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DEMONSTRATION of the Double Refraction due to Motion of a Vanadium Pentoxide Sol, and Some Applications. By R. H. HUMPHRY, M.Sc.

A COLLOIDAL solution of vanadium pentoxide in water has been found by Freundlich, Diesselhorst and Leonhardt (1915) to show double refraction on stirring when it has been aged either artificially or by being allowed to stand. The phenomenon is due to the formation of rod-shaped particles which set themselves in a definite direction when the liquid is caused to move. In linear flow the liquid behaves in the same way as a plate of uniaxal crystal cut parallel to the axis, and placed with the axis parallel to the direction of flow. In convergent light, with the flow along the line of sight, the familiar cross and rings are produced.

The following applications of this double refraction were demonstrated :

(1) Deviation from rectilinear flow owing to the presence of an obstacle. For this purpose the nicol prisms are set in directions perpendicular to and parallel to the direction of the stream.

(2) The thermal convection stream from a wire heated electrically ; the nicol prisms are set at 45° to the direction in which it is desired to investigate the stream. These are also the positions of the nicols for (3) and (4).

(3) Efflux of liquid from a jet below the surface.

(4) Disturbance caused by the fall of a liquid globule of nearly the same density through the solution.

(5) Disturbances below the surface due to surface forces when a drop of alcohol is placed on the surface. Only the effect in certain directions could be observed owing to the positions of the nicols.

The colloidal solution of vanadium pentoxide is the most sensitive of all those which show a similar effect. It was kindly prepared by Mr. E. Hatschek in the following way :

Concentrated nitric acid is diluted to 10 times its volume. 0.5 gm. of ammonium vanadate is placed in a mortar and 2 cc. of the dilute acid are added and the mixture stirred. A further 2 cc. of the acid are added and the pentoxide is washed on a filter until it begins to pass through. It is then taken from the filter paper, placed in 200 cc. of distilled water and allowed to stand for 12 hours in a warm place. In 14 days the solution shows excellent striæ between crossed nicols.

DISCUSSION.

Mr. E. HATSCHEK said that the experiments called for exceptional cleanliness as the sol is very sensitive to electrolytes. Aniline blue is interesting in that it gives colour effects ; it has a well-marked absorption band, and behaves like a positive crystal to wave-lengths on one side of the band, but like a negative crystal to wave-lengths on the other side.

Mr. R. W. PAUL asked whether the effect of subjecting the liquid to an electrostatic field had been tried.

Mr. J. GUILD said he was not satisfied as to the cause of the double refraction. The colloidal particles are too large to have the effect of molecules, and too small to be regarded as transmitting light after the manner of glass dust. In his reading of ultra-microscopic literature he had come across nothing which suggested a satisfactory explanation. In interpreting the appearances obtained by Prof. Coker's method the greatest caution is necessary. The intensity of the effect of a strain or a streamline depends on its direction, and for certain directions it is impossible to detect a strain at all.

In reply to the discussion Mr. HUMPHRY said that the experiments which were shown were only to be regarded as preliminary, and no interpretation of the observed effects had yet been attempted. It seemed possible by use of this effect to throw more light on streamline problems, and with better apparatus, designed to overcome any tendency towards gelation, useful results might be obtained. The effect of an electric field on the arrangement of the particles had been worked out by Freundlich (*Kapillar Chemie*, 1922), who also explained the production of the double refraction. It is true that with stationary nicol prisms certain stream lines are accentuated, while others may not appear at all; but this difficulty would be overcome by having rotating nicols. The more delicate means of examining polarised light might show effects which were missed with nicol prisms.