

such a case we should get a spot of a greyish tint without a nucleus in its centre.

At other times, there may be an opening in the cloudy stratum as well as the photosphere, and, in that case, we should see the dark body of the sun through this latter opening; and if the opening in the upper stratum is larger than that in the cloudy lower one, we should have a dark nucleus, surrounded by a penumbra, as is the case with most spots. If, however, the opening in the lower cloudy layer should be larger than the opening in the photosphere, we should see the sun's dark body only, and a spot without a penumbra would be the result.

This theory explains the appearances in a tolerably satisfactory manner; but many weighty objections have been urged against it, and it will be necessary for us to examine them.

First.—This theory supposes the sun's photosphere to be gaseous; but the light emitted by the sun does not give bright lines, but a continuous spectrum, which is the spectrum of a solid or liquid, but not of a gas.*

Second.—If spots were cavities, all which show a nucleous must penetrate through the entire photosphere, so as to show the dark body beneath it. In such a case it would be impossible to see the dark body at the bottom of the opening, except when the spot is near the centre, and we could *never* see a very small nucleus without a penumbra near the limb, we might as well expect to see the water in a very deep well, standing at a great distance from it, as to see the bottom or nucleus of a sun spot, *without a penumbra*, when we are not vertically above it. *All* such spots would show a penumbra, being one side of the cavity, as they moved from the centre; and we should often see penumbra without nuclei, but never nuclei without penumbra near the sun's limb.

Such however is not the fact, we often see small nuclei, mere points, on all portions of the surface, quite as frequently near the limb as elsewhere. I have often seen such spots myself and they are visible in a fine photograph by Commodore Ashu, which I have at present in my possession.

Third.—If spots were hollows, those which had a nucleus in their center when near the sun's center, should *always* show the penumbra wider when near the limb on the side nearest the sun's edge than on the opposite side. This is sometimes the case, *but not always*.

In "Researches on Solar Physics," the Kew Observers state that they measured carefully the position of the nucleus with regard to the penumbra of a spot, when in different positions on the sun's disc; and they sum up in the following words: "The whole number of cases observed was 605; excluding therefrom 75 where the penumbra is equal on both sides, there remain 530; of which 456 are for and 74 against the assumption that spots are cavities in the sun."

But the 75 spots in which the penumbra was equal on both sides should not be excluded; they are evidences *against* the cavity theory,

*The writer is aware that the experiments of Frankland & Lockyer show that gases may give a continuous spectrum under great pressure; but we have no proof that such a pressure exists on the sun's surface.