

## The Christiansen experiment\*

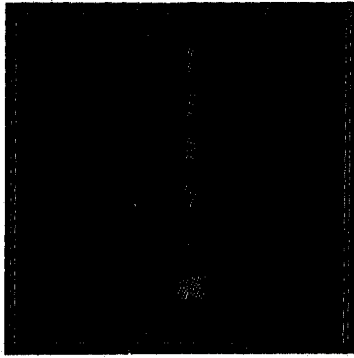
The present article is concerned with the phenomena observed in the well known optical experiment embodying the principle of the so-called Christiansen filters used for isolating monochromatic radiation from white light. A transparent isotropic solid is powdered and placed inside a flat-sided cell of glass, and the latter is then filled up with a liquid of which the refractive index is adjusted to equality with that of the powder for any desired wavelength in the spectrum. The cell then becomes optically transparent for such wavelength, which the rest of the spectrum is not transmitted but only diffused in its passage through the cell.

The material usually recommended for use in Christiansen filters is powdered glass which needs to be specially prepared. We have found that a convenient substance to employ in experimental studies of the Christiansen effect is hexamethylenetetramine, also known as hexamine or urotropin, which is both inexpensive and readily available as a crystalline powder. Hexamine is optically isotropic and its refractive index is intermediate between those of benzene and carbon disulphide in either of which it is nearly insoluble. Beautiful chromatic effects are observed when hexamine powder is placed in a cell and filled up with a mixture of benzene and carbon disulphide in the proportion of roughly one to four. For visual observations, it is convenient to employ, instead of a flat-sided cell, a stoppered hollow prism of  $60^\circ$  angle to contain the material. The advantage of doing this is that the prism functions both as a containing cell and as a dispersing apparatus. All that is necessary is to view the incandescent filament of an electric lamp from a distance through the prism held close to the eye. The spectral character of the transmitted light then becomes immediately evident, and by moving the eye to different positions on the prism face, the various effects described and illustrated below may be observed.

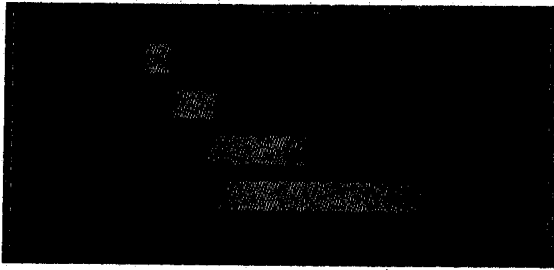
The spectral character and intensity of the transmitted light in the Christiansen experiment is influenced by several factors, of which the depth of the column through which the light filters is of particular importance. The set of six spectrograms reproduced in figure 1 exhibits the sharpening of the spectral band of transmission with increasing thickness of the filter; the uppermost corresponds to a thickness of 18 millimetres and the lowest to 1.5 millimetres. The exposure given had to be greatly increased with increasing thickness of the material so as to record the transmitted light with approximately the same intensity.

---

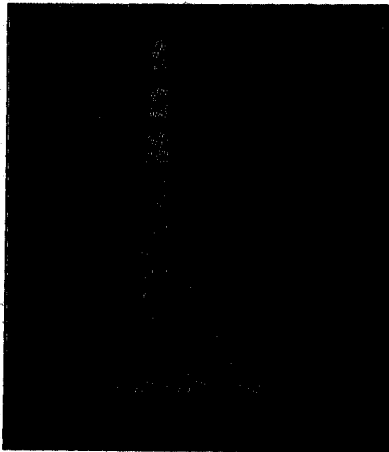
\*Sir C V Raman, "The Theory of the Christiansen Experiment," *Proc. Indian Acad. Sci.*, 1949, **A29**, 381-390. See also, 1949, **A30**, 211-215 and 277-283.



(1)



(2)



(3)

Figures 1-3

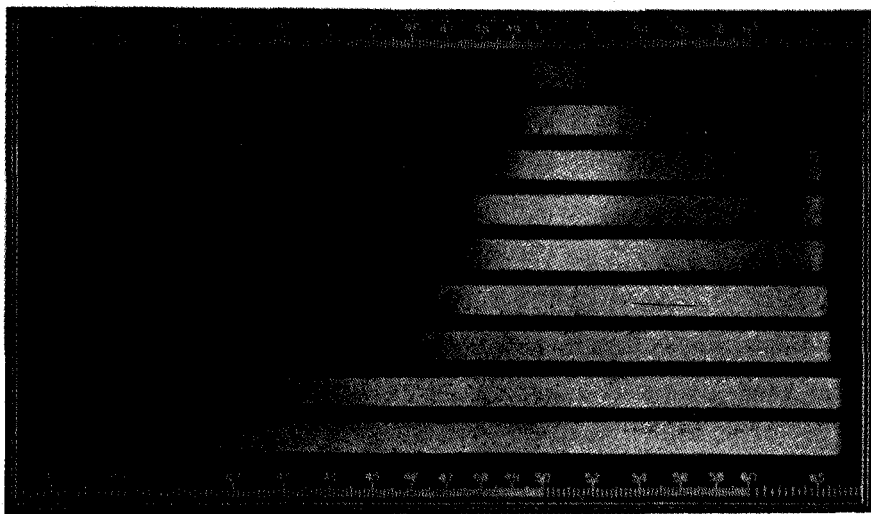


Figure 4

On a superficial view, one may be tempted to believe that the optical behaviour of a Christiansen filter is a matter of geometrical optics, the part of the spectrum at which there is equality of refractive index coming through without deviation, while the rest of the light is diffused as a result of multiple reflections and refractions. Such an explanation of the action of the filter is, however, not only inadequate but definitely misleading as can be seen from the facts set out and illustrated in this article. In a paper published recently and referred to above, an attempt has been made to deal with the subject from the standpoint of wave-optics. The expressions developed in that paper for the extinction coefficient of a Christiansen filter afford at least a general explanation of the facts of observation set forth in the present article. It appears not unlikely however that a fresh approach from the standpoint of the electromagnetic theory of light may be necessary to give a more complete account of the observed phenomena.

*C V RAMAN  
M R BHAT*