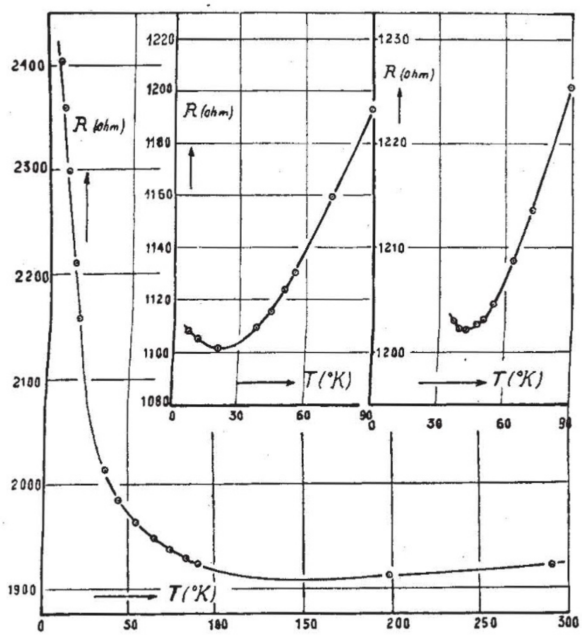


It is interesting to direct attention to the analogy existing between these results and the minima found by de Haas and van den Berg[2] for the resistance of gold wires at liquid helium temperatures.

A. Van Itterbeek
L. De Greve

Physical Laboratory of the University,
Louvain.
June 14.

[1] *Nature*, **156**, 634 (1945).
[2] *Physica*, **3**, 440 (1936); **4**, 663 (1937).

Additional Interference Fringes Produced by Scattering and Reflexion

In a recent observation, F. K. Bauchwitz and D. Shoenberg[1] have reported observing a new interference effect. With the eye accommodated for infinity, they observed coloured circular fringes when looking at a strong point source through a thin air-film formed between silvered plates. The interpretation they give is that the light is first multiply reflected between the surfaces and then scattered, and this scattered light is multiply reflected before being observed.

The colours of thick plates which had been originally observed by Newton were interpreted by Young and by Stokes[2] in a similar manner to this, except that the interference pattern is produced by reflexion and not transmission. While preparing some optical flats a few years ago, interference patterns were noticed which differed from the usual Newton ring pattern and these were investigated. Experiments were carried out which showed that the patterns are produced by scattering and reflexion, and in the process the patterns seen by Bauchwitz and Shoenberg were independently observed as well as a double system of interference fringes, of which, to my knowledge, no previous description has been given.

This double system of fringes, consisting of a pair of patterns similar to the simple Newton ring type for thin plates, was photographed using the following experimental arrangement. Two optically flat glass plates about four inches in diameter were placed one on top of the other, the lower surface of the top plate was made semi-reflecting (semi-aluminized), the top surface of the lower plate being reflecting (fully aluminized). The scattering points were scratches on the semi-aluminized surface, or were simply produced by spreading a thin smear of oil over the surface with the finger. The flats were placed on the table and illuminated by a mercury lamp. The light from the source passed through a narrow slit (about 2 mm. wide) in a large black card, the plates being arranged so that the scratched lines were normal to the direction of the light. They were observed at an angle of 45° to the normal and two sets of interference patterns were visible. One set was localized in the plane of the surface of the half-aluminized plate, whereas the other pattern was localized in a curved surface close to the scattering surface. This latter pattern corresponds to the position of the Newton ring pattern formed by multiple reflexions as given by Feussner[3] and discussed by Tolansky[4]. It is suggested that the two fringe patterns are produced in the manner shown in Fig. 1*a* and 1*b*. The system of fringes indicated by Fig. 1*a* is localized in the scattering surface *C*, whereas the system corresponding to Fig. 1*b* for perfectly flat and parallel plates would be at an infinite distance. For the first set

$$(n_1 + \tfrac{1}{2})\lambda = 2d \cos \theta \; ; \qquad (1)$$

and for the second set

$$(n_2 + \tfrac{1}{2})\lambda = 2d \cos \varphi . \qquad (2)$$

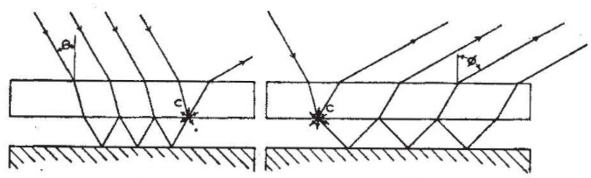
The interference pattern corresponding to the colours of thick plates is given by the summation of these two patterns, whence

$$(n_1 - n_2)\lambda = 2d (\cos \theta - \cos \varphi) \quad . \qquad (3)$$

Owing to the different locations of the two sets of fringes, it is difficult to photograph them together. Fig. 2 gives the general effect of the combination of the two patterns. The plates had been tilted so as to form a wedge angle, the two sets being then approximately straight lines inclined at slightly different angles. The intersection of these systems is clearly seen as bright and dark bands running across the photograph.

The above interpretation may be confirmed by holding a frosted plate in front of the two plates, when the pattern corresponding to the second system is seen. If the frosted plate is placed between the observer and the plates, a pattern similar to the first system is observed. These two patterns are usually distinctly different; for example, in one case a single interference colour pattern covered the diameter of the plate, and in the other the pattern consisted of several lines.

When the mercury lamp was replaced by a white-light source, the double system of fringes could not be distinguished; but a single system occurred which corresponded in position to the intersection of the two systems. This pattern corresponds to the pattern previously studied under the title of the colours of thick plates, and it is suggested that it is produced by the summation of the pair of interference patterns of the simpler Newton ring type.



a *b*

Fig. 1

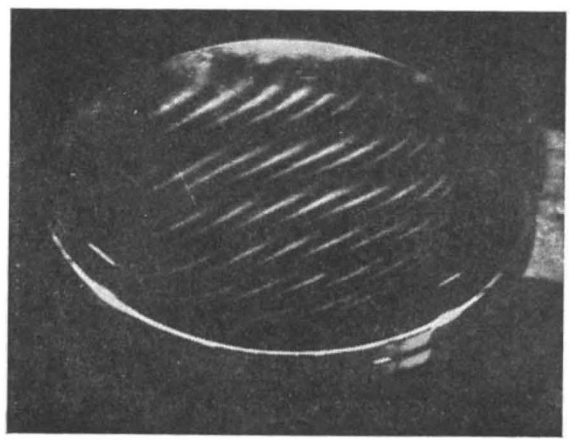


Fig. 2

In order to account for the colours of thick plates, Stokes came to the conclusion that it was necessary for two rays to be scattered from the same scattering element. He reached this conclusion as he was unable to observe the coloured pattern when he viewed a luminous point through a plate of glass, both surfaces of which possessed scattering centres. The alternative theory suggests that the colours are not produced by the diffraction effects at the scattering centres but by interference effects produced by reflexions between the plates, the scattering centres acting as secondary sources of light. The comparative faintness of the transmission pattern corresponding to the reflected pattern can be explained as follows. Since neither surface contained a reflecting layer, the intensity of the double set of interference patterns would be low and the resulting interference pattern difficult to see. These two patterns would be produced in a manner similar to that of transmission Newton ring patterns for thin plates. For glass surfaces that have not been made semi-reflecting these do not have the contrast of reflected interference patterns. The single-coloured pattern produced by a strong white light source can be readily observed, as was pointed out by Bauchwitz and Shoenberg, if the surfaces are heavily silvered. They may also be faintly observed on viewing a distant lamp through a glass plate one or both surfaces of which carries light scratches.

Further details of the experiments carried out were read last year to the Royal Society of Victoria[5] and are being published by that body.

V. D. Hopper

University of Melbourne.
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[1] Bauchwitz, F. K., and Shoenberg, D., *Nature*, **156**, 142 (1945).
[2] Stokes, G., *Trans. Camb. Phil. Soc.*, **9**, 147 (1851).
[3] Feussner, Gehrcke, "Handbuch der Physik: Optik", **1** (1927).
[4] Tolansky, S., *Phil. Mag.*, vii, **35**, 120 (1944).
[5] Hopper, V. D., *Proc. Roy. Soc. Vic.*, **58**, Part 2, Art. (1946).