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RED SUN, RED MOON

Ken Tapping, 12th September, 2017

During this summer here in British Columbia we have had many days when the Sun appeared orange or even dull red in the middle of the day, and at night the Moon shone a deep crimson. The cause was smoke from the many wildfires in the BC interior and also south of the border. The process causing the Sun and Moon to appear that way is Rayleigh scattering. Actually, we see Rayleigh scattering in action on any clear, sunny day. It is what makes the sky blue.

Sunlight travels in straight lines, and when we glance momentarily in the direction of the Sun, that dangerously bright disc we see in the sky comes from our eye capturing the sunlight hitting it and making a solar image on the back of our eyes. We see our surroundings because they are illuminated by sunlight, but we don't see the sunlight doing the illuminating… except when it is scattered.

Our atmosphere is loaded with tiny particles, ranging from atoms up to dust. When light hits these particles it is absorbed and then immediately re-radiated in all directions. This is why haze and thin cloud can make light beams visible, or we use smoke to show laser beams.

As Isaac Newton demonstrated and we can see in every rainbow, white light is a mixture of light waves with different wavelengths, ranging from about 4 billionths of a metre, which we see as blue light, to 8 billionths of a metre, which we see as red. The degree of Rayleigh scattering is very strongly dependent on the wavelength of light. Blue light, about half the wavelength of red light, is scattered 16 times more strongly. A beam of white light will have the blue light scattered out of it, leaving the red. So sunbeams crossing the sky above our heads will have their blue light scattered towards us, making the sky appear blue. The greater the distance through the atmosphere the light beams have to travel, the redder the light passing through will be. That is why sunsets are red, and also, why the eclipsed Moon appears red. The Earth is blocking out the direct sunlight, so the only sunlight getting to the Moon has passed through many kilometres of the Earth's atmosphere, and reddened.

The wildfires currently burning in British Columbia are injecting a colossal amount of particulate material into the atmosphere. The smaller particles act as scatterers, so that when we look in the direction of the Sun or Moon, we see almost totally red light. However, we see this because the red light is less scattered than the blue light. Infrared light has even longer wavelengths and will be scattered far less. So while you are looking at the dull, red Sun, you could be irreparably burning the back of your eye. There are no pain sensors there to warn you and not all the damage becomes apparent immediately. The same danger can arise when viewing the Sun at sunset.

At this time of year we have a chance to see another example of scattering. The Earth and the planets orbiting the Sun, formed from the collapse of a cloud of gas and dust, which formed a disc and then the planets. A lot of that dust disc is still there, and in spring and autumn we can see it. The disc lies in the same plane as the orbits of the planets, so we see it along the strip of sky in which the Sun and planets move – the ecliptic, also called the zodiac. The ecliptic sticks up at a high angle in the west after sunset in spring and at a high angle in the east before sunrise in the autumn. The dust belt scatters sunlight, which we see as a glowing strip extending from the horizon, like a diffuse version of the Milky Way. It is called the zodiacal light. Look for it these evenings in the east before dawn. You'll need a clear, dark sky.

Jupiter is now lost in the sunset glow. Saturn lies low in the southwest after sunset. Brilliant Venus rises in the early hours. Mars and Mercury lie low in the dawn glow. The Moon will reach Last Quarter on the 13th.

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