Coronae, Haloes and Glories

A point source of monochromatic light viewed through a cloud of particles would appear surrounded by a corona or halo due to diffraction by the particles. The radiations diffracted by the particles and reaching the retina of the eye and focussed thereon are superposed and would thus be capable of interfering with each other. The foregoing discussion shows that if the particles are all similar and are disposed at random in space, the intensity in the corona would only *statistically* be a summation of the intensities of the diffraction patterns produced by the individual particles. While the general features of the pattern due to each separate particle would be recognisable in the aggregate effect, the latter is essentially different in detail. Instead of a continuous distribution of intensity, we have a violently fluctuating one which, in general terms, may be described as a dark field on which appear a great many points of illumination irregularly distributed and of varying brightness. The illumination at such points arises from the accidental agreements of phase of the effects of the diffracting particles, while the dark field results from the general cancellation of their effects by mutual interference. *Each such point in the corona exhibiting an observable intensity is, therefore, essentially an optical image of the original source produced by the entire cloud of particles functioning as a randomly distributed set of secondary sources of light.**

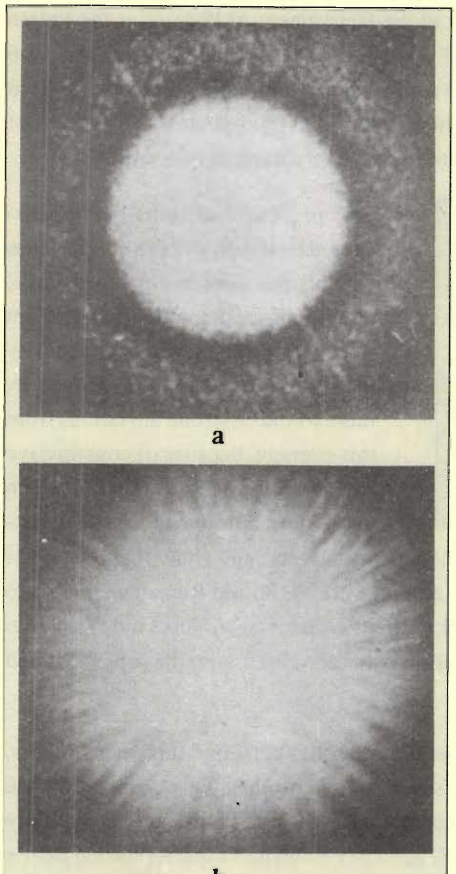

Fig. 66. Diffraction corona due to Lycopodium spores showing. a) Granular structure in monochromatic light, and b) radial streaks in white light.

Extract from the book *Lectures on Physical Optics*, Part 1 by C V Raman, Indian Academy of Sciences, Bangalore, 1959.

* G N Ramachandran, *Proceedings – Indian Academy of Sciences* A, 1943, Vol.18, p.190.

We shall now proceed to a closer examination of the nature of the diffraction pattern produced by a randomly distributed cloud of particles. As remarked earlier, such a pattern is *statistically* a summation of the effects of the individual particles but differs from them vastly in detail. Fig. 66 (a) on page 137 exhibits the central region of the corona observed around a *monochromatic* source of light of small angular extension, when viewed through a glass plate lightly dusted with lycopodium. The central disk of the corona is over-exposed in the photograph and shows no detail, but the granular structure of the pattern is seen very clearly in the first ring surrounding it. *Each of the bright spots in the field is a focussed image of the original source of light, formed by the joint action of the diffracting particles and the lens of the photographic camera.* This is verified by varying the size or shape of the source of light and noting its effect on the appearance of the pattern. It is then noticed that all the bright spots in the field alter in the same way and have the same form as the source. This is illustrated in Fig. 72 which shows the central disc of the corona photographed with a smaller exposure and on a larger scale than in Fig. 66 (a), so as to clearly bring out the structure of the pattern. A small circular aperture and another in the form of a somewhat larger equilateral triangle were used as sources in photographing the two patterns reproduced. The circular and triangular shapes of the individual spots appearing in Figs. 72 (a) and (b) can easily be recognised. The triangles in Fig. 72 (b) appear inverted on the plate with respect to the source, as they should be in the images formed by a converging lens.*

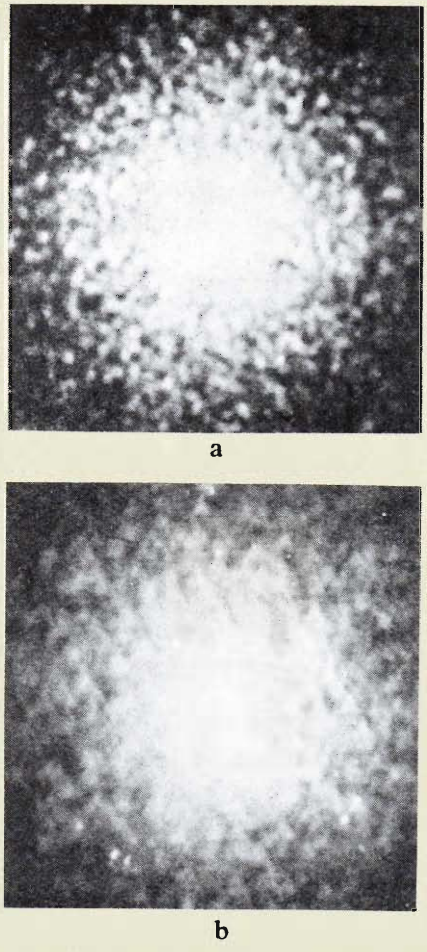

Fig.72. Central disc or corona in monochromatic light with a) a circular pin-hole and b) a triangular aperture as source.

* G N Ramachandran, *Proceedings – Indian Academy of Sciences* A, 1943, Vol.18, p.190.