Saturn in a small telescope.

By C. V. Raman, M.A.

At one of our recent meetings I mentioned that Cassini's division is now a fairly easy object even in a $2\frac{7}{8}''$ telescope. This statement has been received with considerable reserve by some of our members, and I have heard doubts expressed whether such a performance was even theoretically possible with the aperture. The following calculations may therefore be of interest. In a paper published in Vol. II of the Journal I discussed the phenomena of the diffraction of light. I need not go over the same ground, and will now deal only with the application of the principles explained in that paper.

If the object-glass of a telescope is covered by a rectangular aperture, and a point-source of light such as a star is viewed through it, the principal part of the image seen in the field consists of a small rectangular area of light, the angular distance of the dark margin from the centre in seconds of arc being given by the formula.

$$\frac{\text{Wave length of light}}{\text{Width of aperture}} \times \frac{180 \times 3600''}{\pi}$$

Taking the wave-length as $\frac{1}{50,000}$ of an inch and the aperture as $2\frac{7}{8}''$, the angle is found to be 1·4 seconds of arc. If a double star whose angular separation is 1·4 seconds is seen through the instrument, there would be a distinct falling off in illumination between the positions of the geometrical images which might enable the object to be distinguished from a single star under favourable conditions. This falling off in illumination would be more easily appreciated if instead of two point sources of light, we have two fine linear sources close together and parallel to the edges of the aperture. Experiment shows that resolution is quite possible at an angular separation of the two sources equal to that given by the above formula ; the illumination in the centre of the field being about $\frac{1}{5}$th less than on either side of it, if the two line-sources are of equal intensity. If the angular separation is double this, *i.e.*, 2·8″, the field would show an absolutely black line separating the two components.

If now we pass from the case of two parallel linear sources to that of two illuminated *surfaces* separated by a dark line of division, the conditions for resolution are far more favourable. This can be readily understood. It is obvious that the dark division would be more readily obliterated by

diffraction if the whole light of the source were concentrated immediately on either side of it, instead of being spread away to some distance each way. If the source consisted of two equally illuminated surfaces separated by a dark gap of 1·4″, the telescopic field of a $2\frac{7}{8}$″ glass would still show the division very dark. With a dark gap of 0·5″ the illumination in the centre of the field would still be 50 per cent. less than on either side of it and this should be capable of being observed with ease.

Let us now apply these deductions from mathematical theory to the actual case of Saturn's rings. For the 16th February 1914, we have from the Nautical Almanac figures and the accepted radii of the rings, the following radial dimensions :—

	Major axis.	*Minor axis.*
A Ring ...	... 5·7″	2·5″
Cassini's Division	... 1·0″	0·5″
B Ring ...	... 9·3″	4·1″

From these figures and what was said above it is evident that a $2\frac{5}{8}$″ telescope should be capable of showing Cassini's division right round the ring at the present epoch. A steady instrument and a comfortable position for the head and eyes of the observer should be sufficient to enable any of our members to verify this by an evening observation in the quiet of their homes. By stopping down the telescope I can get glimpses of Cassini's division even with 2″ aperture and the difference in the brightness of the A and the B rings is very evident with such small apertures.

Some mathematical calculations of the dimensions, weight, etc., of Earth, Moon and Sun.

By Revd. A. C. Ridsdale, M.A.

The subject of my paper is "some mathematical calculations of the dimensions, weight, etc., of Earth, Moon and Sun." I say "mathematical calculations," because I confine myself entirely to the mathematical part of the work, and make no attempt to treat of the observations and experiments, upon