THE OCCURRENCE OF HAIL

EDITOR’S NOTE.—In response to the demand for more specific data on the occurrence of hail in the United States, the Weather Bureau began in the April number of this Review the publication of reports on the occurrence of hailstorms as observed by its regular and cooperative observers, numbering approximately 5,200. Cooperative observers report directly to the Weather Bureau officials in charge of the several section centers and these officials in turn transmit the reports to the Central Office in Washington, D.C. The reports are incorporated in the table which hitherto has borne the title “Severe Local Storms.” That table will be found on pages 282–284 of this Review, and it will appear in approximately the same position hereafter.

ASCENSIONAL RATE OF PILOT BALLOONS

By William C. Haines, Meteorologist

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Pilot balloons furnish us with an efficient and economical as well as a fairly accurate means of determining the direction and velocity of the wind in the free air. The two-theodolite method, when used in connection with a base-line of 2,500 meters or more in length and well chosen with respect to the direction of the wind, will give results as accurate as the readings of the theodolites. However, in exceptionally long observations, an hour or more in length, or when the balloon is moving in the vicinity of the direction of the base line, the results are not so satisfactory. In either case the angles of the triangle become so small that a slight error in the reading of the angles makes a considerable error in the computed distance and altitude of the balloon, and therefore an error in the resulting wind velocity and direction.

In general, the single-theodolite method is better adapted for the procurement of free-air data than is the double-theodolite method, but the accuracy of its results is dependent upon the accuracy with which the altitude of the balloon is known. The Meteorological Section, Signal Corps, carried on during the war an extended investigation in order to develop a formula that would give the ascensional rate of balloons.

As a result of these studies, the following empirical formula which is a modification of the Dines' formula was developed and adopted as the one giving the best results:

\[ V = 71 \left( \frac{p}{L} \right)^{0.398} \]  

in which \( V \) is the rate of ascent in m./min, \( p \) is the free lift or ascensional force in grams, and \( L \) is the free lift plus the weight of the balloon. This formula was based on about 1,000 two-theodolite observations taken in all seasons of the year and at all times of the day. After the war a slight revision was made as the result of further study and the inclusion of additional data secured by the Weather Bureau and the Signal Corps. The revision consisted of a change in the constant from 71 to 72 and of the introduction of small additive corrections for the first five minutes of ascent. The Weather Bureau has used this revised formula since April, 1921.

\[ R = ax^2 + bx + c \]  

in which \( R \) is the rate of ascent per minute, \( x \) is the altitude in meters and \( a, b, \) and \( c \) are constants. The original data to which the curves were fitted are given in Table 1.