Letters

Wind Fluctuations in the Troposphere

"Upper-air wind fields can undergo large fluctuations in short periods of time," W. M. Protheroe wrote in a recent article [*Science* **134**, 1593 (1961)]. "For example, on one night when multiple balloon soundings were made at Bedford, the wind underwent a vector change of 25 meters per second in the tropospheric region in 52 minutes."

No further information was offered by Protheroe, but study of the soundings furnished him reveals no such rapid changes in wind at any one level. During April 1958 and April and May 1959, two or more soundings were made on each of eight nights; a total of 20 soundings were made, to a height of 9 kilometers. These were made at L. G. Hanscom Field, Bedford, Massachusetts (20 miles northwest of Boston), by an Air Force detachment in support of Protheroe's research contract with the Geophysics Research Directorate, under which scintillation of starlight was studied as possible indicator of upper wind speed and turbulence.

Protheroe selected the wind at the level of maximum shear for correlating with scintillation observations. On the two soundings begun 52 minutes apart on 9 April 1958 from which he obtained a "vector change of 25 meters per second," the winds reported at the tops of the layers of maximum shear (marked with an asterisk in the values given below) and at corresponding levels on the companion sounding were as follows:

2256 EST	*9079 m	300°	50 m/sec
2340 EST	8919 m	300°	48 m/sec
2259 EST	9909 m	310°	72 m/sec
2343 EST	*9867 m	310°	75 m/sec

Thus, while the wind speed at the top of the layer of maximum shear increased by 25 m/sec in 47 minutes, this layer itself was found almost 800 meters higher on the second sounding than on the first.

At a fixed height of 9 kilometers above sea level the wind decreased by 2 m/sec, while at 9.9 kilometers it increased by 3 m/sec, both in 44 minutes. These differences are of the same order of magnitude as the instrumental and observational errors in the reported wind speeds; the change of 10° in wind direction is unimportant, since directions are reported only to the nearest 10°.

Much greater wind changes at fixed levels in short time periods are revealed by a week-long series of hourly soundings made at Bedford in April 1960 for the specific purpose of studying such variability. Details of this unique series, including wind speeds averaged over 1, 2, 3, and 4 minutes and temperatures and heights at standard pressure surfaces, are offered in *Geophysics Research Directorate Research Note 60*, which is available on request.

Of the 168 scheduled soundings, 161 provided usable wind information, but because of instrumental and other difficulties, only 119 differences at 1-hour intervals were available at the 12-kilometer level, where the greatest variability was expected to occur. The synoptic situation during the week of observation was conducive to abnormally large variability in wind speed. The greatest 1-hour change was 39 m/sec, the mean vector change was zero, and the root mean square vector change was 13 m/sec; such a standard deviation implies that the mean absolute change was 10 m/sec.

Protheroe's statement concerning the general variability of upper wind fields is correct, and the figure that he cites is not unreasonable. But rather than being typical, it is 2½ times the mean absolute change at a level of great variability during a week of great wind variability. At this level during such conditions, less than 5 percent of the 1-hour changes would be as great as 25 m/sec.

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Resumption of Testing

We agree completely with the sentiments expressed by Henry S. Kaplan in his letter to V. Zhdanov of the Soviet Union, reprinted in *Science* [**135**, 997 (16 Mar. 1962)]. However, we assume that Kaplan is already boycotting American cancer meetings, since this country has exploded more atmospheric nuclear devices than the Soviet Union and plans to resume such testing.

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