

discouraged in many cases. It had also been discovered in the modern dairy plant which was now using controlled water. The load in a dairy plant was of an intermittent character, however, and it called for the peak milk cooling in 4 or 5 hours. There seemed an opportunity here of having ice in the coils of the evaporators, if it could be arranged to provide for this peak load.

Therefore, the subject of this Symposium was of the greatest interest to refrigeration engineers, partly because sometimes the formation of ice was a nuisance and, at other times, a desired objective. Members of the Institute of Refrigeration were very grateful to the British Glaciological Society for the invitation to take part in this joint meeting.

On the motion of the Chairman, the authors of the papers and the contributors to the discussion were cordially thanked. The meeting was then closed.

## SNOW CRYSTAL GROWTH

### ELECTRON MICROSCOPE STUDY OF SNOW CRYSTAL NUCLEI

(Advance communication)

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THIS study was made by Mr. Motoi Kumai, of the Physical Laboratory of Hokkaido University. The experiments were carried out on Mt. Taisetsu in Hokkaido, at an altitude of 1050 m. The snow crystal is received on a collodion film on the sample holder of the electron microscope, and is left in a desiccator kept at temperatures between  $-4^{\circ}$  and  $-8^{\circ}$  C. The crystal evaporates by sublimation and the supposed nucleus is left on the collodion film. The specimen is then brought to Sapporo and investigated under the electron microscope. One solid nucleus is always observed at the central portion of every snow crystal. It is proposed to call this the centre nucleus. The centre nuclei are between  $0.5$  to  $8.0\mu$  in the largest extension.

In the remainder of the snow crystal numerous small nuclei are to be seen. These are nearly of the same size as the condensation nuclei in the free atmosphere, that is to say, between  $0.01$  and  $0.2\mu$  in diameter. Forty-three successful photographs of centre nuclei have been obtained. Most of the nuclei are believed to be soil particles, but some are composed of carbon; others are micro-organisms or hygroscopic particles of certain chemical compounds. Sixty photographs of condensation nuclei have been taken and the frequency curve of the size has been drawn from 1200 data. Condensation nuclei are found to be composed of two kinds, the most frequent diameter of the larger ones being about  $0.15\mu$  and of the smaller  $0.05\mu$ .

These preliminary observations provide data for consideration of the mechanism of snow crystal growth. The aerosol theory of snow crystal formation is proposed. According to this new theory the excess of water vapour in the free atmosphere is condensed on to the condensation nuclei and numerous minute water droplets in a super-cooled state are formed. There super-cooled droplets then collect on the ice germ and give rise to the snow crystal proper.