

## THE PUNCHARD ENSIGN.

First, the ring had entirely disappeared leaving only the arcs which had increased until they formed an apparent eclipse. But the extra part of these arcs which would have come on the inside the eclipse was not visible. For future convenience I call these the first primary arcs. The same change had happened to the authelite bow, and to the authelite arcs which I will call second primary arcs, except that the southern half, instead of the northern, could be seen, being able to be traced from the sun itself, at least  $130^\circ$  either way, making it in all about  $260^\circ$  in extent. Within and concentric with this was another couple of arcs, precisely similar, except only one-half the size, as they started from the northern interception of the first primary arcs. These may be called first secondary arcs. Now directly below the sun were two authelite bows, the same size as those above, passing through the sun and stretching some  $80^\circ$  either way, their centres being in the horizon. At an altitude of some  $18^\circ$ , two faint but distinctly colored bows,  $15^\circ$  in length with red on the outside intersected the last mentioned arcs.

In the following list the dimensions are given for those interested.

Brightest at 2.20; greater radius, first primary arcs,  $25^\circ, 51'$ ; lesser radius,  $23^\circ, 27'$ ; first secondary arc, same size; greater radius, second primary arcs,  $51^\circ, 10'$ ; lesser radius,  $46^\circ, 55'$ ; (diameters twice as great;) zenith distance sun,  $46^\circ, 55'$ ; altitude,  $43^\circ, 5'$ .

The last series was the most beautiful and yet most simple of them all. The first primary arcs had still more separated, making the minor radius, or the distance to the mock-sun to the sun,  $42^\circ, 27'$ , and the major radius several degrees greater. The second primary arcs were still there, stretching across the heavens, through the sun, at an altitude of but  $20^\circ, 12'$ ; all the rest of what had been seen before, had disappeared. But the finest part was an addition, namely, a most beautifully colored bow, with red inside, concentric with the sun, and curving through the heavens with its highest point at an altitude of  $65^\circ, 40'$ . The last that was seen of this beautiful show was at 4.45, when it slowly faded out of sight. Probably when the sun reached the horizon, the first primary arcs would have been tangent at the centre of the sun, and the second primary arcs coincided with the horizon. It is only necessary to add in explanation that the upper stratum of air was filled with ice crystals, and the sun was refracted by passing through them, forming the colored bows and reflecting on their faces, making the white bows.

This phenomenon ought to be more widely known for such a thing has not previously been seen, to my knowledge, in Andover.

### HALOS OF SEPT. 2, 1882.

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Sept. 2, 1882, as well as the dark day of Sept. 6, 1881, should be recorded in the annals of atmospheric phenomena, on account of the remarkable, and at the same time, beautiful appearances in the sky on the afternoon of that day. Although it was seen by a large number of persons in this town, still, since that time only one mention of it of any kind has been found. That was a letter to a Boston paper stating that it was seen in Boston by some few persons.

I was fortunate in seeing it soon after it began and also in having a little instrument for measuring zenith distance, accurately, to within a few (")'s of an arc.

The Halo was made up of three distinct sets or series, the first lasting from 1.10 until 2 o'clock; the second from 2.10 until twenty minutes before 4; the third from 4.18 until 4.45.

The first was entire and at its brightest at 1.57, about five minutes before it disappeared, when the sun was nearly  $30^\circ$  west of the meridian. There was a ring around and concentric with the sun, having a diameter of  $43^\circ$  S, most highly colored on the upper or northern side, red being inside and violet out. Within this ring were two arcs whose centres were near the line of the sun. But, only the parts inside the original were visible and they, like the ring itself had red inside and were highly colored at their intersection with the ring, making a mock sun at that place. On turning around and looking toward the north-east, there could be seen a semi-circular bow of milky whiteness (called an authelite bow) intersected at a point exactly opposite the sun and at the same altitude,  $46^\circ, 54'$ , making the diameter of the arc fully  $86^\circ$  by two arcs  $10^\circ$  or  $12'$  long, also authelite. This formed a figure resembling the one immediately surrounding the sun in all respects except that its centre was the zenith; its color white and its size double, although hardly half as much could be seen.

That gradually faded out owing to the clouds and the movement of the sun, until 2 o'clock when the sky resumed its natural appearance.

Remaining at my post of observation to watch any part of it which might possibly re-appear, I noticed even within ten minutes a few arcs returning. Waiting a few moments longer, they slowly formed themselves into a complicated series of arcs and rings that will be difficult to describe. But I will try and explain it so that anyone by making a diagram for himself as he reads, may be able to obtain a clear idea of the shape.

Punchard Ensign