Journal of Glaciology, Vol. 24, No. 90, 1979

ABSTRACTS OF PAPERS PRESENTED AT THE SYMPOSIUM BUT NOT PUBLISHED IN FULL IN THIS VOLUME

FIRST-ORDER STRESSES AND DEFORMATIONS IN GLACIERS AND ICE SHEETS

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ABSTRACT. It appears that the well-known theory describing flow of glaciers and ice sheets over undulations is defective with regard to the precise form of the field equations and boundary conditions to be applied. In particular, when surface-wave phenomena are to be described the formulation of Budd does not seem to be applicable.

The governing field equations and boundary conditions are, therefore re-derived, aiming, first, at a clear and systematic formulation of the basic equations, separating, secondly, the steady-state and transient response and, thirdly, attempting to use (regular and singular) perturbation techniques in answering various questions of the state of stress and velocity in a nearly parallel-sided slab. Results are different from previous ones. In fact Budd's analysis of the transfer of the bedrock topography to the surface is paralleled with the striking result that filter functions do not indicate the existence of a preferred-wavelength transfer, but the results show a marked dependency on the steepness of the ice slope. As far as surface waves are concerned, the results of the kinematic wave theory are corroborated for surface elevations that are small compared with the thickness of the ice sheet and for very long waves. When these conditions are not satisfied surface-wave equations become non-linear and exhibit features similar to the Burgers equation. In all these equations diffusion is more significant for ice sheets than for glaciers (with larger mean inclinations).

ICE-SHELF UNDERWATER MORPHOLOGY

By OLAV ORHEIM

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ABSTRACT. A side-scan sonar survey was conducted near the ice front of Riiser-Larsenisen during the 1976–77 Norwegian Antarctic Research Expedition to investigate the underwater ice-shelf morphology. The survey covered several shorter, widely-spaced sections, for a total of about 10 km along the ice front. Only a smaller part of the sections showed a smooth, straight ice front. Most of the observed ice fronts were very rough at the scale of decametres. Projections at around 100 m water depth commonly extended 50–200 m seaward of the above-water ice shelf, and had widths of similar dimensions.

For each section the sonar was towed at one water depth only. Reflections are recorded from the nearest part of the ice shelf, which may occur at varying depths along the section. This complicates the interpretations. To solve this problem we plan to tow the sonar at several depths along ice-shelf fronts and icebergs during the 1978–79 expedition, for better three-dimensional information on the underwater morphology.

DISCUSSION

G. DE Q. ROBIN: I will be discussing the question of melting of the ice front on Wednesday—and will conclude that melting will be greater at greater depths. I am glad to see this information and to learn how irregular this melting can be. Did you find any cases where the ice shelf jutted out below sea-level? I expect this would worry the ship's Captain even more.

O. ORHEIM: It clearly would! I cannot remember any examples of the kind described from the Maudheim expedition, but they may have been present.

R. H. THOMAS: Did the ice front above sea-level show any distinctive features in the areas where these submarine rams were found?

ORHEIM: The recordings were done by an instrument trailing some hundreds of metres behind the ship, and by the time we were aware of them the area was far away, and we had no opportunity to re-examine the ice shelf, so I cannot answer your question adequately. Next season we shall do detailed under-water profiling of the ice shelf and will then also of course study the part above water.

DISSIPATION OF TIDAL ENERGY BY FLEXING ICE SHELVES

By C. S. M. DOAKE

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ABSTRACT. Plastic deformation of ice shelves in the region along the grounding line where they bend with the tide can dissipate enough tidal energy to make them the most important single source contribution to tidal friction (Doake, 1978). Some of the effects are to slow the rotation of the Earth and to cause the moon to retreat from the Earth.

REFERENCE

Doake, C. S. M. 1978. Dissipation of tidal energy by Antarctic ice shelves. *Nature*, Vol. 275, No. 5678, p. 304–05.

DISCUSSION

J. L. FASTOOK: Can this energy dissipation be related to an ablation or melting of the ice shelf?

C. S. M. DOAKE: No.

G. DE Q. ROBIN: Your hypothesis seems reasonable by comparison with Wadham's studies of dissipation of ocean-wave energy in large floes of pack ice at periods around 16 s. He showed that energy dissipation in deforming ice floes was the dominant loss and much exceeded viscous and other losses.

https://doi.org/10.3189/S0022143000014969 Published online by Cambridge University Press