

# Cover illustration

## Heavenly rings

On a cold winter day thousands of years ago, the local inhabitants of northern Europe may have looked into the sky to see a spectacle much like the one on the cover. Perhaps, they became convinced of the presence of a deity. Such is the dazzling power of an ice crystal display, and it has been proposed that the Prophet Ezekiel's vision of a wheel within a wheel was a complex ice crystal display not too dissimilar to our cover this month.

The magnificent and complex ice crystal display illustrated here was photographed by Walter Tape in Antarctica, and can be found on the cover of his book entitled *Atmospheric Halos* (American Geophysical Union, 1994). It illustrates some of the many possible rings, arcs, pillars, and other optical phenomena that often greet the observant.

The innermost circle of reflected light is called the 22° ring, and is very common. Such 22° rings or fragments are visible in most parts of the world, and perhaps up to 200 days a year or more. This is a ring refracted through the prism-like ice crystals formed in the stratosphere or even near the ground if the temperature is right. These rings may be colourful with red on the inside (refracted least) and blue on the outside (refracted most). Ice crystals are six-sided flat or elongated structures (see figure) that refract sunlight to the observer's eye. One only has to look. The larger and dimmer ring is the 46° halo and is less common, but is still seen with some frequency. The curved arc that seems to go through the opaque disc used to shield the bright sun is called the parhelic circle, and is the result of reflected light. This arc is actually a 360° circle and circumferentially parallel to the horizon, if complete. The subtle "concave towards the sun hat" that seems to sit atop the 22° halo is the Parry arc named after Admiral William Edward Parry who was the 19th century's first hero-explorer. He led the first non-Eskimo expedition to overwinter in the Arctic archipelago while on a quest for the Northwest Passage. On his expedition between 1819-20, he carefully described, and correctly drew, the arc in his journals during



A six-sided pencil shaped crystal of ice with the potential to produce many of the displays discussed here.

one of his several trips into the Arctic ice. Incidentally, Admiral Parry's father, Caleb Parry, was one of the first to correctly describe thyroid eye disease.

The bright spots of light along the parhelic circle that seem to be part of the 22° halo are known as parhelia, mock suns, or more famously as "sun dogs." These can be seen without the 22° halo and are perhaps even more common. Sun dogs are produced by the refraction of light through flat hexagon-shaped crystals which are thin plate portions of the six-sided pencil-like crystals (figure) that produce the 22° ring. Sun dogs, usually found in pairs, are often seen as bright colourful spots on clouds approximately 22° away from the sun, and these displays may be a few degrees across often showing a "tail" with the reddish colours on the apex closest the sun. Less commonly, these can also be seen in moonlight and then are known as paraselenae. Sun dogs can even be seen in blowing snow.

The faint "hat" that sits on the larger 46° ring is called the circumzenith arc, or the queen of the arcs. The magnificent arc, also called Bravais' arc, is usually very colourful with a rainbow-like distribution, although the difference is that the red colour nearest the sun indicates the light is only refracted, but not refracted and reflected as light from a rainbow would be. This arc is usually a quarter of a circle facing the sun and its radius will vary depending upon the height of the sun.

It was probably E Mariotte in 1681 who first attributed the haloes around the sun to ice crystals, although Sumerian cuneiform tablets first named the 22° haloes as "tarbasu." Clearly, our early predecessors saw halos, because we know that Aristotle thought they were reflected from tiny mirrors in the sky. But, it remained for Mariotte to prove how such crystals would produce both the 22° arc and the sun dogs. He produced his explanation by demonstrating the refraction through two equilateral triangular prisms placed base to base. In about 1807, Thomas Young, who first began the deciphering of the Egyptian hieroglyphics, and first enunciated the trichromacy colour vision theory, added to the understanding of the multiple forms of the ice crystals, and the different arcs they would produce.

As Greenler discusses in his book, *Rainbows, Halos, and Glories* (Cambridge University Press, 1989) there have been several well documented complex displays similar to the one depicted on the cover. These displays have been so profound and beyond the understanding of those who first witnessed them, that these dramatic celestial colourful arcs, halos, and lines must have conjured the supernatural. One such observation, recounted by Greenler, was described by the Danish astronomer, Hevelius, from a display he witnessed on 20 February 1661. This display was so famous as to have been referred to as the Danzig phenomena. This drawing has seven bright spots which are referred to as the "seven suns." It is an easy step to see how such a display might have been the source for Ezekiel's vision of a ring within a ring and faces being seen across the celestial vault.

### I R Schwab

University of California, Davis, Department of Ophthalmology, 4860 Y Street, Suite 2400, Sacramento, CA 95817, USA; [irschwab@ucdavis.edu](mailto:irschwab@ucdavis.edu)

Photographs by Walter Tape, PhD, taken from his book *Atmospheric Halos*. Thanks to Dr Tape for the use of the photographs and advice on the essay.



## Heavenly rings

I R Schwab

*Br J Ophthalmol* 2003 87: 681  
doi: 10.1136/bjo.87.6.681

---

Updated information and services can be found at:  
<http://bjo.bmj.com/content/87/6/681.full.html>

---

*These include:*

**Email alerting  
service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

---

**Notes**

---

To request permissions go to:  
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:  
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:  
<http://group.bmj.com/subscribe/>