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"Smoky" quartz

The deeply tinted varieties of quartz, such as "smoky" quartz and the yellow or Madagascar variety, are generally transparent in the infra-red region of the spectrum to the same extent as clear rock-crystal, as may easily be demonstrated with the aid of a thermopile and galvanometer. I wish to suggest that a very simple physical explanation of this property may be offered. As has been emphasised in a paper by Prof. R J Strutt (now Lord Rayleigh) in the *Proceedings of the Royal Society* for 1919, these varieties of quartz are really optically turbid media, the opacity arising from the scattering of the radiations in their passage through the crystal by a cloud of small particles present as inclusions. Since scattering of this kind is effective in inverse proportion to the fourth power of the wavelength, it can easily be seen why the longer heat-waves can traverse the crystal without appreciable loss. Some photometric observations which I have made of the relative transparency of the yellow and colourless varieties in different parts of the spectrum support this explanation.

In the paper just quoted Rayleigh has described the very beautiful and striking effects that arise owing to optical rotatory dispersion when a strong beam of *polarised* light is sent through a block of smoky or yellow quartz in the direction of the optic axis; the track of the beam, as made visible by the scattering particles and observed in a transverse direction, shows bright and dark bands if monochromatic light be used, and alternations of colour if the incident beam is of white light, the effect being due to the fact that the scattering particles themselves act as *analysers* of the light incident on them. I find that the phenomenon discovered by Lord Rayleigh can be very prettily shown in another way which is also instructive. A thin, flat sheet of *unpolarised* white light may be sent through the crystal in a direction *transverse* to the optic axis, and the track of the beam observed in a direction parallel to the optic axis through a Nicol. In this case the scattering particles act as *polarisers*, and the scattered light suffers a rotatory dispersion of its plane of polarisation in traversing the quartz along the optic axis before reaching the observer's eye. Hence the whole track of the beam as seen through the observing nicol appears coloured, the tint fluctuating periodically with the thickness traversed as the block is moved to and fro in the line of sight or when the analysing nicol is rotated.

Rayleigh has shown in his paper that the track of a beam of light traversing a beam of *transparent* colourless quartz can be successfully photographed. I find that by using a concentrated beam of sunlight it is possible *visually* to detect the Tyndall blue cone even in this case. Its intensity, however, is exceedingly small.

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