Eclipse for insomniacs

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ECLIPSE FOR INSOMNIACS

Ken Tapping, 7th October, 2014

In the early hours of 8th October, there will be an eclipse of the Moon. For those needing to go to work that day, the timing of this event is not very convenient, but these spectacles are worth seeing.

Full Moons happen when the Sun, Earth and Moon are roughly in line, so that we see the Moon lit from behind us. However, on occasion the three bodies are more precisely in line, so that the Earth passes through the Moon's shadow, or vice versa. On the 8th the Moon will pass through the Earth's shadow, giving us an eclipse of the Moon. With the sunlight blocked off by the Earth, we might expect the Moon to more or less vanish: black against a black sky. However some sunlight will be refracted onto the Moon by the Earth's atmosphere. This means it will still be visible, although much dimmer and dramatically changed in colour.

We are all familiar with how the colour of the sunlight changes during the day. For most of the day the sunlight is yellowish-white. However, as the Sun gets lower and then sets, the light gets yellower and redder, ending with a spectacle of reds and golds as the Sun vanishes below the western horizon. The cause of these colour changes is a process called scattering, where a beam of light hits particles in the air and is scattered off in other directions. This process is much stronger at the short wavelengths – the blue end of the spectrum, so as light passes through the air, the blues and greens are scattered out, leaving the reds and yellows. When the Sun is highest in the sky, the light has to traverse only a few kilometres of the thick, lower part of the atmosphere, so the scattering is weak and the colour of the sunlight scarcely changed. The scattered blue light is what makes the sky blue. However, as the Sun gets lower, the light has to pass through much greater thicknesses of atmosphere, and the scattering gets more severe, so that at sunset the blues and greens are almost fully removed, leaving the reds and yellows, and painting the spectacle of the end of the day.

The sunlight being refracted onto the Moon by the Earth's atmosphere passes through at least twice as much atmosphere as what we see at sunset, so the light heading out into space to the Moon is orange red. If we were on the Moon's surface, we would see the Earth as a dark disc surrounded by a glowing red-orange ring. From the Earth, we see the Moon has a lovely red copper colour. That is, if the Earth's atmosphere is clear and clean. If there is a buildup of atmospheric pollution due to forest fires, volcanic eruptions or something we're up to, the situation is different. If we load the atmosphere with bigger particles, and lots of them, all the wavelengths of light are scattered more or less equally, so the light is just weakened, not changed in colour. Instead of reddish copper, the Moon could be ashy grey, or some intermediate shade.

If you were to observe the eclipse from the Moon, you would see the Earth progressively cover the Sun. As it blocks out more and more of the Sun's disc, the light level will fall. At this stage you are in the outer shadow, or penumbra. Then, when the Sun is totally covered, you are in the full shadow, the umbra. On the 8th, the Moon will start moving into the umbra at 01:45am PDT (4:45am EDT). At 02:15 PDT (05:15 EDT) the edge of the full shadow (umbra) will appear at the edge of the disc. The Moon will be fully in shadow at 03:25 PDT (06:25 EDT), and will start to emerge at 04:25 PDT (07:25 EDT), and be fully out of the umbra at 05:35 PDT (08:35 EDT), and fully out of the penumbra at 06:05 PDT (09:05 EDT). Although the EDT times for the later part of the eclipse are included here, this Moon will set for Eastern Canada before the eclipse is over. The bad timing of this eclipse means that wherever they are, those who observe it are not going to get much sleep.

Jupiter rises in the early hours. Saturn and Mars lie close together low in the sunset twilight. The Moon will be Full on the 8th.

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