eye as some scientific lectures can, and I must therefore trust to the sublimity and importance of the problem, the solution of which I shall try to explain to you this evening, for asking close attention to what I shall say, for without such attention it will be difficult to perceive the sequence of the different steps which lead to the complete solution. We shall consider briefly,

1. How astronomers have determined the figure and dimensions of the earth we inhabit.

2. How they have determined the motions of the earth relatively to the sun and other bodies in space.

3. What is this body Venus which will cross the sun's disc to-morrow?

4 and lastly. How with a knowledge of the answers to the three previous questions does the transit enable us to determine the sun's distance.

1. The figure and dimensions of the earth.

That the earth is limited in every direction we infer from the fact that almost every portion of the earth's surface has been seen by man. Navigators and travellers have in various directions gone round it.

From the fact that when a ship recedes from the land, the hull disappears first in the horizon, and after it the masts, we infer that the earth has continuous curvature, and that in every direction since this phenomenon is observed not only in every horizon where there is a sea, but in every part of any particular horizon. If the earth were an infinite plane, which it appears to us, the masts, on account of their smaller magnitude, would first become invisible. This phenomenon is best seen when two steamers pass one another and are sailing in the same line. We have another palpable proof of this in the fact that the the sum of the three angles of any triangle on the earth's surface is greater than two right angles.

In looking at any considerable portion of the earth's surface, it always appears circular, unless obstructed by mountains or other irregularities, from whatever place or from whatever height it be viewed. This is equivalent to saying that any plane section of the earth is a circle, a property belonging exclusively to the sphere. If the state of the atmosphere be very different at different parts of the horizon, the outline is not perfectly circular, but this can be satisfactorily explained by the unequal effects of refraction.

In every eclipse of the moon, a phenomenon which is produced by the moon entering the earth's shadow, the outline of the shadow is invariably circular. Now, it is only a sphere of all solid figures which can always cast a circular shadow, however it be situated to the illuminating body.

Having proved by these facts the general spherical form of the earth, astronomers next proceed actually to measure it, so as to find out if there be no deviation from an exactly spherical form. This is done by measuring in different parts of the earth the length of an arc of the meridian, in going from one end of which to the other the sensible horizon, that is, the tangent plane to the earth's surface has turned through a known angle. (By doing this we measure at those parts of the earth the curvature of the earth's surface.) We know when our sensible horizon has turned through any angle by the altitude of either pole of the heavens altering by the same amount. Whether it be the earth which rotates or the sphere of the heavens which turns round it, we know that the poles of the earth are always the same. Hence, so long as our sensible horizon is the same the altitude of the pole of the heavens will be constant, but if in going directly to either pole of the earth our horizon turns through any angle, by the same angle will the altitude of the corresponding pole of the heavens be altered. Suppose the earth to have any figure whatever, and P p to be the direction of its axis, and, therefore, that in which the pole of the heavens is seen, on account of the relative sizes of the earth and the imaginary sphere of the heavens, the direction of the pole of the heavens will be the same in all parts of the earth, that is, supposing all the people in the nothern hemisphere to be looking at the pole of the heavens, they would all be looking in exactly the same direction. The pole, however, would not appear to any two considerably apart to be in the same part of the visible hemisphere. This arises from them not having the same horizon, and therefore not the same visible hemisphere. (Illustrated by a figure.)

Practically it is most convenient (in order to avoid as much as possible the effects of refraction) to measure the change in the altitude of a star near the zenith, in order to measure the change in the direction of the horizon. When, then, different arcs of terrestial meridians are by these means measured, it is found that the curvature of the earth diminishes as you go from the equator to either pole, and the law of curvature shows that the figure of the earth is very nearly that of an oblate spheroid, the shorter axis being that diameter passing through the poles or the axis of the earth itself. From these measurements it is likewise an easy geometrical problem to calculate the dimensions of the earth.

But now, if we allow the rotation of the earth about a fixed axis, a proposition which is proved, as we shall presently see by methods altogether independent of its figure, we obtain evidence of the truth of our previous deductions, which puts all doubt away. The spheroidal figure, and of that amount of ellipticity which is found by actual measurement, is the figure which a plastic body of the same dimensions and as mass that of the earth, would have assumed, provided it had the same angular velocity which the earth really has. That the earth as a whole is plastic, and that ages ago it was more so than it is now, there is strong evidence. (Experimental proof given.)

Another proof of the correctness of these calculations is thus obtained: If the earth be a spheroid, the weight of a body must be different at different parts of its surface; the calculated ratio of the weight of a body at the equator to that at either pole on this account is 590:591. Whether this agree with experiment we shall enquire when we investigate the influence of the earth's rotation on weight.

The truth of the earth's spheroidal form, like every other truth in astronomy, is more and more forced on our minds the more we learn; thus, we shall learn that the earth is a member of the solar system, and if you take any other member, *e.g.*, Jupiter, it is observed to have a spheroidal form and of that degree of ellipticity which corresponds to the time of its rotation.

Let us now consider briefly the motions of the earth relatively to the sun. These are two, its rotation about an axis once in a sidereal day, and its revolution around the sun once in a sidereal year.

ROTATION OF THE EARTH ABOUT AN AXIS FIXED IN DIRECTION

Before any deductions can be made from observations of the motions of bodies extraneous to the earth which we inhabit, we must ascertain whether the earth itself be not in motion. It is not difficult for us to understand the motions of the clouds. We generally experience at the same time the force of wind and motion of clouds; by climbing hills we learn that the velocity of the air above may be greater or less than that near the surface, or that the air at the surface may be almost still, whilst that above us is in rapid motion. It is known also that the height of the clouds is such that we may easily ascend above many of them, and when we do so we find that they are merely heaps of small globules of water suspended in the air, and even when their height is so great that we cannot reach them it is easily learned from parallax and the properties of air that they do not nearly