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CHAPTER I

The Sun, the Moon and the Planets

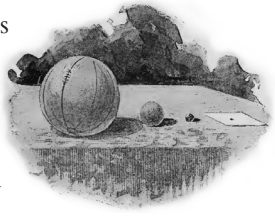
Sir Robert Stawell Ball

1881

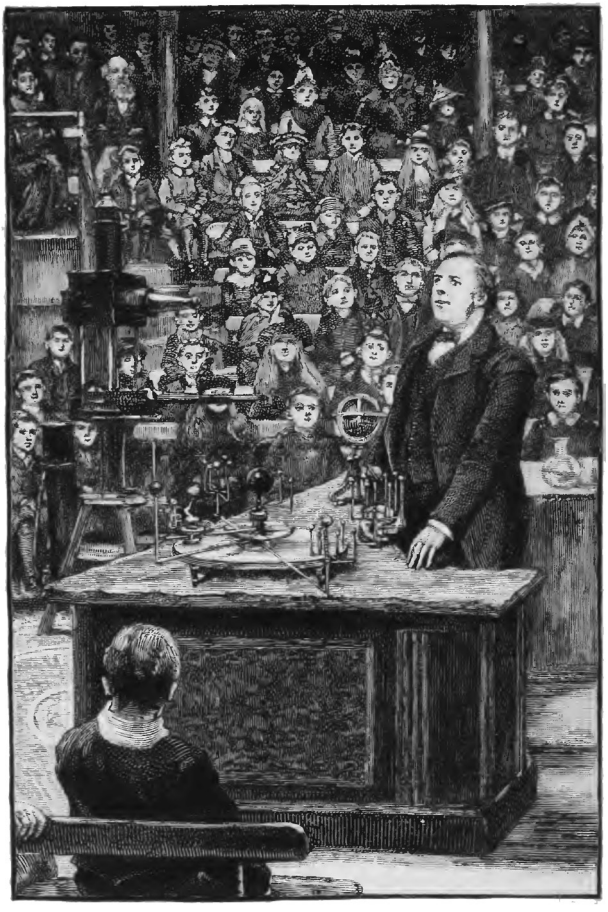
In this fascinating series of Lectures we're treated to an overview of our place in the solar system, a picture still very much in progress at this time. Recent discoveries of new planets, as well as moons orbiting those planets, will be brought to life with much fervour and enthusiasm. We'll then leave the solar system to wonder at the stars beyond and attempt to picture just how far away they are from Earth and whether they have planets of their own. Ball's ability to make the complicated simple through well-thought-out and poetic analogies is striking in its brilliance.

Our exploration of the solar system begins with the star at its heart. We know the sun is hot, but just how hot? Ball asks us to imagine 'an experiment with . . . burning glass that most boys have often tried': the age-old trick of setting fire to things with a magnifying glass. He tells us that scientists have experimented with a similar lens a yard wide. 'Steel has thus been melted by the sunbeams . . . therefore the sun must have a higher temperature than that of molten steel; higher, indeed, than any temperature we can produce on Earth,' he says. (Today we know that it actually has a surface temperature of around 5,500°C.)

Ball's attention then turns to scale, as he places a football on the table of the theatre to represent the sun. How small would the Earth be in comparison? 'A grain of small-sized shot will give the right size,' he reveals. We know today that about one million Earths would fit inside the sun. Photographs of the sun thrown onto the big screen behind him show dark blotches – sunspots. We also see spectacular



Balls representing the sun, moon and Earth, to scale



Ball giving a Lecture in the Royal Institution theatre

images of the sun eclipsed by the moon, allowing a glimpse of the faint solar atmosphere – the corona, which is only visible when the moon blocks out the harshness of the sun's glare in this way. We see prominences, too; vast flame-like structures erupting from the edge of the sun. 'One of them has been seen to rush up with a speed of 200,000 miles an hour – that is, with more than 200 times the pace of the swiftest of rifle bullets,' Ball explains.

It is that handy blocker of sunlight – the moon – that is the centre of attention in Ball's second Lecture. But it is fundamentally different from the sun – it doesn't create any light of its own and only reflects sunlight. The amount of reflected light we see changes with its position around the Earth, creating the phases of the moon. This is aptly demonstrated when Ball places a ball in the path of an electric light and asks the audience on different sides of the theatre what they can see. He then asks us to imagine living on the moon and looking back at Earth. Our

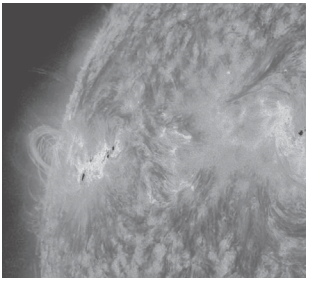


Image of a solar prominence

planet would appear to wax and wane, too, but with much greater lustre.

Ball's demonstration of the phases of the moon

'Think of a light which would be produced if you had thirteen moons . . . shining together. How splendid the night would then be! You would be able to read a book quite easily!' This is because the Earth is bigger than the moon, a fact illustrated with a festive touch.

'There is first to be a nice little round plum pudding, three inches in diameter . . . One boy of sound constitution could eat it all.' A second pudding a foot across – four times the diameter – would represent the Earth. But, 'if one schoolboy could eat the small plum pudding, how many boys would be required to dispose of the large one?' asks Ball. The answer is not four, but sixty-four (or four times four times four).

Failing to predict the Apollo moon landings less than a century later, Ball tells us that 'no explorer can

ever reach our satellite'. (However, fictional stories of people travelling to the moon had existed long before 1881, and technology was marching on, so it seems odd that he ruled out the possibility entirely for all future generations.) Nevertheless, he says we can make the journey via telescope instead. In doing so, we see a closer view of our neighbour's conspicuous dark patches. He calls them 'empty basins which great seas once filled'. (We now know they weren't 'seas', but lava.) Ball explains that these seas are peppered with craters. He shows a rudimentary model of them and asserts they were formed by volcanoes (in fact, we now know they were formed by space debris colliding with the lunar surface). It is also Ball's belief that there are no lunar inhabitants due to the lack of air and water, but he doesn't rule out life on other worlds. 'It seems preposterous to imagine that among all these globes ours alone should be the abode of life.' And it's to the innermost planet – Mercury – that we now turn.

The relative sizes of the Earth and the moon

It is known to be a small, relatively heavy planet closest to the sun. But how can we weigh something