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 2⅞″ 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 2⅞″ 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 which many of these calculations are based. The formulæ, which I propose to put before you, are of course arrived at through the ordinary methods of the various branches of mathematics, but as it would be entirely outside the purpose of a short paper to discuss the mathematical processes by which these formulæ are found, except in special cases, I only propose to give you them for the most part just as they stand, exhibiting the working thereon. I feel that, although many have doubtless worked out many of these calculations for yourselves, and some have made a study of the mathematics underlying them, yet it may perhaps not be unprofitable for all of us, to go through, step by step, in as clear and orderly a manner as possible, some of the simplest calculations, which every one who has any pretensions to being a serious student of astronomy, should be thoroughly conversant with, and have absolutely, as it were at his finger's end. One cannot insist too strongly on the fact, that no headway can be made in the noble science of astronomy, if one is continually shirking all the calculations, with which it is so inextricably bound up. In this connection, allow me to quote the words of one of the greatest of astronomical observers Sir John Herschell. He says—"Admission into the sacred temple of astronomy, can only be gained by one means, namely, sound and sufficient knowledge of mathematics, the great instrument of all exact inquiry, without which no man can ever make such advances, in this or any other of the higher departments of science, as can entitle him to form an independent opinion on any one subject of discussion within their range." In these mathematical calculations which follow, I shall confine myself to the very simplest processes, which no one will have, I hope, any difficulty in understanding and remembering; concerning the dimensions, surface area, volume, form, ellipticity, mass, density, specific gravity, surface gravity, and tidal diminution of gravity, of the Earth, Moon, and Sun. I propose, with the approval of the President, to put before you at this meeting, only the very first part of my calculations regarding the Earth, namely, the Earth's dimensions.

First of all, to start at the very beginning, let us take the *radius of the Earth*—

$$r = \frac{\text{length of arc}}{\text{No. of degrees in arc}} \times \text{radian.}$$

thus F 1° (average) arc = 365,000 feet = (about) $69\frac{1}{4}$ miles.

and radian = $57{\cdot}29^\circ$ = (about) $57\frac{1}{4}^\circ$

then $r = (69\frac{1}{4} \times 57\frac{1}{4})$ miles = 3,960 miles.

and diameter $= 2\,r = 7{,}920$ miles.
and circumference $= 2\,\pi r = (2 \times 3{\cdot}1416 \times 3{\cdot}960)$ miles.
$\doteq 24{,}900$ miles.

or $r =$ any arc $\times \dfrac{\text{seconds in radian.}}{\text{seconds in } \angle \text{ subtending arc}}$

and F $a = 1^\circ$ arc.
and $1^\circ = 365{,}000$ feet.
and radian $= 206{,}265$ seconds.

then $r = 365{,}000 \times \dfrac{206{,}265}{3{,}600}$ feet.
$= 20{,}912{,}979$ feet.

I may remind you that of *the three quantities*—

(1) the angular value of an arc, (2) its linear value, (3) the length of the radius; if any two of these quantities be given, the third can be mathematically calculated.

To what extent do the mountains and oceans *modify the exact globularity* of the Earth ?

if 20 ft. represent Earth's diameter, =8000 m.
then $\frac{20}{8000}$ ft. $= {\cdot}03$ inch=1 mile

and highest mountains are 5 miles high.

$\therefore$ ${\cdot}03 \times 5$ inch $= \frac{3}{20}$ inch $=$ height of the highest mountains—a very small amount, relative to a globe of 20 ft. diameter.

To find any *longitudinal arc in any other latitude* than zero. The trigonometrical formula is, non-equatorial arc, = (equatorial arc $\times$ cos latitude).

For example, let us find the value of 1° arc at latitude 45°.
If 1° arc at equator $= 69\frac{1}{4}$ miles
then 1° arc at 45° lat. $= (69\frac{1}{4} \times \cos 45^\circ)$ miles
$= (69\frac{1}{4} \times {\cdot}70711)$ miles
$=$ (about) 48 miles.

We will next take the *Earth's surface area.* There are several mathematical formulæ, which give us this quantity.

For example, $4 \times$ area of great circle
$= 4\,\pi\,r^2 = 4 \times 3{\cdot}1416 \times (3960)^2$ square miles
$=$ (less ellipticity of $\frac{1}{298}$th) 197,000,000 square miles
or $= \pi \times (\text{diameter})^2 = 3\frac{1}{7} \times (7920)^2 =$ &c.
or $=$ diameter $\times$ circumference $= 7920 \times 24{,}900 =$ &c.
or $= \dfrac{(\text{circumference})^2}{\pi} = \dfrac{(24{,}900)^2}{3{\cdot}1416} =$ &c.

Earth's volume—The volume of a sphere is

$= \frac{1}{6} \pi \times (\text{diameter})^3 = \cdot 5236 \times (7920)^3$

$= 259,800.000,000$ cubic miles

$= 38,242,027,930$ billion cubic feet

or $= \frac{4}{3} \pi \times (\text{radius})^3$

$= \frac{4}{3} \times 3\frac{1}{7} \times (3960)^3 = \&c.$

or (by the method of solid rectangular conical sectors)

$= \frac{1}{3} r \times$ area of surface $= (\frac{1}{3} \times 3960 \times 197,000,000)$ cubic miles $= \&c.$

(*To be continued.*)

Extracts from Publications.

Jupiter visible before Sunrise.—The planet Jupiter can now be well seen in the mornings, and it is important that telescopic observers examine his disc carefully and note the chief features. Last year the equatorial current had increased its rate of movement, its rotation being 9h. 50m. 11s. from a number of spots on the south edge of the northern equatorial belt. Are these markings still visible, and what is their velocity as compared with that determined during the previous opposition?

The great red spot also exhibit a quickening of speed in 1914, the rotation period being 9h. 55m. 35s. It is probable that at the present time the red spot precedes the zero meridian of System II (see Ephemeris for physical observations of Jupiter in Nautical Almanac) about 3h. 40m. It is impossible to tell exactly, however, because the planet has been too near the Sun during the past winter for corrective observations to be made. Transits of the red spot and hollow in the southern belt may, however, be looked for at the following times:—

			H.	M.				H.	M.
April	14	...	14	27	May	3	...	15	6
,,	16	...	16	5	,,	8	...	14	14
,,	21	...	15	12	,,	15	...	14	59
,,	26	...	14	20					
,,	28	...	15	58					

Some estimated transits would be valuable in order to determine what the rate of rotation has been during the last six months.