A NOTE ON ROCKFALLS AND NORTH FACES IN THE LAKE LOUISE AREA.

JAMES GARDNER, *University of Iowa*

Rockfalls are a well-recognized hazard to mountaineering in the Canadian Rocky Mountains. Data collected during the summers of 1965, 1966 and 1967 in the Lake Louise area suggest a relationship between diurnal rockfall frequency and rock surface temperature. The relationship, which is displayed in Figure 1, is especially apparent on north faces.

The mountains in the area are composed of thinly-bedded and jointed limestones, dolomites, shales and quartzitic sandstones. A sample population of mountain walls shows a strong orientation toward the north to east directions (63%). Walls with this orientation (i.e. the north faces) have the greatest mean vertical height (1600 feet) in the area.

Rockfall frequency is relatively high on these north faces. In 842 observation hours spread over the three summers, 563 rockfalls were directly observed. Of these, 73% occurred on north faces. The diurnal distribution has a pattern with maximum frequencies in the mid-day period (1100-1500 hours) and in the early morning (0700-0900 hours) (Figure 1). Minimum frequencies occur in the period just prior to sunrise.

Two microclimatic factors that encourage rockfall are found on the north faces. These are: the presence of summer snow and ice patches, and the unique diurnal temperature regime at the rock surface. It has been shown that the presence of snow and ice on mountain walls in the summer, induces a freeze-thaw temperature regime in their vicinity.[1] This leads to relatively rapid mechanical breakdown of the thinly-bedded and jointed bedrock, and ensures the presence of some meltwater which may contribute to rockfall activity. Furthermore, the rock surface temperature and presumably the snowpatch surfaces, respond quickly to the incidence of direct sunlight. This leads to the early morning maximum temperature (Figure 1) and perhaps contributes to the corresponding high rockfall frequency. A decline in rock surface temperature occurs during mid-morning when the north faces go into shadow. Following this is a second temperature maximum accompanying the normal daily rise of environ-

[1] Gardner, J., 1969, "Snowpatches: their influence on mountain wall temperatures and the geomorphic implications," *Geografiska Annaler*, 51, Ser. A, (3), pp. 114-120.

mental temperature in the mid-day period. These temperature data were collected using continuously recording distance thermographs during the summer of 1966 (see Gardner, 1969, for full explanation).

The relationship between the temperature curve and rockfall frequency (Figure 1) suggests a causal connection. Rockfall seems to respond consistently but with a slight lag to fluctuations in rock surface temperature. The same was not observed on southern exposures where one temperature and one rockfall maximum per day occurred.

Although the friable nature of the bedrock underlies all rockfall activity, the peculiar nature of the temperature regime and the presence of snow and ice are seen as major contributing factors in the concentration of summer rockfall activity on north faces. This concentration and the fact that two rockfall maxima occur in the diurnal period should be food for thought for mountaineers.

Figure 1

"NORTHFACE" ROCK SURFACE TEMPERATURE
AND
ROCKFALL FREQUENCY ON "AVERAGE DAY"