ICE SHELF OSCILLATIONS

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GRAVITY measurements taken on the Filchner Ice Shelf during the Antarctic summer of 1956-57 indicate that the shelf is oscillating; this oscillation has introduced uncertainties in gravity measurements of the order of 0·5 milligal.

It may be possible to utilize this oscillation to study the structure of the shelf in the following manner: in a simple oscillating system displaced a distance x, the relationship between the period of oscillation t, acceleration $\ddot{x}$, and displacement x is

$$x = \frac{t^2}{4\pi^2}\ddot{x}$$

By substituting the observed period of oscillation $t \simeq 1$ min. and $\ddot{x} \simeq 0{\cdot}5$ milligal we find $x \simeq 0{\cdot}05$ cm.

If a gravity survey over the shelf were made, it would be possible to map these small vertical displacements. Possible results from such a survey are as follows:

If we assume that the shelf is oscillating as a simple weighted cantilever with a uniform load, then the amplitudes x_1 and x_2 at two points located distances z_1 and z_2 from the point of support would be related as:[1]

$$\frac{x_1}{x_2} = \frac{6l^2z_1^2 - 4lz_1^3 + z_1^4}{6l^2z_2^2 - 4lz_2^3 + z_2^4}$$

where l is the length of the cantilever.

From the derived value l one could predict where the shelf was anchored. The existence of islands under the shelf might be indicated if the shelf were anchored on these islands.

Any non-uniform change in the amplitude $x = f(z)$ might be associated with fissures in the shelf where much of the flexing of the shelf would be localized; thus it might be possible to predict the location where calving would take place. Such information might be useful in determining base sites on shelf ice.

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REFERENCE

1. Timoshenko, S., *and* McCullough, G. H. *Elements of Strength of Materials*. New York, Van Nostrand, 1940.