

TABLE 1.—Halos observed at York, N. Y.—Continued.

B. LUNAR HALOS.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual total.
Year 1918.....	0	0	2	0	0	0	0	0	0	2	1	2	**7
1909-1918, inclusive (10 years), total..	14	8	14	6	8	1	1	4	4	7	15	20	586
Mean.....	1.4	0.8	1.4	0.6	0.8	0.1	0.1	0.4	0.4	0.7	1.5	2.0	58.6
Smoothed mean	1.4	1.1	1.0	0.8	0.6	0.3	0.2	0.3	0.5	0.8	1.4	1.7	.....

\*\*During 1918, 4 of the 7 lunar halos were followed by precipitation within 36 hours. Average interval was 12 hours.

1918.<sup>1</sup>

- January 11. 11:15 a. m. Very bright circumzenithal arc and part of 46°-halo.
- February 14. 3:30 p. m. Circumzenithal arc.
- February 16. Circumzenithal arc lasted 9:05 to 9:15 a. m. Solar distance, 46° at 9:10 a. m. Solar distance of north parhelia at 9:15 a. m., 24°.
- February 17. Very bright circumzenithal arc from 9:20 to 9:30 a. m. Bright parhelia and arc tangent to 22° at 9:30 a. m.
- February 22. 7:50 a. m. 22°- and 46°- (upper arc) halos.
- March 11. 7:40 a. m. 22°- and 46°- (upper arc) halos, parhelia and circumzenithal arc.
- April 22. 22°- halo all p. m. 4:35 p. m. parhelic circle<sup>o</sup> complete; southeast parhelia about from 22°- halo; 4:42 p. m. northwest infr4, lateral colored arc.
- June 8. 7.26 p. m. 22°-halo, faint, was visible in spite of the solar eclipse in progress at the time, which, together with low altitude of sun, cut down radiation exceedingly. Halo was visible only in part and for but a few minutes.
- September 2. 5:30 p. m. Circumzenithal arc and north parhelia.
- October 24. 4:43 p. m. Circumzenithal arc. Solar distance to middle of arc=51°. Faint accompanying 22°-halo.

LUNAR RAINBOW AT TATOOSH ISLAND, WASH.

By R. C. MIZE, Observer.

[Dated: Tatoosh Island, Wash., Dec. 15, 1918.]

A complete rainbow was observed here from 4:40 a. m. to 4:50 a. m. this date, more than three hours before sunrise. The sky was three-tenths covered with fracto-cumulus clouds moving slowly from the west, a light sprinkle of rain was falling, the moon's altitude was about 10 degrees and its phase nearly full. The rainbow was very distinct, even where no clouds were visible, and the right extremity was visible below the horizon. The red could be distinguished above the horizon near the right extremity. In other portions of the bow no color could be positively identified, but contrasts were clearly evident throughout its entire length. The rainbow disappeared when rain ceased falling at the station.

WIND ALOFT AT HOUSTON, TEX., DECEMBER 18, 1918.

By Lieut. I. R. TANNEHILL, Signal Corps Meteorological Service.

[Dated: Houston, Tex., Jan. 6, 1919.]

The horizontal projections (on Fig. 1) of the paths of three pilot balloons followed on the morning of December 18, 1918, show possibly a whirl in the atmosphere at an elevation somewhat greater than 1,200 meters. This was not a whirl in the sense of a dust whirl of local significance, but was of great dimensions and persisted for at least two hours. At a height of a little more than 2,000 meters the wind direction was evidently nearly the reverse of that at the surface, and the current at that level was observed

<sup>1</sup> All above observations recorded in 75th Meridian Time, except the last four (Apr. 22, June 8, Sept. 2, and Oct. 24), which are recorded in 60th Meridian Time.

from Park Place and Ellington Field (both a slight distance from Houston, Ellington being near Galveston). Irregularities in the amount of wind movement indicated in certain minutes during the rise of the balloons may have been the result of vertical movement of the air, which could not be differentiated from horizontal movement, since but one theodolite was used at either station. In assuming a uniform ascensional rate from formula an error arises in the distance of the balloon when there is an irregularity in the rate of ascent. The diameter of the whirl made by the balloon was about  $\frac{1}{4}$  kilometer. This does not represent, however, the magnitude of the whirl in the atmosphere, nor does it prove that there actually was such a whirl.

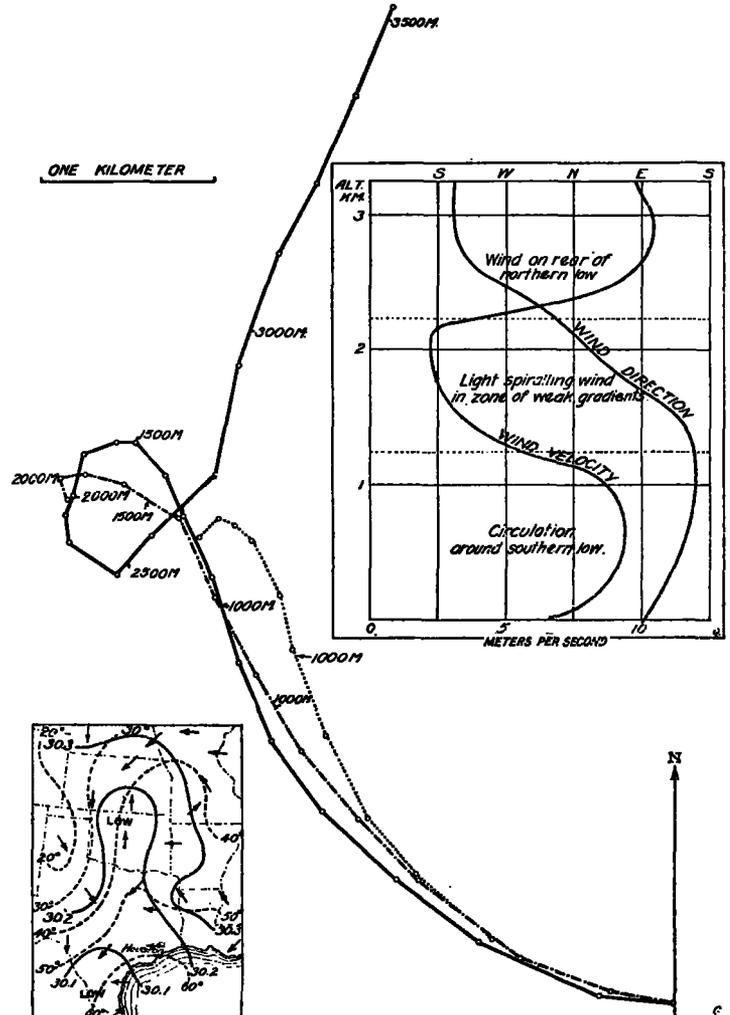


FIG. 1. The long lines represent the horizontal projections of pilot balloon flights, December 18, 1918: Solid line, balloon flight beginning 7:55 a. m., Park Place; dotted line, balloon flight beginning 7:25 a. m., Park Place; dot-and-dash line, balloon flight beginning at 9:33 a. m. at Ellington Field. The small circles show the positions of the balloons at the end of each minute. The figures show the probable altitudes of the balloons at certain points on the projections. The upper inset is a vertical projection of the wind direction and velocity as shown by the horizontal projections. The lower inset is a section of the weather map, 7 a. m. (90th Mer. time), December 18.

Discussion.—The inset diagram shows, in a general way, the changes of wind direction and velocity with altitude as deduced from the horizontal projections of the balloon paths; and the small section of the weather map for 7 a. m. (90th Mer. Time), December 18, shows an east wind in the lower levels circulating around the southern low center, and an upper southwest wind which was associated apparently with the circulation around the center to the north. This upper current was probably colder than the lower one, as is indicated by the colder weather in west Texas, where the winds were probably westerly at all levels. There were heavy rains on the 19th.—C. F. Brooks.