

An eclipse, It's my kind of magic

An eclipse? It's my kind of magic, - "A solar eclipse has an undeniable aura, but stripping away all its mystical baggage, says Richard Dawkins, reveals the true magic - science, The Sunday Times, July 25, 1999

The total solar eclipse on August 11, when the moon's shadow will cross the Atlantic in a swift half-hour, making landfall in Cornwall at 11:11 am, is the first to hit mainland Britain since 1927. We won't have another until September 23, 2090. The 1927 eclipse gave Yorkshire 15 seconds of totality, compared with the two minutes that south Cornwall will enjoy this year. Even so, about 3m people, Virginia Woolfs Bloomsbury party among them flocked north to witness it in what is believed to be the largest single movement of people by train.

I have never seen a total solar eclipse and I don't intend to miss this one. Our family were going to Cornwall, but we changed our minds when we heard about the druids, astrologers and new age airheads who threaten to overrun that unfortunate county. The Archdruid of Cornwall, claiming that "there is not a lane in Cornwall where someone hasn't seen fairies or the little people", is planning a god and goddess night, evenings of fortune-telling and a sun dance to discourage rain on the day of the eclipse.

So it's Austria for us, a little farther along the shadow's path, where there should be less "spirituality" to distract from the real magic of the eclipse.

Why has such an aura of mystery grown up around total solar eclipses? It's partly that they are perceived as rare. But they are not rare, if we take the planet as a whole. It's just that the long narrow area swept out by each path of totality is small compared with the area of the planet, most of which is uninhabited.

More years than not, there is a total eclipse of the sun to be seen somewhere on Earth. The town of Novo Rodondo in Angola will have one on June 21, 2001, and another on December 4, 2002. There's a spot in the Pacific - for all I know there's an inhabited island there - which will experience total solar eclipses in 2005, 2010 and 2019, and will be very close to a fourth in 2020. Dedicated eclipse groupies who are prepared to travel, the world in pursuit of them will have 68 solar eclipses to choose from in the next century'.

Incidentally, the apparent rarity but actual commonness of eclipses makes them handy for astrologers. Someone has sent me an analysis of Prince Charles and Princess Diana's lives (amusingly, its feats of divination were retrospective) showing that each significant event occurred within a year or so of an eclipse. But eclipses are so frequent that the key events in any life can't help being associated with an eclipse somewhere in the world. The best one is Prince William's birth, which occurred on the same day as a partial eclipse - in Antarctica.

If we must make portents out of eclipses, Northern Ireland will experience its next total eclipse of the sun on June 14, 2151. Not quite the anniversary of the battle of the Boyne, but June 14 is the very day William of Orange first landed in Ulster on his campaign which culminated at the Boyne, symbol of the religious hatreds that beset the unhappy province. Perhaps the largeness of this astronomical prodigy will help to shrink Bigendian versus Littlendian bickerings into proportion. Might we even dare to hope that, by 2151, there won't be any Catholics or Protestants left, only people?

What is it about a total eclipse of the sun that leads many, to describe it as the most amazing experience of their lives? We are able to see (and conduct normally, impossible research on) the suns glowing, Corona and if we are very lucky, solar flares; also jewel like Baily's beads which are profiles of mountain valleys on the moon.

Reports also speak of an eerie quiet as bewildered birds stop singing (though in another report the quiet was shattered by people "hooting and hollering like pagans"). It may feel menacingly colder and some feel a yearning sensation of loss, followed by exultation when the light returns. All this I can only look forward to, having no personal experience.

Virginia Woolf wrote in her diary in 1927: "I had very strongly the feeling as the light went out of some vast obeisance; something kneeling down and suddenly raised up when the colours came. They came back astonishingly quickly and beautifully in the valley and over the hills - at first with a miraculous glittering and ethereality, later normally almost, but with a great sense of relief. It was like recovery ... We had seen the world dead."

From a high vantage point in clear dry climates you may watch the shadow hurtling apocalyptically across the plains at 1.000mph. This must be a spellbinding sight. Here's another, and this you can experience in regions where the eclipse is not total, including the whole of Britain on August 11 (always assuming the weather is fine). Before the eclipse, find a wood where sunlight filters through the canopy. Notice how many of the dappling patterns on the ground are near-perfect circles. The reason is not that the canopy has circular holes for the sun to shine through. Regardless of shape, each small gap between the leaves acts as the pinhole of a natural pinhole camera. Each circular spot on the forest floor is an inverted real image of the round sun. Now, imagine what will happen to those hundreds of little sun images during a partial eclipse, when the sun becomes a slender crescent. You can keep your fairies and little people. Here is authentic magic on the forest floor.

Any object in the solar system, whether planet, moon or asteroid offers a shadow on the side away, from the sun. 'Me shadows usually fall on empty space. But because the solar system originally condensed out of a spinning disc of gas, most of its orbiting bodies are still confined to one disc-shaped plane. The sun is the centre of the disc, so planets and moons shade each other more often than they would if they formed a spherical cloud around the sun. We don't notice when Venus or Mercury traverses the sun, but the moon is another matter because it is so close. Being part of the primordial disc, it orbits the Earth in roughly the same plane as the Earth orbits the sun so, not surprisingly, its shadow sometimes falls on the Earth (eclipse of the sun) and the Earth's shadow sometimes falls on the moon (eclipse of the moon).

If the two orbits were exactly in the same plane - if the solar system were the perfect remains of a perfect disc - why, then, eclipses would have to occur every month of every year. The moon would be eclipsed whenever it was full (opposite the sun from Earth). Two weeks later, the new moon (between the sun and us) would inevitably eclipse the sun. But reality is messier than my idealised abstraction. The moon orbits the Earth in its own little plane, which is tilted at about five degrees to the Earth's orbit around the sun. As these two tilted orbits move in and out of phase with each other, the monthly opportunities for a solar eclipse are actually taken up only occasionally, according to a complicated pattern called the saros cycle which repeats itself every 18 years.

In most months, at new moon when there should ideally be an eclipse of the sun, the shadow of the moon misses the Earth altogether. In effect it passes north of the North Pole or south of the South Pole. The saros cycle takes no account of the spinning of the Earth on its independently tilted axis so—another complication—the 18 year repeats don't revisit the same part of the world.

Because the Earth spins on its own axis every 24 hours, an eclipse shadow sweeps very fast along a roughly eastward path, thousands of miles long but very narrow. Only people in this path see a total eclipse. Many more people, in a much wider band, see a partial eclipse with part of the sun's disc obscured and a crescent remaining.

In any one spot, a total eclipse lasts only a matter of minutes as the shadow speeds over the surface of the globe. But in the same spot we can see the sun partially eclipsed for an hour or so as its crescent shrinks towards totality, and for another hour or so after totality as the opposite crescent grows towards the full sun.

The diameter of the sun is about 400 times that of the moon. And, as it happens the sun is about 400 times farther away from us than the moon. So the moon fits almost exactly over the sun. The coincidence is pure luck, completely meaningless, though many prefer to credit providence.

Anyway, it has a satisfying consequence. If the moon's apparent size were larger. We shouldn't see the sun's corona, solar flares or Baily's beads: an eclipse would be just like ordinary night. If the moon's apparent diameter were less than the sun's ... well, that happens sometimes and we see an "annular" eclipse: a ring of bright sun all round the moon's circumference. It happens because the moon's and the sun's distance from us are not fixed. When the moon is a bit farther away than usual compared with the sun, total eclipses become annular eclipses. The northern tip of Scotland will see one in 2003.

The coming eclipse may conjure for us the shade of Einstein. General relativity momentarily predicted that light from distant stars should be bent by, the mass of the sun and the apparent position of the stars should shift. But the effect would be big enough to detect only if the light beams passed very close to the sun. Stars appearing that close to the sun can't be seen against its glare. Except...during a total eclipse. So, Arthur Eddington took his instruments to Principe Island for the eclipse of 1919 and returned in triumph. Einstein himself was underwhelmed. If the predictions had not been fulfilled he would have been "sorry for the dear Lord. The theory is correct".

Most of all, what I appreciate about eclipses is the scalpel-sharp precision with which they can be predicted. In 19th-century boys' yarns, Rider Haggard's heroes would use an exactly forecast eclipse to confound (literally) benighted savages. For me, that same precision stands for the power of science to confound today's metaphorically benighted intellectual savages who fashionably deny that there is a real world or that we can discover true facts about it. As Dr Johnson said: "I refute it thus."