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ON THE VERTICAL DISTRIBUTION OF THE DENSITY OF THE SNOW COVER

by

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Abstract

Special observations have been carried out for an investigation into the vertical distribution of the density of snow.

The density of the snow cover has been discussed at length in a number of investigations since the density of snow is of manifest practical significance. It is, for instance, essential in the estimating of the water equivalent of the snow cover. For this purpose the average density of the snow cover is usually determined, *i.e.* the density of the snow pillar between snow surface and ground. The density differences of the various snow layers thus fail to be observed.

To obtain more detailed information about the density of the snowpack at different depths, the Hydrological Office arranged for special measurements to be taken in Ivalo, Nellim and in Juuka, Nunnanlahti, in the winters of 1961 and 1962 (Fig. 1). Observations were carried out on unshaded level ground preferably every five days, if possible. A hole with one wall an even, vertical plane was dug into the snowpack. From this wall horizontal samples 45 cm long were taken with a snow balance equipped with a cylinder for measuring the snow. The bottom of the cylinder covered 100 cm². The density of the snow sample was weighed in the usual manner. The sites of the horizontal samples are shown in Figure 2; the samples themselves represent the average density at depths

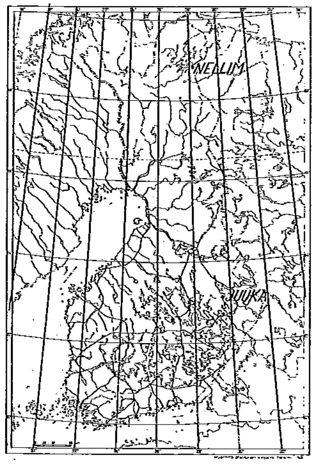

Fig. 1. Sites of observation stations.

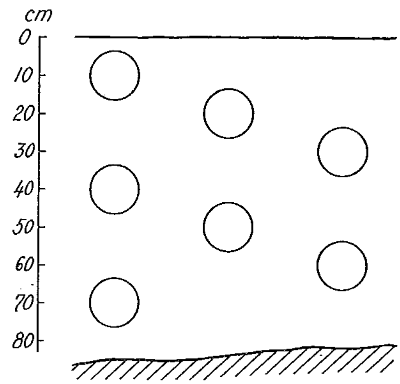

Fig. 2. Samples from the snow cover.

of 10, 20, and 30 cm, measuring from the surface of the snow cover. The density of the surface layer was determined by a cylindershaped snow sample, 10 cm deep, directed vertically from the surface downwards. This has been taken to represent the average conditions at a depth of 5 cm measured from the surface level.

From the method of measurement used here it follows that the samples leave undisturbed the thin surface layers of she snow, usually situated on the top of the snowcover, and between which significant differences of density may occur. The method thus provides a noticeably more smoothed picture of the actual distribution of the density of the snow.

The results of the measurements are shown in Figures 3 and 4, and in the part of figures showing the snow cover the equivalence curves of the density have been drawn. The figures thus illustrate the vertical distribution of the density of the snowpack. They also give the daily precipitation and the maximum air temperature observed at a near-by meteorological station.

It appears from the figures that in general the density fluctuates considerably near the surface of the snow cover. During the period of accumulation of snow the density seems to increase from the surface of the snowpack downwards. The maximum density during the accumulation period, however, does not usually seem to appear close to the ground, as has generally been assumed, but higher up. During the melting period the density of the surface layer is greatest and density seems to decrease towards the ground. The highest observed density values close to the surface of the snow cover during the melting period were smaller than 0.5. The water which forms on the surface during melting evidently penetrates the lower layers of snow, since their density does not markedly exceed the value 0.3.

The figures clearly reveal the effect of precipitation, particularly during the accumulation of snow. In Nellim, for example, the alterations in the depth of the snow cover in the winter of 1961 are well explained by the amount of precipitation during the period when the air temperature was below 0°C. When the air temperature rises above 0°C the density usually increases next to the surface of the snow cover. In the diagram for the winter of 1961 in Juuka the effect of the warm period which occurred at the end of February and the beginning of March is clearly evident.

The influence of wind on the density of the snowpack may be significant: driven by the wind, snow layers of great density may occur on the surface of the snow cover. It has not, however, been possible to study the effect of the wind on these measurement results.

Nor was it possible to study the effect of evaporation from the snowpack and the condensation of water-vapour on the density of the snow, since the observation data were insufficient. For this purpose more detailed and accurate observations will be needed.

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Figures 3 and 4. The vertical distribution of density in the snowpack, together with the maximum air temperature and amout of precipitation.

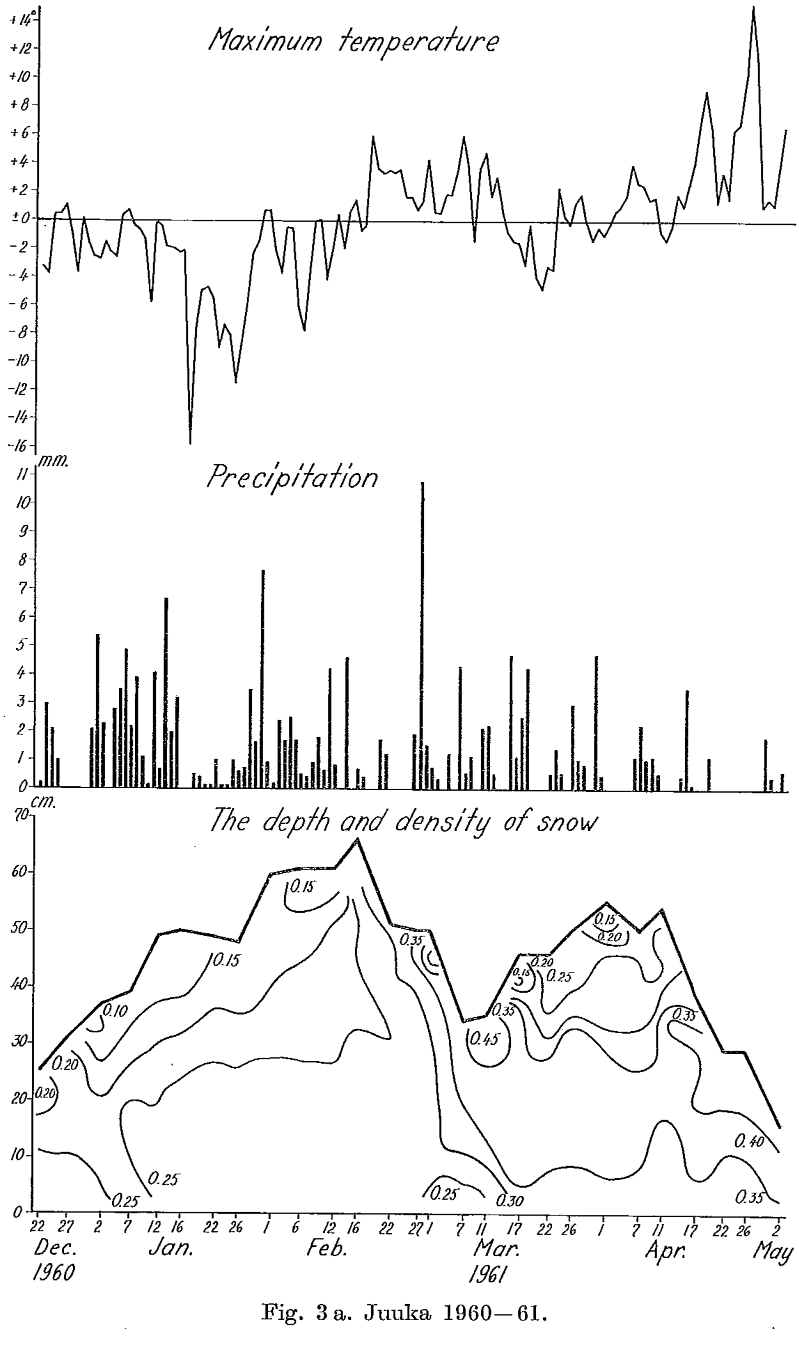

Fig. 3 a. Juuka 1960—61.

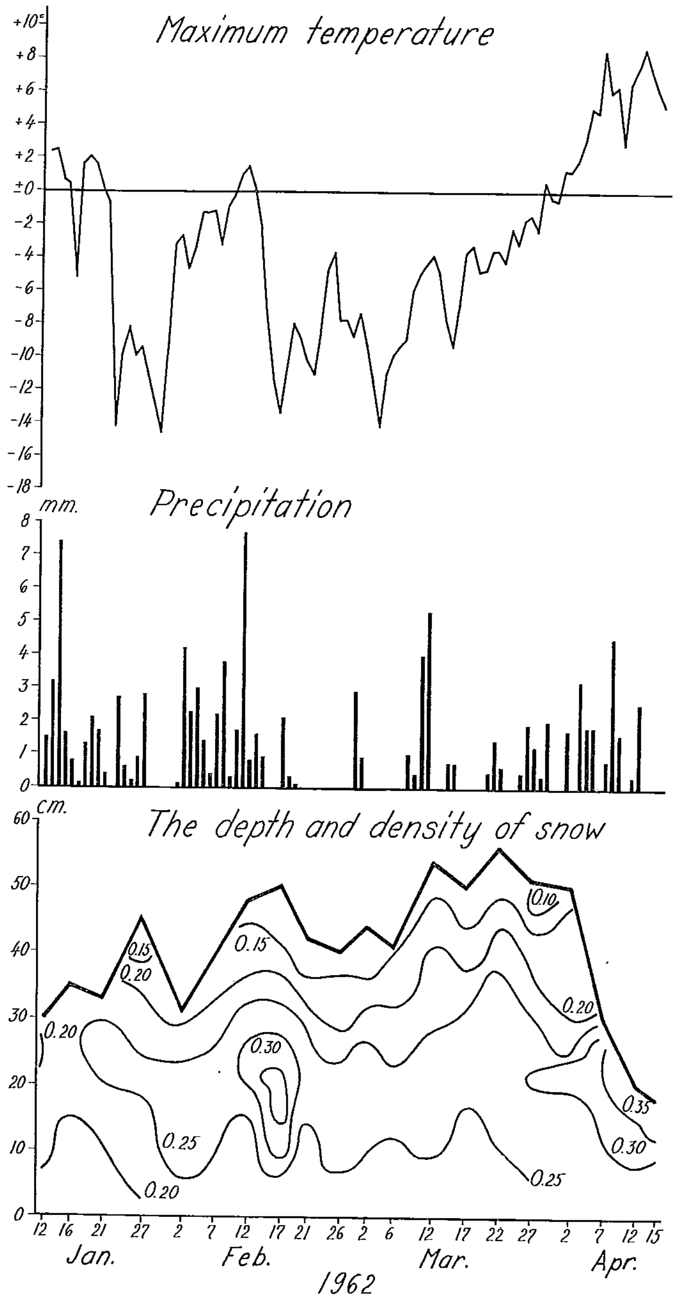

Fig. 3 b. Juuka 1962.

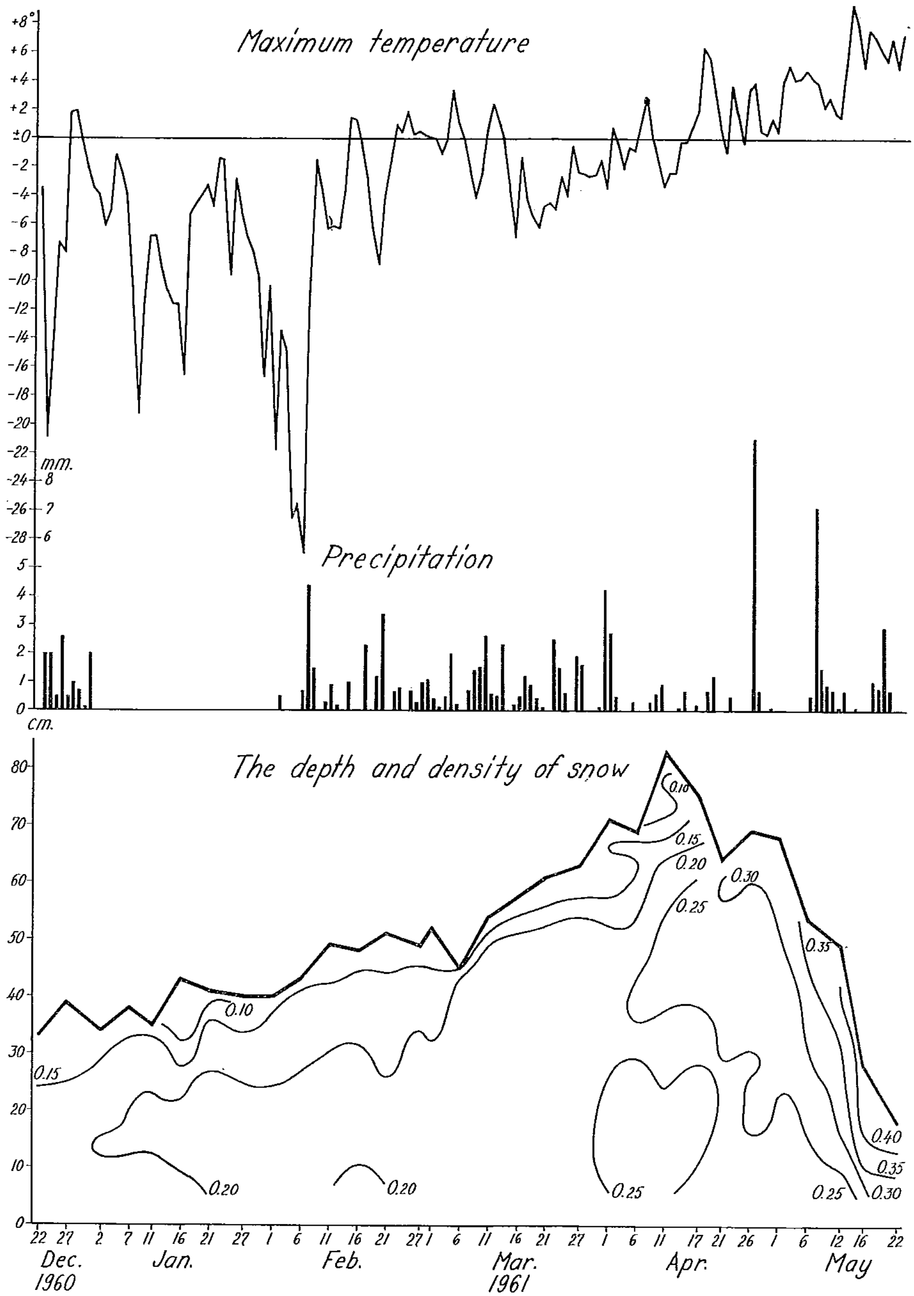

Fig. 4 a. Nellim 1960—61.

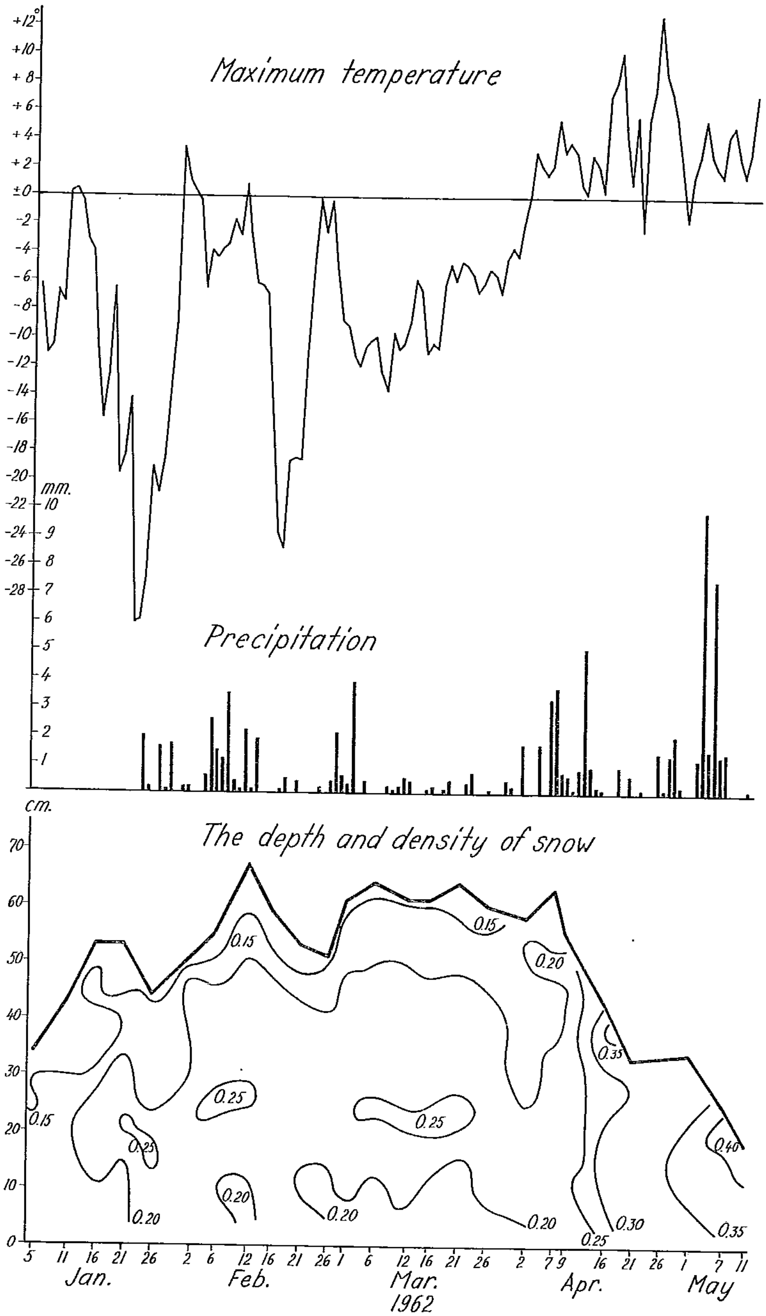

Fig. 4 b. Nellim 1962.