Paper II.—ON THE PHYSICAL CONSTITUTION OF THE SUN.

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(*Read before the Society, February 17th*, 1869.)

Since I had my Equatorial fitted for Celestial Photography, I have taken many pictures of the sun and devoted much time to the study of its physical constitution, and I am confirmed in my opinion, that "sun spots," are planetary bodies that have fallen on the sun.

The many photographs that I possess of spots, taken during their transit across the sun's disc, with the umbra in the centre of the penumbra, when seen on either limb, and also when seen centrally, convince me that they cannot be cavities.

It seems strange to me that a theory which is based upon mere assumption should be supported by so many distinguished Astronomers; why are we to suppose that the body of the sun is dark? and why are we to assume that an opening in a luminous envelope should be of a darker color than the surface?

Is there anything, by analogy, that would lead us to suppose that an opening in a gaseous or liquid body, should have its edges, internally and externally, well defined, and continuing its form for several days? How are we to account for the bridge (which generally divides the umbra) being much brighter than the surface of the Sun?

As I suppose them to be small asteroids that have fallen upon the Sun, there is nothing contrary to analogy, to suppose that a zone or belt of small planets should revolve between Mercury and the Sun; indeed such a zone will

account for the perturbations of Mercury, and will perform the duty assigned to Vulcan. And this zone may be the zodiacal light.

Now, if these asteroids revolve in orbits, inclined to the sun's equator, varying from 10° to 40°, then as the catastrophe of falling into the Sun would happen in passing their perihelia, those asteroids that had their perihelia in North Latitude would form the Northern zone of spots, and those having their perihelia in South Latitude would form the Southern zone. And because few of their orbits are inclined to the sun's equator above 40°, we have a clear reason why the Polar regions of the sun are exempt from spots; and because a spot cannot be in perihelia when in the ascending or descending node, we have a reason why the equatorial region is rarely visited by them. Every student of the sun must have early discovered the fact, that spots, as a very general rule, are formed on the side of the Sun farthest from the Earth, and as the sun revolves upon its axis in about twenty-five days, we have conclusive evidence that the sun is passive, and that the earth is active in the cause of spots. If they are planetary bodies, then it is reasonable to suppose that they should fall on the side of the sun opposite to the disturbing body; but if they are of a meteorological nature, then we might suppose them to be formed on the side nearest the earth.

It will be very easy to calculate the planetary influence in disturbing these small bodies, and predict when it is likely to have a maximum or minimum period. I say likely, because there are two things necessary for a solution of the problem, one of which only is known: we should know the period of greatest number of asteroids passing their perihelia, and also the time of maximum disturbing force.

However, this we know, that if they are planetary bodies, then at periods of maxima there should be a combination of disturbing bodies, so as to give a maximum effect. We

see by the "Researches on Solar Physics," that there was a maximum on or about the 15th July, 1860; and by looking at the position of the planets, I find that Mercury, Venus, the Earth and Mars were nearly in a straight line on one side of the Sun, and, consequently, all acting together to draw these asteroids upon the sun opposite to the earth. And upon looking at their positions on the 1st December, 1856, when there was a minimum period of spots, I find that the Earth, Venus, Jupiter and Saturn were in four different quarters of the heavens, and that Mercury and Mars were nearly opposite to each other. I am fully persuaded there has been, and always will be, at periods of maxima and minima of spot frequency, a combination of the planets that will give decisive evidence that spots are planetary bodies.

Now, a planetary body falling on the sun, would soon form a mass of liquid metal, covering a great space, with dross surrounding it. It is very probable that this mass of metal would split in various directions, and that the central part would be thickest for some time. Here we have a reason for the umbra, penumbra, bridge, and nucleus, and all the changes usually seen to take place would be fully and easily accounted for under this supposition.

Again, if they are planetary bodies, their velocity in passing their perihelia would be greater than the surface of the sun upon which they impinge. Here then we account for the drift, which should always in that case be towards the equator. Under these circumstances I should suppose the equatorial region of the sun to be hotter than the polar—which has been suggested, and also that there would be currents that would distribute the dross over the entire surface of the sun, which assumes a form variously described as granulations, willow leaves, &c.

Long after the asteroid has fallen, the dross would be displaced by the undulations, forming what is seen as faculæ,

and I should fancy if there is much drift that the faculæ would be seen mostly on the following side of the spot.

The spectroscope tells us that all the known metals are in a state of incandescence in the sun. And in conclusion no other solution can be given to the question, "How is the enormous expenditure of light and heat kept up?" but by supposing that planetary bodies fall into it.