allowing us to use their cold room, and Mr R. Wegman of the department for his assistance.

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Melting Point Behaviour of Glacier Ice

IN their communication[1], Radd and Oertle draw attention to the modified Clapeyron equation

$$\frac{\mathrm{d}T}{\mathrm{d}P} = -\frac{T(V_{\mathrm{ice}})}{\Delta H_{\mathrm{fusion}}} \tag{1}$$

in connexion with the depression of the freezing point of glacier ice. Their account, however, is too general. Their use of the term "unconfined" in relation to the liquid phase can be misunderstood by glaciologists and geologists.

The essential point in equation (1) is that it gives the freezing point depression ΔT when the ice and water are under different pressures. A more appropriate general form of the equation is[2]

$$\Delta T = \frac{-(V_{\mathrm{ice}}\ \Delta P_{\mathrm{ice}} - V_{\mathrm{water}}\ \Delta P_{\mathrm{water}})\ T}{\Delta H_{\mathrm{fusion}}} \tag{2}$$

Equally important are the circumstances making an equation of this type relevant. For the present case of glacier ice in contact with unfrozen saturated soils, it is the restriction of size (which can be considered a curvature) imposed on the ice–water interfaces by the walls of soil pores, together with the effect of interfacial tension, that is important. If the ice–water interfaces have a radius r

$$P_{\mathrm{ice}} - P_{\mathrm{water}} = \frac{2\,\sigma_{\mathrm{ice-water}}}{r} \tag{3}$$

For an ice mass in contact with unfrozen soil, r may have a value between infinity and r_{pore} (the equivalent radius of soil pores), depending on the extent to which the ice–water interfaces intrude into surface pores. The depression of the freezing point ΔT is given[3] by (for simplicity taking the case of constant P_{water})

$$\Delta T = \frac{-V_{\mathrm{ice}}\ 2\,\sigma_{\mathrm{ice-water}} T}{r\,\Delta H_{\mathrm{fusion}}} \tag{4}$$

The temperature at the base of the glacier on a bed of unfrozen soil may, according to this equation, have a range of values, the lowest depending on r_{pore}. Thus ΔT is limited by the type of soil in question. It was through overlooking this fact that Poynting[4] failed to establish equation (1) experimentally.

The soil below the glacier freezes when $r \leq r_{\mathrm{pore}}$. Using appropriate values in equation (3) for, say, a silty clay with $r_{\mathrm{pore}} = 0{\cdot}3\mu$ one finds that $P_{\mathrm{ice}} - P_{\mathrm{water}} \geq 2$ kg cm^{-2} is a condition for freezing of the soil. If this is not already satisfied, with the groundwater pressure being P_{water}, freezing temperatures at the base of the glacier will cause a fall in water pressure at this point. There may be an associated migration of water to give an additional layer of basal ice, as in the frost heave process. $P_{\mathrm{ice}} - P_{\mathrm{water}}$ is an effective stress (in soil mechanics terminology) and of importance for the subsequent post-glacial, mechanical properties of the soil.

On the other hand, if the glacier rests on a rock bed containing water only in cracks (larger than pore size), there is no significant difference in pressure according to equation (3). Thus the freezing point depression is then given by the "normal" relation

$$\frac{\mathrm{d}T}{\mathrm{d}P} = \frac{T(V_{\mathrm{water}} - V_{\mathrm{ice}})}{\Delta H_{\mathrm{fusion}}} \tag{5}$$

Detailed experimental studies of the matters discussed with reference to soils have been made by me[5] and by other authors. Only scant attention has been given, however, to the significance of these relations in glaciology, where movement of the ice is a further complication. They seem important for questions not only of glacier regime but also of geotechnical properties of soils at some time overlain by glaciers.

A slip is noted in Radd and Oertle's reference to Hudson's paper, which is given below[6].

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Dynamics of the Disintegration of a Drop by Electrical Forces

TECHNIQUES have recently been developed for modelling the dynamics of the flow of incompressible fluids using a high-speed computer[1,2]. The dynamical equations were solved by representing the fluid by a series of marker particles moving in a cartesian mesh, and assuming that each particle experiences a linear acceleration during a selected short interval of time. By computing the new positions and velocities of the marker particles at the end of successive time intervals, accurate calculations can be made of the motion of the fluid throughout the period of interest. This marker-and-cell technique has been applied to a study of the instability of an uncharged liquid drop of radius R and surface tension T situated in an electric field strength E. This problem, which is important in certain situations in cloud physics[3], has previously been treated analytically[4] by assuming that the drop retains a spheroidal shape throughout the period of deformation until the instability point is attained. The calculated instability criteria, namely, the $E(R/T)^{\frac{1}{2}} = 1{\cdot}625$ when the ratio of the semi-major to semi-minor axes $a/b = 1{\cdot}9$, agree well with experimental measurements. The present numerical calculations permit a quantitative assessment to be made of the validity of the spheroidal assumption and, of greater importance, provide a description of the dynamics of the disintegration of a drop subjected to intense electrical forces. In order to save computer time the initial condition was assumed to be that a spheroidal drop of undistorted radius 0·2 cm and surface tension 70 dynes cm^{-1}, possessing a degree of deformation represented by $a/b = 1{\cdot}9$, was introduced into a field of strength $E = 9{,}500$ V cm^{-1}, which is 4 per cent greater than the