

more or less blackness, according as the opening occurs opposite to a sandy, rocky, or aqueous portion of the surface of the Sun's disk.* The halo surrounding the nucleus is further a portion of the outer surface of the vaporous stratum; and as this is less opened than the photosphere, owing to the funnel-shaped form of the whole excavation, the direction of the passage of the rays of light, impinging on both sides on the margins of the interrupted envelope, and reaching the eyes of the observer, occasions the difference, first noticed by Wilson, in the breadth of the opposite sides of the penumbra, which appears after the nucleoid spot has moved away from the center of the Sun's disk. If, as Laugier has frequently remarked, the penumbra passes over the black nucleus, causing it wholly to disappear, this obscuration must depend on the closing of the opening—not of the photosphere, but of the vaporous stratum below it.

A solar spot, which was visible to the naked eye in the year 1779, fortunately directed William Herschel's superior powers of observation and induction to the subject which we have been considering. We possess the results of his great work, which treats of the minutest particulars of the question in a very definite manner, and in a nomenclature established by himself. His observations appeared in the *Philosophical Transactions* for 1795 and for 1801. As usual, this great observer pursued his own course independently of others, referring only in one instance to Alexander Wilson. In their general character, his views may be regarded as identical with those of Bode, and he bases the visibility and dimensions of the nucleus and the penumbra (*Philos. Transact.*, 1801, p. 270, 318, tab. xviii., fig. 2) on the assumption of an opening in two envelopes, while he assumes the existence of a clear and transparent aerial atmosphere (p. 302) between the vaporous envelope and the dark body of the Sun, in which clouds that are either wholly dark, or only faintly illumined by reflection, are suspended at a height of about 280 to 320 geographical miles. William Herschel seems, in fact, also disposed to regard the photosphere as a mere stratum of *unconnected* phosphorescent clouds of very unequal surface. According to his view, "an elastic fluid of unknown nature rises from the crust or surface of the dark solar body, generating only small luminous pores in the higher regions where the action is weak, and large openings, with nuclei, sur-

* Bode, in the *Beschäftigungen der Berlinischen Gesellschaft Naturforschender Freunde*, bd. ii., 1776, p. 237-241, 249.