# THE EARTH STANDS FAST.

## PROOFS THAT THE EARTH REVOLVES NEITHER UPON ITS OWN AXIS NOR YET ABOUT THE SUN.

GENTLEMEN:

It requires not a little courage to stand before you here to demonstrate the erroneousness of an opinion which you have thought the only true and correct one since the years of your childhood. I believe I may judge of the opinion you have of me this moment by that which I should have had myself three months ago of him who should assert to me that *the Earth stands immovable and the Sun is revolving about it*. Such a man I should have considered either very ignorant or a lunatic; and yet now I regard the fact of the stability of the earth as a truth which cannot be shaken. Moreover, I believe that those of you who are without prejudice and free from prepossessions and will examine what I am going to lay before you will soon share my opinion.

Not long ago we had an opportunity of seeing the tests with the pendulum which, according to the theory of the widely-known physicist, Mr. Leon Foucault, are said to furnish the proof of the daily rotation of the earth upon its axis. I had well-nigh failed to take any notice of those pendulum tests. Although, when explaining to my pupils, boys and girls, in my geographical and physical lessons, the revolution of the earth about the sun, I had always found one point (which you will learn in the course of my lecture)

very strange—nay, incomprehensible—yet I was so convinced of the daily rotation of the earth, and its yearly course round the sun, as to deem Mr. Foucault's pendulum-proof entirely superfluous. Nevertheless, I was present at the experiment, and I will explain it in a few words, to make the application clear.

If we imagine around the earth's sphere a limited—or unlimited—number of circles, parallel with the equator, we call these circles, precisely on account of their parallelism with the equator, parallel circles. It follows, from the spherical form of the earth, that the circles become smaller the nearer we place them to the poles; and if we should imagine two parallel circles drawn around the earth through this lecture-room, the northern one, even thus, would be somewhat smaller than the southern one. Let now the earth revolve in twenty-four hours upon its axis, so that the two imaginary circles laid through this room have made a complete rotation. As both have made their circuit in equal time, and as the southern one is larger than the northern one, the single parts of the one to the south must move with greater rapidity than those of the one to the north.

Let us glance briefly at the instrument, so widely-known and yet in many respects an enigma, which we will call the pendulum. It may be shown that the even oscillation of the pendulum is independent of the alterations (rotations) of its point of suspension. This immutability of the even oscillation was said by Mr. Foucault to prove the rotation of the earth upon its axis. If, for example, we let a pendulum oscillate in a direction from north to south, across the two parallel circles which we have in imagination drawn through this room, then will its even oscillation, as Mr. Foucault assumes, be unaffected by the rotation of the plane (or point of suspension), and consequently will move in

advance of the northern, more slowly rotating parallel circle, but will fall behind the southern, more rapidly rotating parallel circle. The path of the pendulum will, therefore, soon deviate from the direction, north to south, the end formerly swinging to the north swinging more and more towards the east, and the end swinging southward more and more towards the west, until finally the pendulum swings entirely in the direction from east to west. At this point the cause of deviation has ceased; for the pendulum swings no more across two unequally-rapid parallel circles, but across a single circle. As the cause of deviation no longer exists, the deviation ought to cease. *But no, it continues! The pendulum also leaves the direction, east to west, to deviate to southeast and northwest, and thus reaches, conditions under which, according to Foucault, it must deviate again!*

Now, as the pendulum does not remain in the direction from east to west, but also deviates from this, I think I am entitled to the belief that the deviation of the pendulum is caused by something other than the rotation of the earth—something, it is true, which is still unknown to us. Furthermore, I have found, by careful experiments, that the deviation is not the same with all pendulums. The heavier the bob, the slower becomes the deviation of the pendulum; the lighter the bob, the more rapidly the deviation takes place. Since the rotation of the earth upon its axis, if existing, must be a uniform one, necessarily with all pendulums the deviation should be uniform; but this is not the case.

The conviction that the Foucault experiment with the pendulum was erroneous made me examine more carefully the further reasons from which, heretofore, the rotation of the earth upon its axis was inferred; and thus, I perceived
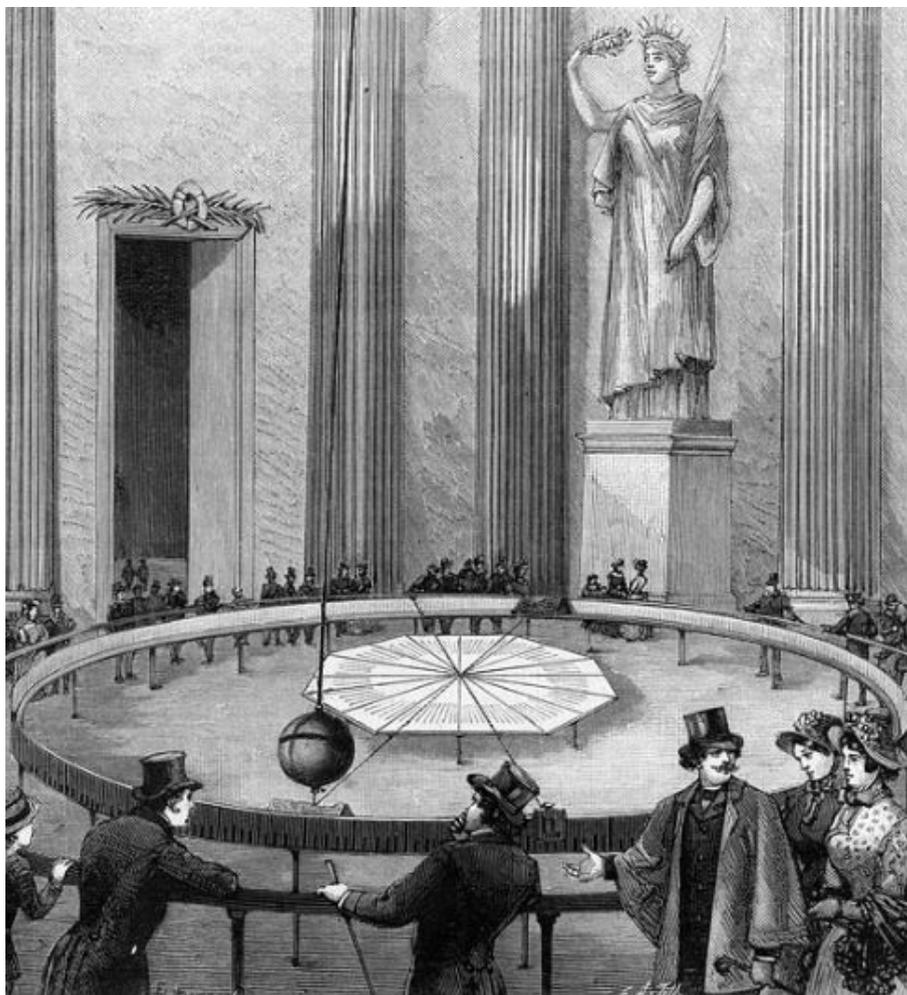
that there had been no demonstration whatever of such a supposition.

Long ago the Indian, Brahmagypta, the Pythagorean, Philolaus, Niketas of Syracuse, and Aristarch of Samos (who was born 267 B. C.), asserted that the star-sphere is immovable, and that the earth, revolving upon its axis, causes the daily rise and set of the celestial bodies. These men, who were all profound thinkers, accepted the opinion cited because they could not comprehend the velocity with which the celestial bodies must fly to compass their daily

courses round the earth in twenty-four hours. But in our times every one will concede that this objection is without force. Tell a country lad, in a place where there is yet no railroad and only wagons are possessed, that we can make a mile in five minutes, and he will think this utterly impossible. And yet we know that light travels 40,000 miles a second, and that the velocity of electricity is still greater.* Therefore, gentlemen, the argument is rendered void, that celestial bodies (having their orbits in a space which, according to our supposition, is either vacuous or filled with a very thin matter of the nature of which we know nothing definite yet) could not have such a velocity as to finish their course around the earth in twenty-four hours.

Let us now dwell upon another argument which has been accepted, but which is equally void. Measuring the meridians of the earth, we have found that the earth is flattened towards the poles, and that a diameter of the equator is larger than an axis from pole to pole. Man, who tries to penetrate all the secrets of nature, attempted, alas, to investigate the cause of this flattening towards the poles, and Newton thought to find the cause in the rotation of the earth. By this motion all particles of the globe, especially the bodies on the surface, are said to have an impulse to fly away from the earth, and this opinion is in agreement with

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*These figures are quite as obsolete as is the idea of railway-speed. The lecture was delivered in 1854. The velocity of light is now estimated at 186,000 miles per second through the air, while the velocity of electricity, through the air as a medium, is said to be about the same as that of light, suggesting a connection between the two things. The discharge of electricity from a Leyden jar over a copper wire, Wheaton estimated at 288,000 miles per second.

Newton, accepted by all. This tendency is called centrifugal force. At the poles, where the velocity of rotation is zero, this force would be equal to zero, and would increase thence to the equator in proportion to the size of the parallel circles; for, as I have already remarked, the greater the parallel circle the more rapidly each point of it must move—provided the earth actually rotates upon its axis. It is said, therefore, that much more of the mass of the earth is pressed toward the equator, and a much greater mass is accumulated around the equator, for here the centrifugal tendency acts with the greatest force. Hence, they assert, the earth must revolve, for without the rotation of the earth the centrifugal tendency would not exist, and without the centrifugal tendency there would be no accumulation of greater masses in the equatorial zones.

We have here another alleged proof of the rotation upon the axis which I cannot accept, and which has been repudiated by others before me.

I am far from objecting anything to the correctness of the measurements of the degrees, although the measurements made on various occasions do not in the least agree. We will take it for granted that a diameter of the equator is larger than the length of the earth's axis. Are there, however, no other and nearer-lying reasons which might have caused a larger accumulation of masses at the equatorial latitudes? It is known that heat has an expanding, cold a contracting force. Is it not possible that, during the unnumbered thousands of years since our earth came into existence, the tropical heat has caused the continuous expansion of the equatorial latitudes, while the cold of the poles has caused the continuous contraction of the polar regions?

There is, however, still another and nearer reason why the larger accumulation of masses in the equatorial latitudes has originated. The earth seems to be in a state of continuous growth, and the flora and fauna add very much to this growth. It is neither here the place, nor have we the time, to speak of the immense coal strata which we find at considerable depths (and still more of which we shall find as soon as we succeed in penetrating deeper into the earth). Likewise, it would lead us too far if I undertook to tell you of the animal remains, partly microscopic, which form whole mountains and strata. I merely mention the fact that turf moors grow upon many of our higher mountain-chains, and that our farmers produce a stratum of humus upon rocky ground by laying out meadows, because they know that a stratum of earth is generated by the growth of the sod. And now, let me ask, where could this growth, by faunal and floral remains, go on with greater effect — in the warmer regions, where fauna and flora abound, or in the polar regions, where there only is a reduced life which constantly decreases the nearer you approach the poles?

Now, gentlemen, so long as simpler reasons are offered to us in explanation of how the accumulation of masses in the warmer zones has taken place, in the course of so many thousands of years, I cannot make up my mind to accept this as a result of a centrifugal tendency caused by the rotation of the earth upon its axis; and this the less as, later on, I shall call your attention to some contradictions in which this theory of centrifugal tendency would entangle us.

I now go on to the fourth and last consideration by means of which the rotation of the earth is thought to be demonstrated. The Frenchman, Richer, observed in the year 1672 that a pendulum clock going normally in Paris lost