IV. 2. GROUND TEMPERATURE MEASUREMENTS IN THE SCHEFFERVILLE AREA, P.Q.*

Lennart Annersten

(Summary)

The aim of this paper is to describe the permafrost investigations carried out in the Schefferville area, P.Q., and to report some preliminary results.

During the summers of 1956 and 1957, the first permafrost investigations in the area were initiated by the Iron Ore Company of Canada. Permafrost was found to vary from 12 to 60 metres (40 to 200 feet) in thickness; these variations were to some degree related to vegetation and exposure.

To evaluate such environmental factors as snow cover, vegetation, exposure, etc., 8 thermocouple cables were installed at various sites within a limited area in the summer of 1959. This research programme was made possible by the co-operation of the Iron Ore Company of Canada, the National Research Council, and the McGill Sub-arctic Research Laboratory in Schefferville. This programme, was again extended in 1961 when 6 new thermocouple cables were installed. A total of 360 metres (1185 feet) of drilling was done and thermocouple cables installed in the holes to depths varying from 15 to 60 metres (50 to 200 feet). Readings on these have been taken almost monthly.

Because of errors inherent in the measuring equipment, the readings from the thermocouples showed variations that cannot be regarded as true temperature variations. A significant test of the readings since 1959 below the 15 metre (50 feet) depth, where no seasonal temperature variations can be detected in the readings, indicate that ground temperatures over the period September 1961 - January 1962 were 0.2°C warmer than previous readings. Climatological data, however, indicate that there should have been a cooling trend in the ground temperatures, so that this warming was more likely caused by stripping of the vegetation around the installation. This has apparently changed the thermal regime of the surface, the net effect being an increase in ground temperature.

The plotting of mean annual soil temperatures, calculated for various depths and sites, produced two types of curves. The first

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* A complete report of this study will be published by the Department of Geography, McGill University.

type indicated a general temperature increase with depth due to the influence of the geothermal gradient. The second type indicated a general temperature decrease with depth. It is suggested that this is caused by lateral heat flow in areas with different surface thermal regimes caused mainly by variations in snow cover between exposed and more protected areas.

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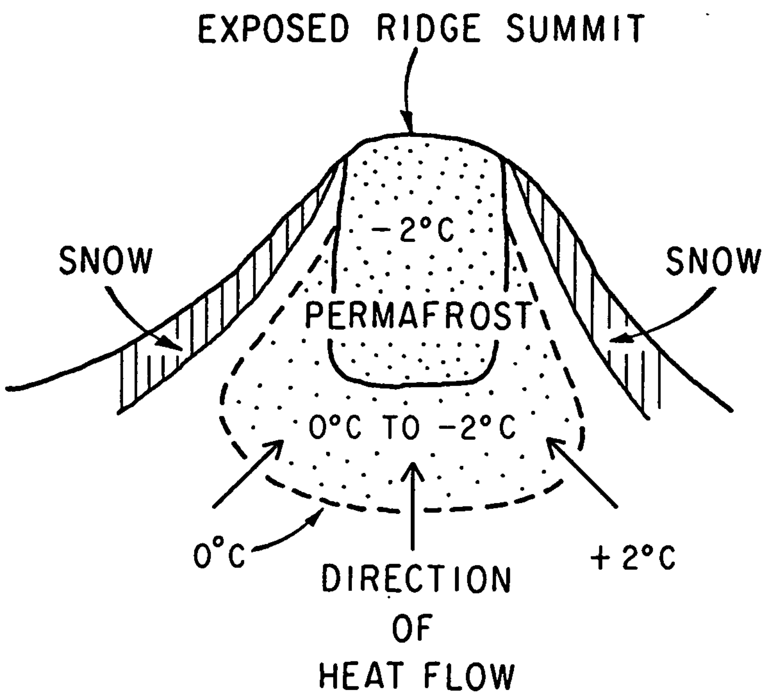
Discussion

J. R. Mackay asked how often readings were taken that were used in the statistical analysis of the ground temperature regime. He added that the larger the number of readings, the more significant they are statistically. The author replied that monthly readings were used in the analysis.

N. W. Radforth observed that if there is vegetation (mosses and lichens) even only a few inches thick over the area in question, then it follows that its removal would cause a subsequent increase in the mean ground temperature. In addition, if the type of vegetation changed, then the influence would change. This would afford a means of testing whether the removal of vegetation is responsible for the increase of ground temperatures during 1960-61 over 1959, whereas climatological data suggests that the reverse result in the ground temperature regime might have been expected.

R. Yong wished to know the boundary conditions assumed for heat transfer in the ground. The author replied by presenting the following illustration:-



J. D. Ives commented on the apparent increase of temperature at the 15 metre depth during the period 1959-60 and 1961-62. The stripping of the lichen mat, attendant upon drilling operations at the sites of thermocouple installations has probably had an important effect upon the ground temperature regime. At the 15 centimetre depth, a temperature difference of 11°C in 40 days accrued between an undisturbed site with a 10 centimetre thick lichen mat and a stripped site adjacent to it. This effect should result in accelerated heat flow into the ground in the summer. In winter, however, the reverse process is not necessarily operative because the variation in snow depth, rather than in vegetative cover, appears to be the dominant factor in local differences in the thermal gradient of the upper 6 metres. L. W. Gold added that if the vegetation cover is removed, then the thermal resistance to heat flow is reduced. This will result probably in an increase in amplitude of the thermal disturbance but will not necessarily change the mean ground temperature. The net effect of removing the vegetation may be a greater increase in summer ground temperatures than in winter ground temperatures because of the snow cover. C. B. Crawford remarked that the Division of Building Research has found that there is generally a good correlation between degree days and depth of frost penetration. At Schefferville, however, it was found that the depth of frost penetration was considerably deeper than the above relationship would indicate. A 50 foot thermocouple string was installed in this area near a shaft which was filled with ice. The temperatures of the thermocouples never dropped below 33°F.