Nature (London) **107** 714 (1921)

The colours of breathed-on plates

The phenomena of breath-figures on glass are of considerable interest, and have been written upon in the columns of *Nature* (*London*) by the late Lord Rayleigh, Dr John Aitken, and others. One specially interesting aspect of the subject to which I have recently devoted some attention is the explanation of the beautiful optical effects exhibited by breathed-on plates of glass. If a clean, cold plate of glass is lightly breathed-on and then held in front of the eye, and if a small distant source of light is viewed through it, coloured haloes will be seen surrounding the source. The characteristic feature of the halo exhibited by a moderately heavy (but not too heavy) deposit is that the outermost ring in it is achromatic, with a reddish or brown inner margin, followed inside by a succession of rings of various colours. As the film of moisture evaporates, the halo contracts and the coloured rings move inwards, ultimately disappearing at the centre of the halo. The entire halo presents a radiating fibrous structure.

The explanation of these phenomena presents some difficulties. One is tempted to suppose (as, indeed, Donlé and Exner have already) either that the minute droplets of water condensed on the plate which diffract the light are of approximately equal size or that they are arranged at more or less constant distances from each other. A microscopic examination of the condensed film shows, however, that neither of these suppositions is anywhere near the truth. The size of the individual droplets shows a variation of several hundred per cent, and their arrangement in the film is entirely irregular, being determined presumably by the presence of invisible condensation nuclei on the surface of the plate—a view that is strongly supported by the fact that successive deposits on the plate are seen under the microscope to preserve the same configuration with a surprising degree of accuracy. Further, if the size of the droplets were the determining factor in the production of the diffraction haloes, it would be difficult to understand why as they evaporate the rings in the halo should *contract* in size.

These facts necessitate an entirely different supposition regarding the element of regularity in the film which enables it to give rise to a recognisable system of coloured diffraction haloes. Measurements I have made seem to show that the droplets in the film—whether large or small—have practically all the same angle of contact with the surface of the plate, this angle of contact diminishing as the film evaporates. The formation of the coloured haloes is, on this view, due to the passage of the light *through* the minute lens-shaped droplets; the maximum deviation of the light determined by the common angle of contact fixes the position of the outermost achromatic halo, and the colour-sequence following within it would be practically the same for all the droplets irrespective of their size. This would also furnish a satisfactory explanation of the contraction of the halo as the film evaporates.

C V RAMAN

22 Oxford Road, Putney, S.W.15
26 July