

METEOROLOGICAL SERVICE OF THE ARMY.<sup>1</sup>

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In August, 1917, the Chief Signal Officer directed Lieut. Col. R. A. Millikan to organize an Army Meteorological and Aerological Service, the purpose of which was three-fold:

(a) To provide the American Expeditionary Forces with all the meteorological and aerological information needed.

(b) To supply the aviation fields, the coast artillery stations, the ordnance proving grounds, and the gas-warfare service within the United States with such meteorological and aerological data as might be useful to them.

(c) To undertake for the first time in the history of the world the problems of mapping the upper-air currents over the United States, the Atlantic, and western Europe in aid of aviation, and particularly with reference to trans-Atlantic flight.

In carrying out the first of these projects, there were selected approximately 550 men of high qualifications, most of them physicists or engineers, who were given a two months' course in meteorological and aerological theory and observations at College Station, Tex. Three hundred and fourteen of these men were sent overseas where they have been operating as an effective and well-organized branch of the work of the American Expeditionary Forces. In addition to furnishing a general weather forecast for the American Expeditionary Forces, this service has supplied a meteorological unit to each aviation post, each gas-service post, each artillery post, and each sound-ranging post of the American Army in France. Under the effective direction of Maj. [now Lieut. Col.] W. R. Blair, one of the most experienced aerologists of the United States, commissioned for the service from the Weather Bureau, about 20 upper-air stations were established in France and England and a forecast based on data furnished by these stations made regularly to the American Expeditionary Forces.

For the accomplishment of the second element of the program, 28 stations manned by 150 men, all carefully picked at the start and well trained at College Station, have been established for furnishing local data as to either surface or upper-air conditions, or both, to the flying fields, artillery posts, and proving grounds in this country. The largest of these stations is that at the Aberdeen Proving Ground, which is manned by 22 men and furnished to the Bureau of Ordnance all necessary data for the determination of ballistic wind which, in view of the development of high-angle fire, has become altogether indispensable for the construction of range tables needed for obtaining accuracy in the work of the artillery.

In carrying out the third element of the program, 26 meteorological stations were established, placed at carefully selected points over the whole of the United States, which stations have been manned by trained observers who telegraph to Washington each day observations on wind velocities at all altitudes up to 35,000 feet. In one instance these observations have been carried to 65,000 feet. On the basis of these observations, a daily forecast of upper-air winds is now being issued. The use which such forecasts may serve, both in connection

with the aviation mail service and ultimately with the trans-Atlantic service, may be seen from the fact that above the level of 10,000 feet, 95 per cent of the winds in both the United States and Europe are from west to east and often attain velocities in excess of 100 miles an hour. On November 6, 1918, at Chattanooga, Tenn., a velocity of 154 miles an hour at an altitude of 28,000 feet was observed. It is because of this easterly direction of these upper air currents that all of the long flights thus far made have been from west to east. The importance of a forecast of such currents for the purpose of long flights will be appreciated as soon as the foregoing facts are understood. An airplane capable of a velocity of 154 miles an hour in still air either would remain stationary or travel at 308 miles an hour depending on whether it was headed into or with a wind of the velocity of that observed at Chattanooga.

All of the aerological work so far mentioned has been done with the aid of theodolites especially designed by Maj. W. R. Blair for this service. Sixty of these have been built for the work in this country and 20 shipped abroad.

The problem of exploring the upper-air currents over the Atlantic was at first thought insoluble on account of the absence of fixed bases, but the Meteorological Service has developed propaganda balloons which already have flown at an average altitude of 18,000 feet from Omaha to New Jersey, a distance of more than 1,000 miles. The success of the project now has made possible the mapping of the upper-air highways across the Atlantic, for arrangements are being made to send up from both coastal stations and from trans-Atlantic steamers these long-range balloons designed for from 2,000 to 3,000 mile flights, and adjusted to maintain a constant altitude and to drop in Western Europe their records of average winds in these heretofore unchartable regions. The importance of this work for the future of aviation needs no emphasis.

The success which the Meteorological Service has attained would have been wholly impossible had it not been for the intimate and effective cooperation which has been extended to it in all of its projects by Director C. F. Marvin and the entire staff of the United States Weather Bureau.

## INFLUENCE OF WEATHER ON MILITARY OPERATIONS.

[Bibliography.]

From the beginning of the war, Prof. R. De C. Ward collected carefully the press and other reports which mentioned the influence of weather on military operations. These he brought together into 19 very interesting articles which appeared in *Popular Science Monthly* (now *Scientific Monthly*), the *Journal of Geography*, the *Journal of the Military Service Institution*, and the *Scientific Monthly* from 1914 to 1919. Some brief abstracts of these papers have appeared in *Science*,<sup>1</sup> *Nature*,<sup>2</sup> and elsewhere, but no abstract can do justice to the detailed originals. Therefore, instead of trying to present a summary of these papers, it is thought best to present the bibliography

<sup>1</sup> Cf. "A Signal Corps School of Meteorology," *MO. WEA. REV.*, Dec., 1918, 46:560-562. More extended accounts of war meteorological work of the Weather Bureau, Signal Corps, and Naval Aviation Service will be published in an early number of the *REVIEW*.—ED.

<sup>1</sup> Cf. *Science*, June 30, 1916, N. S., vol. 53, pp. 934-935.  
<sup>2</sup> Cf. *Nature*, Aug. 29, 1918, vol. 101, pp. 514-15.