A Science Service Feature

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REFRACTION MAKES HALOS

If you took an ice prism one face of which made an angle of 60 degrees with another, and if you allowed sunlight to pass perpendicularly in one side and out the other, you would find a band of colors in the order of the spectrum; red, orange, yellow, green, blue, indigo, and violet. The red would be nearest the line of the original sunlight. Now if you sought to measure the angle which the yellow light makes with the original direction of the unbent white light, you would find it to be close to 22 degrees. You have reproduced for yourself the refraction of sunlight by myriads of tiny hexagonal crystals of ice, falling in every conceivable orientation through the air. Though most of the crystals will not be in just the right position to make the colors at 22 degrees radius, there often are enough in the right position to give the distinct colored ring we call the halo.

Experimenting with a square of ice you can simulate the conditions that make the 46-degree halo, for when the light enters an ice crystal through one face, and then comes out through another at an angle of 90 degrees the light is bent 46 degrees. Rarely are there enough crystals of the sort required and in the correct position to produce a distinct ring of light, or 46-degree halo, in the general whiteness of the sky.

Not infrequently the minute crystals forming high in the air have a tabular form, which favors their falling with their biggest faces nearly horizontal. Under these conditions refraction through faces at 60 degrees can take place only in a nearly horizontal direction. This makes parhelia, or sundogs. Likewise, the refraction through faces at 90 degrees can come only from light in above and out a side. This makes the circumzenithal arc. Simple reflection from the horizontal faces makes the sun pillar, a common accompaniment of the sun-dogs.

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