*On Theory of the Flow of Glaciers**

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Abstract: According to the generally accepted theory of viscoplastic flow of ice, the velocity of ice flow, related with shear stress by the exponential law (after GLENN), is independent of omnidirectional (hydrostatic) pressure. The author's experiments in Antarctica and analysis of distribution on the depth of ice density in the Antarctic shield, however, showed that this pressure affects, to some extent, the flow of ice, namely, flow velocity decreases with increasing omnidirectional pressure. The same effect, but in a still more pronounced form, has been noted in frozen grounds.

The paper sets forth the theory of viscoplastic flow of ice taking into account the dependence of flow velocity on omnidirectional pressure.

It is well known that the flow of glaciers and ice shields takes place under conditions of a complex stressed-deformed state, and therefore in order to describe the process of flow it is necessary to know the relationship between all the components of stresses and velocities of deformation. This relationship is usually given in tensor form, the stress tensor being divided into a deviator σ_i causing a change of form (flow), and omnidirectional pressure σ_0 causing a change of volume. The author has suggested a generalized expression defining the relationship between the stress deviator, the velocity deviator and omnidirectional pressure.

The initial equation of this theory relating stress and deformation is written in the following general form:

$$\sigma_i = \varphi_1(\dot{\varepsilon}_i) + \varphi_2(\dot{\varepsilon}_i)\Phi(\sigma_0), \qquad (1)$$

where σ_i–intensity of shearing stress, $\dot{\varepsilon}_i$–intensity of flow velocity, σ_0–omnidirectional pressure.

The first term of the equation characterizes flow under conditions of pure shear, the second—retardation of this flow by the forces of omnidirectional pressure.

The function $\varphi_1(\dot{\varepsilon}_i)$ is assumed to have an exponential form (after GLENN), and so is the function $\varphi_2(\dot{\varepsilon}_i)$. The function $\Phi(\sigma_0)$ is taken as linear. Then Eq. (1) has the form

$$\sigma_i = A\dot{\varepsilon}_i^{\,m} + B\sigma_0\dot{\varepsilon}_i^{\,n} \qquad (2)$$

or $\dot{\varepsilon}_x - \dot{\varepsilon}_0 = X(\sigma_x - \sigma_0)$; $\dot{\gamma}_{xy} = 2X\tau_{xy}$ ······etc., where $X = \dfrac{\dot{\varepsilon}_i}{2\sigma_i} = \dfrac{\dot{\varepsilon}_i^{\,1-n}}{2(A\dot{\varepsilon}_i^{\,m-n} + B\sigma_0)}$

This is the generalized equation of the flow of ice. The equation parameters A, B, m and n are determined from a test under complex stressed conditions.

The paper also discusses special cases of Eq. (2) simplifying this equation, and demonstrates the utilization of this equation in solving problems.

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