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MOHONK LAKE COOPERATIVE WEATHER STATION

Halos, Mock Suns, and Coronas

14 March 1974

Halos are one of the secondary weather phenomena that may be noted on the monthly reports that Cooperative Weather Station observers submit to the National Weather Service. The word "halo" is a general term for various arcs, spots, and occasionally full circles which may be seen in relation to the sun. Some of them may also be seen around the moon.

The Mohonk weather station did not record these secondary phenomena during its early years. The first note of a solar halo appeared in January 1946. Since then, to 15 March 1974, solar halos have been recorded 64 times. Forty-seven (73%) of these have been in 1972, 1973, and 1974. This does not indicate more frequent occurrence but simply more careful observation and recording. My reference books indicate that consistent sky observation every day throughout the year would show some form of solar halo visible every three or four days, with more being seen in April and May.

The onset of awareness has been nicely expressed by M. Minnaert in his book "The Nature of Light & Colour in the Open Air," as follows:

"After a few days of fine bright spring weather the barometer falls and a south wind begins to blow. High clouds, fragile and feathery, rise out of the west, the sky gradually becomes milky white, made opalescent by veils of cirro-stratus. The sun seems to shine through ground glass, its outline no longer sharp but merging into its surroundings. There is a peculiar, uncertain light over the landscape; I 'feel' that there must be a halo round the sun!"

Source & Significance

Halos and related phenomena are a part of the passage of frontal storm systems, but they are not of much help in predicting the weather — old superstitions to the contrary. Once our eyes are opened to them the most common observation is of a portion of a circle, or a bright spot or spots, at an angle of about 22° from the sun, visible through thin clouds. They are often missed by the casual observer because of the brightness of the sun. Caution: do not risk eye damage by looking directly at the sun. Stand at the edge of the shade of a building or tree, or hold your hand in the line of sight.

The 22° ring is the small halo. It is much more common to see only a portion of this ring than the whole circle. Quite frequently bright spots appear, with or without the ring and just outside of it. Rarely one sees a much larger outer ring at some 46° from the sun. Also rarely one sees arcs of brightness tangent to various portions of the halos.

All of these phenomena are the result of ice crystals in the upper atmosphere. They have been picked up by the prevailing westerly winds from a storm front moving east, and then settle into a quiet layer

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of air. Their presence is manifested by transparent veils of cirro-stratus clouds of varying degrees of density at 20 to 25 thousand feet. The ice crystals take the form of hexagonal plates, columns, or needles. These all are of small size and settle slowly by gravity. When they are in the form of needles, with axes parallel, halos are produced. The symmetry of the various phenomena is due to the shape of the crystals.

The small halo is due to refraction of the sun's light through innumerable ice needles. Sometimes it appears to our eyes as a narrow whitish ring (or portion). At other times various colors may be seen, a sort of rainbow with the order of colors in reverse — with red on the inside, then yellow, green, white, and violet on the outside. The large halo is produced by both refraction and internal reflection within 90° ice prisms randomly oriented. There may be the same order of colors but they are less bright than those in the small halo. The spots are called mock suns or sun-dogs or parhelia. They are the result of concentrations of light on a small halo at the same height above the horizon as the sun. Sometimes the halo is absent and only the spots show. This has been noted a number of times at Mohonk.

The moon may produce a parallel set of phenomena, under similar conditions and by the same physical mechanisms. However, since the source of light is so much less intense, few of them are seen and color is generally absent.

Coronas are faintly-colored luminous rings around a celestial body visible through haze or a thin cloud, caused by diffraction of light. They are much smaller than halos, with a radius of 4 to 8 degrees. When colors show, blue is nearest the source of light, as with the primary bows of rainbows. The Minnaert book has several pages of description of "coronae" phenomena, including one type that occurs in the eye of the beholder.

Superstitions

"Halos predict the coming of a storm in one to three days." Halos are associated with the types of cloud that precede a storm in a broad geographical sense. However, there is no assurance that precipitation will occur at every place where the advanced cirro-stratus clouds have made halo phenomena visible. One can only say that generally a halo indicated there will be precipitation somewhere to the east of the storm within a few days. A sampling of Mohonk records suggests that about two-thirds of the time after a halo sighting, precipitation occurs in 1 to 4 days.

"The number of stars seen within the circle around the moon tells the number of 12-hour periods before it will rain." This superstition was told me by a Mohonk workman in 1939. It has no basis in fact. The relative density of ice crystals would influence the number of stars visible, but it is not directly correlated to the speed of the advancing storm.

Mohonk Observations of Halo Phenomena

The most celebrated set of halo phenomena that occurred in this area lasted two days, November 1st and 2nd, 1913. If seen, this

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event was not recorded here.

As noted, the observation and recording of solar halos has improved during the last three years. The following table shows the number recorded in the weather reports by years:

1946	1	1965	1	
1950	1	1966	2	
1951	1	1969	1	
1952	1	1970	1	
1953	1	1971	3	
1956	1	1972	8	
1959	1	1973	26	
1961	1	1974	(13)	through 3/15
1964	1	Total	64	

The distribution by months is of considerable interest:

Jan.	21	July	2
Feb.	9	Aug.	1
Mar.	13	Sept.	0
Apr.	0	Oct.	3
May	4	Nov.	1
June	2	Dec.	8
		Total	64

These figures indicate that either solar halos are more prevalent during the winter months, or my observation was more consistent, or they are more apt to be noticed when the sun is lower in the sky. The predominantly cloudy days of November may account for the low score in that month. Notes were sometimes recorded as to the amount of the circle visible, whether colors were seen, and the presence of mock suns; but these observations have not been sufficiently consistent to warrant tabulation. However, colors and mock suns are often seen. On the other hand, full circles and tangenical arcs have rarely been observed. I have no record of seeing the 46° halo, but on 5 May 1933 a relative saw the two halos as full circles. Halos have been seen from about an hour after sunrise to about an hour before sunset. Sometimes conditions have been such as to make them visible all day or recurrently during the day. At other times they were quite transient and lasted only minutes.

Technological Mock Sun. On 2 January 1974 at 9:30 a.m. with a clear sky I observed briefly a mock sun in the vapor trail of a jet plane.

Lunar halos have been seen a number of times, but for reasons I can't explain this phenomenon was recorded only once in the weather records, 16 February 1946 at 9:30 p.m.

Lunar coronas have been recorded twice — 6 April 1955 and 29 January 1961. The latter was photographed in color. Doubtless this manifestation of ice crystals could have been seen at many other times.

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Afterglow is a diffuse light seen in mountains following sunset or preceding sunrise. The color ranges from purple to yellow and results from the reflection of light from fine dust in the upper atmosphere. At 6:45 a.m. on 1 October 1959 I observed a strange purple "glow" in ground fog, which I assume may have been the morning counterpart of sunset afterglow.

Iridescent Cloud. The most beautiful manifestation in this family of phenomena in the drama of weather was an iridescent cloud which was studied for an hour and photographed in color. It occurred in late afternoon on 31 January 1972. Minnaert's book discusses this rare phenomenon in some detail and indicates that it may occur at all seasons. It is close to the sun and shows best near sunset. What I observed was a thin veil of clouds against a clear blue sky. They were above and to the south of the sun. A horizontal "ribbed" configuration was noticeable in part of the veil. The beauty came from the quality of the colors. Violet, green and rose could be seen — in variegated areas but without discernable pattern. Reviewing the slides of this event brought to mind such words as pearly, iridescent, and luminescent. From the extent of the coloration and the angular distance from the sun I believe that this was one of the very rare "mother-of-pearl clouds."

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