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DOTS IN THE SKY

Ken Tapping, 11th July, 2017

When we look at the stars in a clear, dark sky, we see bright dots. Some of them are much brighter than others, and some stars are coloured. If you get out the telescope you will still see the stars as dots, although the colours will be much clearer. If you set up the telescope for a high magnification you will see little round blobs instead of dots. However, what you are seeing are the limitations of the telescope to discern detail. The stars are still dots. Even with the biggest telescopes on Earth, the stars remain tiny dots. Since this is the case it is really amazing how much we have managed to learn about those dots, starting from nothing.

Our remote ancestors enjoyed clear, dark skies, without the light pollution that is so hard to escape today. They noticed some "stars" moved, and called them "wanderers" (planetos). The others seemed not to move and were called fixed. These they formed into groupings called constellations, which they named after heroes, animals and things from mythology. Few constellations look much like what they are supposed to represent, which proves the power of our ancestors' imaginations.

In about 450 BC Anaxagoras suggested the Sun is a star. Around 300 BC Aristarchos, another Greek scientist, suggested that if we can see planets changing position in the sky but the stars appear not to be moving, then the stars must be immensely further away than the planets. He also deduced the Earth orbits the Sun.

One big problem was that although it was clear stars are extremely distant, we had no idea what those distances were. We could not determine how much the differences in brightness were due to stars themselves and how much was because of their lying at different distances from us. However, there was a trick that helped a bit.

If we see a little cluster of people chatting together, about a kilometre away, the size of that cluster is much smaller than a kilometre so we can assume they are all more or less the same distance from us, although we might not know exactly what that distance is. Stars also occur in clusters so we can do the same trick. If one star looks brighter than other members of the cluster, it probably is truly brighter. Star clusters can have hundreds or thousands of members. We can tabulate the relative brightnesses of all the cluster members, and from their colours we can deduce their temperatures. With all that information neatly tabulated, we cannot resist the temptation to plot a graph. Let's put temperature along the bottom and brightness up the left-hand side. In the early years of the 20th Century, this idea occurred completely independently to Ejnar Hertzsprung and Henry Norris Russell. They both found something odd. Although there were stars scattered around the diagram, most of them lay of a line joining the cool, dim corner of the plot to the hot, bright corner. This line became known as the main sequence. We now know that when stars form they settle onto the main sequence, where they stay for most of their lives. Stars anywhere else on the plot are usually on the way out. That simple plot was enough for us to actually start work on the physics of how stars work and evolve. When we found stars orbiting one another we could determine their masses. This enabled us to check our calculations and find a really stunning fact. The brightness of a star depends only on its mass and its age.

Today we can measure the distances of many stars, whether or not they are in clusters, so now we have a huge amount of data. With lots of data on stars of all brightnesses and temperatures, we have learned a lot about how stars form, live and die, and how they work. Even so, through our biggest telescopes, they are still dots in the sky.

Jupiter is low in the southwest after sunset, and Saturn low in the south. Venus rises before dawn, shining brilliantly, like an escaped aircraft landing light. The Moon will reach Last Quarter on the 16th.

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