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Abstract: The article presents answers to queries of readers of the periodical "New Scientist," related to the field of science. Glories look like rainbows, but are formed in a different way. Unlike rainbows, they depend on both refraction and scattering of light. The coloured rings are caused by diffraction. Physicist Charles Thomson Rees Wilson observed glories from the observatory on Ben Nevis in Scotland and created a cloud chamber to study them in the laboratory. Glories are common in mountainous or high-latitude regions, where the low angle of the sun means that people can easily come between sun and cloud.

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The last word

Triple trouble While visiting the east coast of Iceland last August I saw an atmospheric phenomenon that was new to me: a triple, almost quadruple, rainbow around my shadow. I was above the cloud line, with the sun behind me, as I looked over a cliff. What is it and what caused it?

• What your questioner saw was a glory, in a typical situation: he was high up, with the sun behind him, looking out onto a body of uniformly sized water droplets.

Glories look like rainbows, but are formed in a different way. Unlike rainbows, they depend on both refraction and scattering of light. Light from the sun is usually randomly scattered by solid, irregular dust particles in the air (the most common effect of which is that the sky appears blue). But in this case, because the droplets are regular and transparent, and a certain amount of refraction occurs, more light tends to be scattered in the direction of the observer. This makes the glory look brighter than the surrounding area — another difference from rainbows.

The coloured rings are caused by diffraction. The light waves scattered by any one droplet are slightly out of step with light waves from nearby droplets. This tends to reinforce or cancel certain wavelengths, giving rise to the different coloured rings.

Glories are common in mountainous or high-latitude regions, where the low angle of the sun means that people can easily come between sun and cloud. Once, the only people in a position to see them were climbers and alpine shepherds. Now they can often be seen

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when flying. If you are on the shadow side of an aircraft, in the sun and above the clouds, look out of the window and down.

If you are in a group when you see a glory you may be perplexed to see the coloured rings only around the shadow of your own head, and not around the shadows of your companions. But, of course, people only see a ring around their own shadow as each glory is individual. Even stranger, if you take a picture with a camera held at waist level, the glory would be around your midriff.

When the glory combined with your shadow is projected onto the clouds the effect is eerie and is called a Brocken spectre. This name comes from the story of a climber who, in 1780, was working his way across a precipice on the Brocken, the highest peak in Germany's Hartz mountains. Suddenly a huge human figure with a ring of light around its head appeared in the clouds below. The poor climber was so terrified by the manifestation that he fell to his death.

There is a magnificent photo of a Brocken spectre at www.sundog.clara.co.uk/droplets/globrock.htm. It is easy to understand how such a sight could have been taken as a ghost or a holy figure. Perhaps the idea that saints have halos around their heads came from this phenomenon. Many classical paintings show halos as vertical discs centred on the eyes of saints.

Alistair Scott

Gland, Switzerland

The final point above is made more plausible by the next letter — Ed

• I can offer an interesting historical anecdote that draws a parallel between the Renaissance and your questioner's experience.

The 16th-century Italian artist Benvenuto Cellini is said to have seen a similar halo, now widely believed to be a glory, surrounding the shadow of his own head and cast upon a field of dew-laden grass. He believed it to be an indication of his genius and piety.

John Manifold

Hornchurch, Essex, UK

• The glory is formed by the interference of light that has been back-scattered from individual water droplets in the mist. The different rings of the same colour correspond to different-order interference maxima.

The radius of each ring is proportional to the light's wavelength and inversely proportional to the droplet radius. So if the droplets in the mist are of uniform size, several distinct coloured rings can be visible. Droplets of about 10 micrometres diameter will produce rings of a few degrees in angular radius, much smaller than that of a primary rainbow, which is 42 degrees.

The physicist Charles Thomson Rees Wilson observed glories from the observatory on Ben Nevis in Scotland and created a "cloud chamber" to study them in the laboratory. Subsequently he realised this effect could be used to detect the tracks of charged particles, for which he received a Nobel prize in 1927.

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John Hardwick

Abingdon, Oxfordshire, UK

This week's questions Lightweight scales

My 5-year-old neighbour Oliver wants to know why butterflies and moths are not able to fly when they lose the dusty surface of scales from their wings — when they collide with a wet window, for instance.

Jane Elek

Research Entomologist

Forestry Tasmania

Hobart, Australia

Lump life

I attach a photo of a phenomenon that has me baffled. These gelatinous lumps turn up about this time each year, around the perimeter of the pools in my garden. Although they appear at around the time frogs are breeding, they do not seem to be spawn because they don't appear to contain any eggs. The photo shows lumps that have been subject to rain: when fresh they are more angular in shape. They remain in the grass for up to a week, and then disappear as quickly as they appeared.

Bob Harbinson

Welshpool, Powys, UK

PHOTO (COLOR)

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