METEOROLOGICAL ASPECTS OF THE INTERNATIONAL BALLOON RACE, FROM DETROIT, MICH., SEPTEMBER 10, 1927

By C. G. ANDRUS

[Weather Bureau, New York]

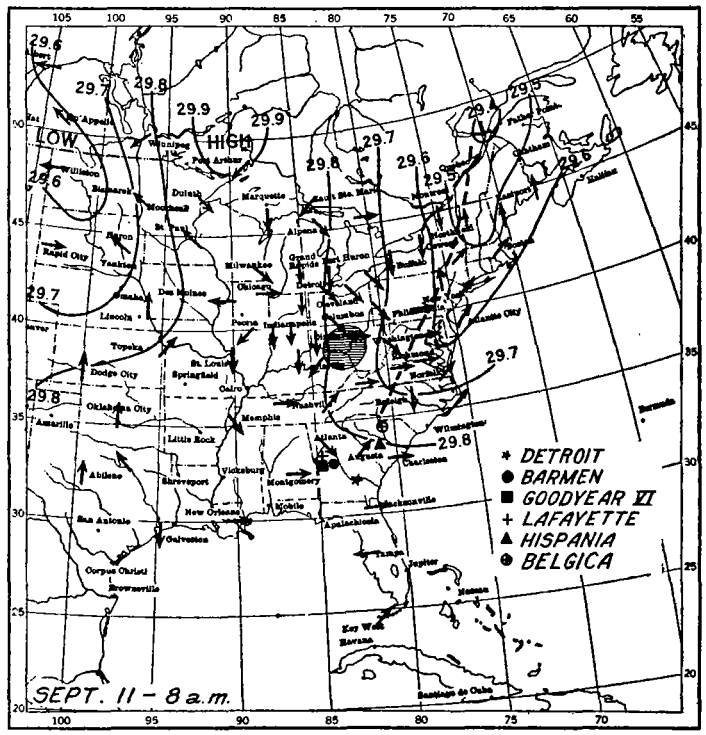
TABLE 1.—*Surface wind at Detroit, Mich., September 10, 1927*

	Miles per hour		Miles per hour
7 a. m., SW	3	2 p. m., WNW	7
8 a. m., SW	5	3 p. m., W	5
9 a. m., SW	5	4 p. m., W	5
10 a. m., SW	5	5 p. m., NW	6
11 a. m., SW	8	6 p. m., NW	5
12 m., WSW	9	7 p. m., N	4
1 p. m., W	7		

The balloons took off between 3 p. m. and 5 p. m.

The position of the group of aeronauts at 8 p. m. of the 10th was close to the wind-shift line, but within the north-wind zone. So close to the line were the balloons known to be that advices by radio were drawn up to discuss the current conditions and outlook for positions in front of and behind the line of wind-shift. The LOW had now developed more force and the south to southwest winds on its front more vigor especially over eastern Pennsylvania and New York. In the rear a narrow but well-defined zone of winds solid in direction to an altitude of 10,000 feet was located, directed toward the SSE.

For the first time in such a race, the idea of giving the balloonists not merely the ground meteorologist's notion as to what was going on and what should be the airman's tactics, but also giving them a description of the barometric lines and the wind and weather change areas, was given trial, and from this broadcast by the radio station WJR at Detroit, the balloonists were enabled to do their own thinking on plans for success. The radio now forms an essential, and the drawing of a weather map in the basket of a racing balloon should become no more novel than the charting of barometric lines in the chart room of an ocean liner.



The race during the 11th was a continuation of the southward drift, the balloons striving to avail themselves of the best of the slow-moving streams of air in the area still just behind the wind-shift line. Convection with its instability took its toll and the attendant expenditure of ballast and gas brought several of the

balloonists to ground in western Virginia and North Carolina. The persistency of this northerly wind zone was one of the outstanding developments of the race, meteorologically speaking.

The next day, the 12th, witnessed the landing of the last of the teams, the winner, the American *Detroit*, Hill, pilot, coming to rest 745 miles almost exactly south of Detroit after a valiant flight of about 48 hours. The second place was captured by the German *Barman*, piloted by Kaulen, who also stayed aloft 48 hours and made a mileage of 688. The remaining four balloons to take prize places, the American *Goodyear*, the French *Lafayette*, the Spanish *Hispania*, and the Belgian *Belgica*, all landed in Georgia or South Carolina during the 12th. As will be seen the speed was slow, averaging 5 to 6 m./s. Toward the end the balloonists were becoming involved in a secondary center of low pressure forming in southern Georgia, and the persistency of the north winds from start to finish may be accounted for in some degree by this low-pressure development.

Hill's experience in the *Detroit* was doubtless shared by the other balloonists in finding that the day winds were churned up by convection so that the best drift southward prevailed at high altitudes above the zone of convective influence; as the north wind may be assumed to have its power maintained by its content of comparatively cool air, the currents just above the ground being cooled by radiative influence should possess the fastest drift. The winner used this "skin" of wind.

Convective activity with its adiabatic vertical temperature gradient means a busy time aboard a balloon, which can never be in equilibrium long while within such a condition and is usually bent on taking either a rapid descent or ascent; if left unchecked, this will result in accelerated vertical motion, which will mean a greater expenditure of ballast or gas. During the 11th and 12th the balloonists found daytime conditions of this sort, developed by sunshine.

Electrical storm activity was more threatening than real, and after the first night the zone of thunderstorms appears to have been located ahead of the balloons and at its worst to have been marked by storms developed more by unstable temperatures than by displaced moisture, and consequently less severe. The weather except at the start was mostly satisfactorily fair and little blind flying was done.

The outcome of the race testifies to the limited nature of the possible courses of action. All the balloons, but one which was disabled over Lake Erie, landed a short distance south of the Appalachian ridges in the Carolinas and Georgia. The similarity of courses and velocities of travel are conclusive evidence that all were playing the same aerial game. Fortunately, neither the sea nor severe weather forced any of them down, while the results speak eloquently of careful ballast economy and persistent search for the best wind streams over a period of time which tried both patience and endurance.

AN EXAMPLE OF WIDESPREAD BUMPINESS IN THE AI

By C. G. ANDRUS

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Airplane flights over the New York–Cleveland airway October 12, 1927, encountered extraordinary roughness on the air. Roughness, or, as sometimes called, bumpiness, in varying degrees of severity is commonly met but evokes little comment from seasoned aviators unless its intensity becomes a decided handicap in flight. Usually when it is severe it is local, frequently associated with line squalls, tornadoes, violent thunderstorms, or gales upturned by mountain ridges. Inasmuch as the roughness of October 12 extended over about 350 miles of a strip of territory and for more than six hours, it is believed to deserve a brief note.

Pilot Collins arrived at Hadley Airport in the forenoon, after a rough journey from Cleveland, in which he found the rain to be rapidly on the increase both in severity and extent over that which had been reported before he left; the air was moist and warm at moderate altitudes, and within areas of condensation the turbulence was plainly indicated by roughness. At noon he reversed his plane's course, taking off for Cleveland with weather reports which granted a meager amount of ceiling and visibility, a generous supply of rain, and a boisterous SE. and SSE. wind along the course. He landed at the Bellefonte, Pa., landing field at 1:50 p. m., reporting impossble weather for immediate continuation of the flight owing to low ceiling, rain, and severe rough air. He states that the roughness was the worst of his experience, and that it occurred not only just above the ridges but in an even worse manner within the clouds which were outpouring rain one to four thousand feet above the 2,500 feet of the Allegheny Mountains. Tossed about by vertical currents which carried the plane through sudden variations in altitude of more than 1,500 feet, the pilot found it difficult and exhausting to maintain either course or control, so that blind flying became more perilous than usual, for once within the opaque confines of the cloud masses great "bumps" and "pockets" would have separated pilot and plane had he not been belted down.

At the same time another pilot guiding the east-bound mail plane was struggling with the same hazards. During moments when the plane was first on one end and then on the other the altimeter would record tremenduous fluctuations in altitude; running into a heavy rain-squall cloud whose base would be 3,000 feet above sea level, he would be tossed up to 6,000, and while pointing the plane nose down with an air speed of 140 miles per hour would hover there, finally emerging from the cloud into another mass of air in a down current almost as violent. Dodging around such volcanoes of rain, cloud, and air over a sea of mountains and valleys such as in central Pennsylvania is a hazardous practice, and this pilot, H. G. Smith, sought relief in a stop at the Snowshoe, Pa., landing field. Although belted to their seats, both pilots were so thrown about and against their cockpits that they were sore and bruised. The difficulty of keeping their craft pointed in any one direction for a moment at a time has a semblance to the experience of mariners aboard craft which are wallowing in the seas near the eyes of hurricanes; maintaining safe altitude is, however, an added requirement.

An analysis of the conditions from which this roughness arose shows that an unusual combination of two factors provocative of vertical components within air masses was evidently in action. The generation of roughness results from either mechanical or thermodynamical forces; the former are actuated by topographic unevenness which deflects either up or down air passing