HYDRODYNAMIC PROBLEMS ARISING FROM THE INVESTIGATION OF THE TRANSVERSE CIRCULATION IN THE ATMOSPHERE

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Introduction. The motion of the atmosphere can be considered as a mean flow which has a very large scale and is only slowly changed and, superimposed on this, the low level, smaller scale phenomena usually associated with the polar front. If the mean pressures over a period of about a week are plotted, it is seen that the latter disturbances are averaged out and only the large scale mean motion is shown. Such a plot of the northern hemisphere shows, in addition to the mean westerly flow of air, large scale closed isobaric systems spaced at comparatively regular intervals over the surface of the earth. These include the Aleutian and Icelandic low pressure areas to the north of the westerlies and the Pacific and Bermuda high pressure areas to the south of the westerlies.

It has been noticed that the position and strength of these systems control the paths of the low level storms. This fact has been used in the development of a long range forecasting technique which has proved to be very successful for periods as long as three months. A knowledge of the properties of these large scale systems is thus not only of academic interest but of considerable value in the development of long range forecasting techniques.

In the investigation of these large scale transverse motions in the atmosphere, two controlling factors have been suggested and discussed by the author [1] and by Rossby [2] and Haurwitz [3]. These are first, the dynamical instability of the shearing motion on either side of the belt of westerly winds and second, certain forced oscillations in the atmosphere. The first of these and several related problems are discussed here.

In making these calculations several approximations are made. The principal ones and the reasons for their adoption are as follows:

(1) As the systems are very deep, that is, the wind momentum vector for a vertical section is roughly constant, it was felt that the horizontal field of motion was the dominant factor; consequently, vertical velocities are neglected; and horizontal momentum is assumed not to vary with height.

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