to initiate glaciation are likely to be above or below those currently observed.

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