

that does not seem to have been heretofore observed. The first two are those marked *aa* and *bb*, which apparently are the upper bitangent arc of a halo of  $46^\circ$  and part of a "secondary" parhelic circle, respectively. At the intersections of these two arcs were observed bright spots which might be called "secondary" parhelia of  $46^\circ$ . The "secondary" parhelic circle was probably caused by the vertical parhelion at *c*, which in turn was produced by the intersection of the light pillar and the  $22^\circ$  halo.

The arcs *dd* are difficult to account for. Possibly they are parts of an "elliptical helio-centric halo," similar to that observed by Hissink in 1901, and referred to by Besson, MONTHLY WEATHER REVIEW, July, 1914, p. 445, top of column 1.—*W. R. Gregg.*

#### INFERIOR ARC OF $46^\circ$ -HALO, APRIL 25, 1918.<sup>1</sup>

By J. LAKE VESPER, Assistant Observer.

[Dated: Weather Bureau Office, Columbus, Ohio, May 20, 1918.]

A very interesting and unusual<sup>2</sup> optical phenomenon in the form of a double solar halo was observed at this station, Columbus, Ohio, on April 25, 1918.

When first noted at 11:50 a. m., 90th meridian summer time [?], it was exceedingly well defined and evidently had been visible for some time previous. Its duration for attractive brilliancy lasted until 12:40 p. m., after which it gradually faded.

The time of day at which it occurred (the sun being almost at its maximum elevation in the sky) was most advantageous for the observation of the complete  $22^\circ$ -halo. It was accompanied by the lower arc of a  $46^\circ$ -halo, the arc measuring approximately  $50^\circ$  in extent. The brilliancy of the  $22^\circ$ -halo was well defined for the  $360^\circ$ , with the exception of the lower segment symmetrical with the arc of the  $46^\circ$ -halo. This segment had attained a very great brilliancy, causing the arc of the  $46^\circ$ -halo to be visible.

The latter lacked somewhat the brilliancy of the  $22^\circ$ -halo, but the color was well defined, with the blue predominating.

A double solar halo observed at this station by Mr. T. G. Shipman, August 1, 1911, at 12:10 p. m. [90th mer. time], was similar, the radius of the outer halo being  $46^\circ$  and the inner  $22^\circ$ . Its coloring was very marked and beautiful.

Dr. Louis Besson, in his article, "The Different Forms of Halos and Their Observation" (this REVIEW, July, 1914, 42: 438-9), states that the average frequency of such phenomena at Paris is eight days per annum, and in two-thirds of the cases only the superior portion of the  $46^\circ$ -halo is visible. This case of the lower arc is therefore a rare one and worth recording here.

#### ELLIPTICAL HALOS OF VERTICAL MAJOR AXIS.

By J. B. DALE.

(Craigness, New Malden, Surrey, Apr. 10, 1918.)

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The accepted explanation of the halos of  $22^\circ$  radius which are seen surrounding the sun and moon implies

<sup>1</sup> Publication approved by Division of Aërological Investigations.  
<sup>2</sup> The  $46^\circ$ -halo or its upper arc is not so very rare in this country. The REVIEW for July, 1914, pp. 431-436, presents in its figures 1, 3, 5, and 8, illustrations of  $46^\circ$ -halos seen in November, 1913; cases of the  $46^\circ$ -halo are also reported in the REVIEW for October, 1917, p. 486, and for May, 1916, p. 215.—*C. A., Jr.*

that they are exactly circular in form. About two years ago, however, I noticed a halo which appeared to be elliptical with the major axis vertical. I was unfortunately unable to take any measurements on that occasion, but on March 18, 1918, a lunar halo, which was visible for a considerable time during the evening, also appeared to possess a decided, though slight ellipticity. That this deviation from the circular form was not an illusion I was enabled to verify by noting the positions of Capella and  $\gamma$  Geminorum relative to the ring.

At 7:30 p. m. Capella appeared to be exactly upon the inner edge of the halo, while  $\gamma$  Geminorum was within the ring at a distance from it, which, as nearly as I could judge, was a quarter of the moon's diameter. From these data I find that the radii of the halo measured from the centroid of the illuminated disk of the moon through these two stars were  $22.8^\circ$  and  $21.4^\circ$ , respectively. Assuming that the halo was elliptical with the major axis vertical, I deduce values of  $23.3^\circ$  and  $21.4^\circ$  for the semi-major and semi-minor axes. I am aware that a more or less complete halo, the major axis of which is horizontal, is occasionally seen surrounding the  $22^\circ$ -halo, but records of halos elongated vertically are rare. In 1908 Prof. Schlesinger noticed one, the axes of which were about  $7^\circ$  and  $4^\circ$ .

Sir Napier Shaw informs me that very little is done in this country on the shapes of halos, so that this letter may serve to direct attention to the desirability of obtaining accurate measurements.

#### REAL VELOCITIES OF METEORS.<sup>3</sup>

By CHARLES P. OLIVIER.

[Reprinted from Science Abstracts, Sect. A, Jan. 31, 1918, § 29.]

From a list of real flights of meteors observed by members of the British Astronomical Association (B. A. A. Journal, January, 1917), eight doubly-observed meteors are selected as assigned to a radiant near R. A. =  $302^\circ$ , Decl. =  $-8^\circ$ . This position is not far from the ecliptic, and appears to be a very likely example of a stationary radiant. To investigate the orbits reductions were made by Bauschinger's method, and the results are presented in a table showing the elements for each meteor orbit. Some difficulty is introduced by the importance of the duration of the time of flight, the observation of which is scarcely accurate enough when made visually, and it is hoped that systematic work may soon be done with photographic registration, apparatus having been designed for this purpose by the late Cleveland Abbe. It is concluded that the radiant under discussion is the most promising of all those hitherto examined with regard to its likelihood of being a stationary radiant.—*C. P. Butler*].

#### VISIBLE WEATHER [CHINOOK WEATHER; ?]

The following interesting communication, by Robert T. Pound, is reprinted from Scientific American, New York, February 16, 1918, page 147:

LAVINA, FERGOUS COUNTY, MONT.

[Lat.  $46^\circ 12' N.$ , long.  $109^\circ W.$ ]

On December 14 [1917], after several days of storm, my brother and I noticed that the western end of the Big Snowy Mountains, about 20 miles northwest of our place, seemed strangely distorted, the distor-

<sup>3</sup> The Observatory, October, 1917, No. 518, p. 365-368.