Correspondence

LOWEST TEMPERATURE IN CANADA

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Regarding the article "On the Lowest Temperature on Earth" appearing in the January 1958 issue of the *Monthly Weather Review,* I have a few remarks to make which might clarify the situation regarding the lowest temperature ever recorded in Canada.

Previous to February 1947, the record Canadian low temperature was −78.5° F., observed at Fort Good Hope, N. W. T. in December 1910, as indicated in the article. This absolute low temperature has been exceeded twice at Snag, Yukon, on February 2 and 3, 1947. The corrected minimum temperature on February 2, was −80.1° and on February 3, it was −81.4°. The value of −81° F., is taken as the absolute lowest temperature ever recorded in Canada.

Since the article states that in Canada two official sources report conflicting data, it should be pointed out that the Monthly Weather Map, which is prepared about three weeks after the close of each month, must be considered as a preliminary or provisional report. As outlined in the article, the minimum originally reported from the station was −83° and was obtained by extrapolation. When the thermometers were received at these Meteorological Headquarters, several months later, and calibration tests carried out, an official value of −81.4° F. was set. Since February 1947 there have been no official temperatures in Canada lower than −80°.

I hope that this information will clarify the alleged discrepancy in the official Canadian meteorological publications.

COMMENTS ON "THE ERROR IN NUMERICAL FORECASTS DUE TO RETROGRESSION OF ULTRA-LONG WAVES"

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The paper by Paul M. Wolff (*Monthly Weather Review,* July 1958) discusses some practical results of one of a class of empirical numerical models which have been suggested in recent years. I would like to point out the interesting family resemblance between these models, because all of them contain some of the more important effects of tropospheric divergence resulting from forced flow over mountains, large-scale heat and cold sources, and other complex factors which account for the special behavior of long waves.

I would also like to take this opportunity to discuss a more general formulation of this group of models, because I feel that more rapid progress may be made if researchers in this field realize that different individuals are independently attempting to develop the same fundamental idea. This generalization is obtained by borrowing an assumption from the perturbation theory of hydrodynamics. It is assumed that the actual wind field in mid-troposphere consists of a perturbation-component superimposed on a large-scale quasi-stationary flow. As in the perturbation method, it is assumed that this quasi-stationary flow, which will be called hereafter the "basic current," is given; and we seek to predict the evolution of the perturbation. Since, as will be clarified later, we are not immediately concerned with mathematical difficulties, the basic flow need not be confined to a straight zonal current with little or no shear. It may have almost any form related to the general circulation, provided its rate of evolution is small compared to that of the perturbation. Another requirement, characteristic of the simple models to be described presently, is that it must be chosen so as to minimize the divergence of the perturbation. Various possible forms of the basic current will be discussed later.

The group of models which have been proposed up to the present may be formed through use of the simplest possible vorticity equation containing divergence:

$$\frac{\partial \zeta}{\partial t} = -\mathbf{V}\cdot\nabla\eta - f\nabla\cdot\mathbf{V} \tag{1}$$

The symbols have their usual meaning and the equation applies to the actual wind field, which by definition is the sum of the basic current and the perturbation.

Equation (1) may also be applied to the basic current, whose time rate-of-change is assumed to be small:

$$0 \approx -\mathbf{V}_B\cdot\nabla\eta_B - f\nabla\cdot\mathbf{V}_B \tag{2}$$

Here, the subscript B refers to quantities measured in the basic current.

Use is now made of the assumption that the divergence of the perturbation is small. This enables us to replace the divergence of the actual flow by that of the basic flow, so that equations (1) and (2) may be combined, giving:

$$\frac{\partial \zeta}{\partial t} = -\mathbf{V}\cdot\nabla\eta + \mathbf{V}_B\cdot\nabla\eta_B \tag{3}$$

This is the prediction model proposed by the writer [1], where the basic current was taken to be the normal seasonal circulation. In this particular adaptation, the

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