Various procedures may be used in employing replicas for studying ice samples. One of the most informative is to prepare a series of replicas representing planes through the ice at two or three millimeter intervals. This is accomplished by removing two or three millimeters of ice between each polishing operation. Such replicas piled on top of one another disclose the three-dimensional structure of the ice grains, and studies of this sort may provide valuable information relative to the forces and mechanisms leading to the formation and transformation of ice grains in a massive structure. Use of replicas containing dye [6] should be particularly useful in some of this research.

The study of glacier ice, in addition to throwing more light on the problems concerning the flow of glaciers, might lead to some fundamental discoveries in the field of crystal structure and metallography. It is such a simple system; the method for study is straightforward; the polishing process is very easy, and the etching technique is free of mechanical distortion. Control observations may be maintained due to the transparent nature of the substance and its birefringent nature.

The writer is greatly indebted to Dr. de Quervain for his kindness in allowing him the freedom of his laboratory on the Weissfluhjoch and permission to try out the replica techniques on his polished samples of glacier ice from the Z'mutt Glacier.

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THE SPECIFIC GRAVITY OF ICE

Professor P. L. Mercanton has sent the writer the results of some measurements of the density of clear ice at 0° C. in the Glacier de Saleinaz in 1917. These show densities of 0·9080, 0·9013, 0·9105 and 0·9050 respectively, giving a mean of 0·9059 gm./cc. Taken in conjunction with several measurements of ice with air bubbles, yielding values below 0·90, these results lead Professor Mercanton to the conclusion that for practical purposes it is preferable to use 0·90 rather than the usual 0·91 as the density of glacier ice.

It seemed hard to account for glacier ice if really clear, that is to say bubble-free, having a different specific gravity to other ice. The problem is also complicated by the fact that the salt solutions now proved to be present in glacier ice would tend to increase rather than decrease its density. The writer therefore submitted Professor Mercanton's note to Professor K. Lonsdale who replied:

> "The theoretical density for pure ice derived from accurate measurements of the lattice constant of ice formed from distilled water at 0° C. is 0·9168 gm./cc. Any deviation from this value must signify
>
> (i) the presence of impurity, including possibly air,
> (ii) a variation of lattice constant, or
> (iii) a mosaic structure for the ice crystals in which there are gaps between the boundaries larger than normal molecular distances, though perhaps not large enough to allow inclusions.

Professor Lonsdale added that in her opinion (ii) would be impossible unless impurities were present which had not remained between the glacier crystals of the ice mosaic but had entered the lattice. In so far as (iii) is concerned Professor Lonsdale thought it possible that foreign atoms or groups of atoms might go between the individual crystals of the mosaic in such a way as to give large gaps, the ice crystals being held apart by sparsely distributed impurity atoms, and in that case making a reduction on balance greater than the added weight of the impurity.

The writer's view is that Professor Mercanton's generalization of 0·90 is a convenient one to adopt, especially as entirely bubble-free ice is not common. The true structure and composition of clear glacier ice await their final determination.

G. Seligman