

An ingenious observation, which has subsequently been fully confirmed, made by the astronomer, Alexander Wilson, of Glasgow, of a large solar spot, on the 22d of November, 1769, led him to an elucidation of the penumbrae. Wilson discovered that as a spot moved toward the Sun's margin, the penumbra became gradually more and more narrow on the side turned toward the center of the Sun, compared with the opposite side. The observer, in 1774, very correctly concluded,* from these relations of dimension, that the nucleus of the spot (the portion of the dark solar body visible through the funnel-shaped excavation in the luminous envelope) was situated at a greater depth than the penumbra, and that the latter was formed by the shelving lateral walls of the funnel. This mode of explanation did not, however, solve the question why the penumbrae were the lightest near the nuclei.

The Berlin astronomer, Bode, in his work entitled "Thoughts on the Nature of the Sun, and the Formation of its Spots" (*Gedanken über die Natur der Sonne und die Entstehung ihrer Flecken*), developed very similar views with his usual perspicuity, although he was unacquainted with Wilson's earlier treatise. He, moreover, had the merit of having facilitated the explanation of the penumbrae, by assuming, very much in accordance with the conjectures of Cardinal Nicolaus de Cusa, the existence of another cloudy stratum of vapor between the photosphere and the dark solar body. This hypothesis of two strata leads to the following conclusions: If there occur in less frequent cases an opening in the photosphere alone, and not, at the same time, in the less transparent lower vaporous stratum, which is but faintly illumined by the photosphere, it must reflect a very inconsiderable degree of light toward the inhabitants of the Earth, and a gray penumbra will be formed—a mere halo without a nucleus; but when, owing to tumultuous meteorological processes on the surface of the Sun, the opening extends simultaneously through both the luminous and the cloudy envelopes, a nucleoid spot will appear in the ash-gray penumbra, "which will exhibit

* Alexander Wilson, *Observations on the Solar Spots*, writes as follows in the *Philos. Transact.*, vol. lxiv., 1774, part i., p. 6-13, tab. i.: "I found that the umbra, which before was equally broad all round the nucleus, appeared much contracted *on that part which lay toward the center of the disk*, while the other parts of it remained nearly of the former dimensions. I perceived that the shady zone or umbra, which surrounded the nucleus, might be nothing else but the shelving sides of the luminous matter of the Sun." Compare also Arago, in the *Annuaire* for 1842, p. 506.