

$$\frac{\partial I}{\partial m} = \int_0^{\infty} \left\{ e^{-\frac{n}{2V}(kx+m)^2} - e^{-\frac{n}{2V}(kx-m)^2} \right\} f(x^2) dx$$

which is positive or negative according as m is negative or positive. Therefore

$$I(m) \leq I(0).$$

The completely unbiased character of the E^2 -test (Tang, 1938), by stating the problem in its canonical form and following the above method of argument, can easily be shown to follow from the complete unbiasedness of the t -test just proved. This chain of reasoning can be followed up to show the completely unbiased character of the likelihood ratio test for the general regression problem and then further of the Wilk's criterion.

Detailed proofs will be published elsewhere.

Indian Council of Agric. Research,
R. D. NARAIN.

New Delhi,
December 28, 1948.

Daly, J. F., "On the unbiased character of likelihood ratio tests for independence in normal systems," *Ann. Math. Stats.*, 1940, **11**, 1. Tang, P. C., "The power function of analysis of variance tests with tables and illustrations of their use," 1938, **2**, 126.

NEW BAND SYSTEMS OF THE $TlCl$ MOLECULE

EXCITING the vapour of thallium chloride in a high frequency discharge through a continuously evacuated pyrex tube, two new systems of bands, one between λ 4300— λ 4150 and the other between λ 4150— λ 3800 have been obtained in addition to the band system around λ 3200 analysed by Howell and Coulson.* The more refrangible system consists of about 75 bands in all which are degraded in either direction, while a few of them are headless and diffuse. The other system consists of about 18 bands which are mostly degraded towards the red, though a few of them are violet-degraded. The vibrational analyses of these two systems have shown that the lower state, which is found to be common to both of them, is the upper state of the ultraviolet system $^31-^1\Sigma$, established by Howell and Coulson. Predissociation similar to that found in the upper state of the ultraviolet system, is observed in the lower state of both the systems at $v'' = 5$. The following vibrational constants

have been determined for the more refrangible system.

$$\nu_0 = 24683.3 \quad \omega_e' = 101.3 \quad \omega_e'' = 206.5 \\ x_e' \omega_e' = 0.1 \quad x_e'' \omega_e'' = 6.5$$

The locus of intense bands in this system falls on a Condon parabola which is to be expected with such relative values of ω as occur here. The following constants are suggested for the other system.

$$\nu_{0,0} \sim 24040 \quad \omega_e' \sim 100 \quad \omega_e'' \sim 205$$

The chlorine isotope effect observed in the system supports the vibrational analysis.

The close proximity of these two systems suggests that the upper levels may form an electronic doublet.

Details will be published elsewhere.
Andhra University, P. TIRUVENGANNA RAO.
Waltair,
January 2, 1949.

* Howell and Coulson, *Proc. Roy. Soc.*, 1938
166, 238.

THE EMISSION SPECTRUM OF BISMUTH IODIDE

A NEW BAND system between λ 5900— λ 5650, attributed to the diatomic molecule, BiI, is recorded in emission in a high frequency discharge, in addition to the band system with origin at $\nu = 23388.9$ cm^{-1} , reported by Morgan.* Vibrational analysis of this system has led to the determination of the following vibrational constants.

$$\nu_0 = 17216.0 \quad \omega_e' = 195.0 \quad \omega_e'' = 167.9 \\ x_e' \omega_e' = 1.0 \quad x_e'' \omega_e'' \sim 0.3$$

By analogy, this system may correspond to the low frequency system observed in the other bismuth halides.

Details will be published shortly.
Andhra University, P. TIRUVENGANNA RAO.
Waltair,
January 19, 1949.

* Morgan, *Phy. Rev.*, 1936, **49**, 47.

PLEOCHROIC HALO FROM THE CHOTA NAGPUR GRANITE

WHILE consulting literature regarding the occurrences of pleochroic haloes in minerals, the description of a pleochroic halo mentioned by Dr. L. A. N. Iyer¹ in granite from Chota Nagpur was noticed. He records, "In one of the crystals of biotite in the granite from south of Jatiba, a good pleochroic halo is present with a dark red grain in the centre, which is presumably zircon. It shows an inner lighter

ring and an outer darker ring." He then cites the measurements by Joly² 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 paper³ 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.

Geology Department, M. S. DORAISWAMI.
Andhra University,
Waltair,
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 Berek's compensator is lost, the compensator cannot be used. Rogers and Kerr¹ 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 there-

fore the tables supplied by them are necessary for its use. This is not so. The formula given by the makers is—

$$\log \Gamma = C + \log f(i).$$

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 Berek's 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 Berek's 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 = $\lambda = 550 \mu\mu$ (the wavelength of white light). Therefore the constant C or $K = \frac{550 \mu\mu}{14.55}$.

The mineral (say hypersthene) is then placed on the stage and turned 45° from the position of extinction with its C-crystallographic axis \perp 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 $D = \left(\frac{550 \mu\mu}{14.55}\right) \times 24.95$, 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 screw. In this case it is 0.05 mm., which is expressed in $\mu\mu = 60000$. Therefore birefringence of hypersthene is $\frac{943.2 \mu\mu}{60000 \mu\mu} = 0.0157$.

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

Central College, P. R. J. NAIDU.
Mysore University,
February 10, 1949.

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