ring and an outer darker ring." He then cites the measurements by Joly[2] and says, "The radius of these haloes vary only between 0·0152 mm. and 0·0160 mm., in Europe in rocks of pre-Cambrian age; whereas the halo above referred to in the Chota Nagpur granite has a radius of 0·030 mm., nearly double that of those recorded in European rocks." He has explained that it would be a thorium halo.

Referring to Joly's paper[3] we find that the dimensions of haloes which he has attempted to compare with progressive geological aging is that of the primary uranium haloes. These correspond to alpha-particles which exhibit maximum of ionisation in air at a distance of 2·2 cm. This primary uranium halo represents the earliest stage in the development of pleochroic haloes.[4] In fully developed normal haloes where we find a series of concentric rings, the outermost radius in the case of the uranium haloes corresponds to the alpha-particles from RaC. The measurements on this as given by Joly in his paper gives an average of 0·032 mm. The rings formed as a result of the disintegration series of the thorium family give measurements in biotite as 0·041 mm.; 0·026 mm.; 0·011 mm., etc.

From the description and the microphotograph of the halo in the Chota Nagpur rock, it appears that it is a normal halo of the uranium series and that the outermost ring as is to be expected corresponds to the range of alpha-particles from RaC and hence measures about 0·030 mm. as recorded by Dr. Iyer. The simple explanation that it represents RaC of the uranium series fully satisfies the measurements.

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January 11, 1949.

1. *Rec. G.S.I.*, 1931, **65**, 500. 2. *Proc. Roy. Soc.*, *Ser. A*, **102**, 682, *et seq.* 3. *Ibid.*, p. 694. 4. *Phil. Trans. Roy. Soc.*, *A*, **217**, 51 *et seq.*

BEREKS' COMPENSATOR

THERE is an impression that, if the tables supplied by the makers of the Bereks' compensator is lost, the compensator cannot be used. Rogers and Kerr[1] remark, "the value is inserted in a simple formula supplied by the makers of the instrument. Solution of the formula gives the correct retardation for the mineral grain." This might be interpreted to mean that the formula is that of the makers, and that therefore the tables supplied by them are necessary for its use. This is not so. The formula given by the makers is—

$$\text{Log}\,\Gamma = C + \log f(i).$$

This is a method of solving by logarithms the well-known formula for retardation; $\Gamma = C \times f(i)$ or $R = K \times D$ (given by Johannsen for the use of the Babinet compensator)[2] where Γ or R = retardation of the mineral to be determined, C or K = the constant of the Bereks' compensator determined on any microscope, and $f(i)$ or D, the reading of the drum of the compensator for any mineral, whose birefringence is to be determined.

If the tables are lost, the procedure is :—

The Bereks' compensator is calibrated for white light by reading the divisions on the drum from the first order violet on the one side of the black cross to the first order violet on the other side. Say the readings are 44·2 and 15·1. Then 44·2 minus 15·1 divided by two = 14·55 = λ = 550 $\mu\mu$ (the wavelength of white light). Therefore the constant C or K $= \frac{550\mu\mu}{14\cdot55}$.

The mineral (say hypersthene) is then placed on the stage and turned 45° from the position of extinction with its C-crystallographic axis $\perp_r$ to the long direction of the compensator, and the drum read from the dark bar of compensation on the one side to the dark bar on the other. Say the readings are 54·7 and 4·8. Therefore $f(i)$ or D = 54·7 minus 4·8 divided by two = 24·95. Applying the general formula for retardation, Retardation of hypersthene Γ or R = C or K $\times f(i)$ or D = $\left(\frac{550\,\mu\mu}{14\cdot55}\right) \times 24\cdot95$, and solving by logarithms, $\log \Gamma$ or R = log 550 + log 24·95 — log 14·55, using Clarkes' tables, Γ or R = 943·2 $\mu\mu$. Birefringence $(n_2 - n_1) = \frac{R}{M}$, where R = retardation and M = thickness of the section.[3] The thickness of hypersthene is measured by a micrometer serew. In this case it is ·06 mm., which is expressed in $\mu\mu$ = 60000. Therefore birefringence of hypersthene is $\frac{943\cdot2\mu\mu}{60000\mu\mu} = \cdot0157$.

(The microscope used in this case is Leitz 313769 with objective P_3 and ocular P_1 5×).

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February 10, 1949.

1. Rogers, A. F. and Kerr, P. F., *Optical Mineralogy*, 1942, p. 77. 2. Johansen, A., *Manual of Petrographic Methods*, 1918, p. 375. 3. *Op. cit.*, p. 370.