Some computations on Seiches in Lake Fife at Khadakvasla, Poona

S. JANARDHAN

Meteorological Office, Poona

(Received 4 September 1958)

ABSTRACT. Chrystal has worked out a number of formulae for seiche-periods under various assumptions regarding the shape of the bed of the lakes where these seiches are excited. Based upon his method, periods of seiches that could be excited in Lake Fife at Khadakvasla have been computed. The periods of the uninode, binode, trimode and quadrimode seiches are obtained approximately as 1½ hours, 2/3 of an hour, 5/12 of an hour and 1/3 of an hour respectively.

Hidaka’s method of solving Chrystal’s differential equation by the use of the theorem of Ritz in the calculus of variation, has been used for the case, where the lake’s bottom is assumed parabolic. The uninode period thereby worked out for Lake Fife comes out to be 1½ hours.

For a test of these computed values, experimental observations are required and it is suggested that a suitable limnograph be set up for the purpose of recording these oscillations when natural phenomena excite them.

1. Introduction

The term ‘seiches’ was originally applied to rhythmic variations of the surface level, observed at the Geneva end of Lake Leman in 1730. Subsequently they have been observed at a great many places and it is now known that they are excited either by seismic activity or by certain meteorological factors such as passage of a storm, barometric oscillations, rapid changes in wind direction and magnitude etc, over bodies of water not sufficiently big by themselves to be directly influenced by astronomical tide-generating forces. In a seiche-oscillation, the entire water mass heaves up and down as one mass, the period of oscillation depending only on the dimensions of the water-body excited, except in those cases where the body of water opens into a sea.

The theoretical determination of ordinary longitudinal seiches in lakes, the shape and size of whose transverse sections vary only slowly, has been reduced by Chrystal (1905 a) to the solution of a linear differential equation of second order, in the normal form, with certain boundary conditions. The solution was then applied by Chrystal (1905 b), to Loch Earn and Loch Treig, with encouraging results. In a subsequent paper Chrystal (1908) has investigated the effect of a number of types of pressure disturbances on a special lake.

Wedderburn (1910, 1912) who discovered the temperature seiche (where the water-body has stratification due to temperature differences) has reduced the problem of such seiches to the solution of a second order differential equation, very similar to that of Chrystal for ordinary seiches.

The problem of seiches in its most general aspects, involving any kind of configuration for the bottom of a lake has been tackled by Proudman (1914) and an application of Proudman’s method to Lake Geneva by Doodson, Carey and Baldwin (1920) has yielded highly satisfactory results.

Chrystal’s seiche-equation has also been solved in various other ways by Defant (1918), Ertel (1933) and Hidaka (1936). The concept of the equivalent electric and acoustical circuit for a lake has been used by Darbyshire and Darbyshire (1957) in determining the seiches of Lough Neagh.

‘Seiches generated by earthquakes are called ‘seismic seiches’. An account of