

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>On the Completely Unbiased Character of Tests of Independence in Multivariate Normal Systems</i> —R. D. NARAIN ..	41	<i>The Preparation of Transparent Jellies of Aluminium Molybdate</i> —S. P. MUSHRAN	48
<i>New Band Systems of the Tl Cl Molecule</i> —P. TIRUVENGANNA RAO ..	42	<i>Chemical Investigation of the Seeds of Jatropha curcas Linn.</i> —C. M. DESAI AND M. T. VYAS ..	49
<i>The Emission Spectrum of Bismuth Iodide</i> —P. TIRUVENGANNA RAO ..	42	<i>The Dinitration of Meta-Chloracetanilide</i> —B. B. DEY, R. KRISHNA MALLER AND B. R. PAI ..	49
<i>Pleochroic Halo from the Chota Nagpur Granite</i> —M. S. DORAISWAMI ..	42	<i>Preliminary Antimalarial Screening Tests of some Biguanide Derivatives</i> —H. L. BAMI, S. NATARAJAN, A. S. RAMASWAMY, N. N. DE, B. H. IYER AND P. C. GUJIA ..	50
<i>Berek's Compensator</i> —P. R. J. NAIDU ..	43	<i>Influence of Hydroxycarboxylic Acids on the Reaction Between <math>\alpha</math>-Naphthylamine and Dichromate and <math>\alpha</math>-Naphthylamine and Vanadate</i> —M. NARASIMHA SASTRI AND J. V. S. RAMANJANEYULU ..	52
<i>Electrolytic Preparation of Azo Dyes II</i> —V. V. RAMAN, AND M. V. SITARMAN ..	44	<i>A Preliminary Investigation into the Viability of Immature Embryos of Corn under Conditions of Cold Storage at Freezing Point</i> —P. UFFAMAN ..	52
<i>A Preliminary Note on Diseases of Gram</i> —S. C. DAS AND D. P. MOTIRAMANI ..	46		
<i>Alkali-Sensitive Linkages in Irradiated Cellulose</i> —T. S. A. PADMANABHAN, L. R. SUB, P. F. E. MANN, S. K. RANGANATHAN AND T. S. SUBRAMANIAN ..	47		

ON THE COMPLETELY UNBIASED CHARACTER OF TESTS OF INDEPENDENCE IN MULTIVARIATE NORMAL SYSTEMS

To prove the unbiased character of likelihood ratio tests like the test of significance of the multiple correlation coefficient or Hotelling's  $T^2$  test, Daly (1940) used the non-null frequency distributions of these test criteria. This leads to obvious difficulties when tackling the general regression problem and the test of independence of several sets of variates, and Daly (1940) has shown only their locally unbiased character.

This paper demonstrates an approach which does not require an explicit knowledge of the frequency distribution of the test criteria, and it has been possible to prove that the likelihood ratio test for the general regression problem and the Wilk's criterion for independence of sets of variates, are completely unbiased.

As the simplest demonstration of the procedure which is applicable generally, consider the  $t$ -test for the significance of the mean of a

normal population. Let the frequency function of a sample of size  $n$  be

$$(2\pi V)^{-\frac{n}{2}} e^{-\frac{1}{2V} \sum_{i=1}^n (x_i - m)^2} \prod_i dx_i.$$

The region  $W-w$  complementary to the critical region  $w$  for testing the hypothesis,  $m=0$  is given by

$$\bar{x}^2 \leq K^2 \chi^2,$$

where  $K^2$  is a positive constant depending on the size of the critical region and

$$n\bar{x} = \sum_i x_i$$

$$\chi^2 = \sum_i (x_i - \bar{x})^2.$$

We write

$$I(m) \equiv \int_0^{\infty} \left[ \int_{-Kx}^{Kx} e^{-\frac{n}{2V} (\bar{x}-m)^2} d\bar{x} \right] f(\chi^2) d(\chi^2)$$

where

$$f(\chi^2) d(\chi^2)$$

is the frequency function of  $\chi^2$  which is distributed independently of  $\bar{x}$ . To show that the test is completely unbiased is equivalent to showing that

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

We have

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

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  $\lambda$  4300— $\lambda$  4150 and the other between  $\lambda$  4150— $\lambda$  3800 have been obtained in addition to the band system around  $\lambda$  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  $\omega$  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  $\lambda$  5900— $\lambda$  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  $\nu = 23388.9$   $\text{cm}^{-1}$ , 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, *Phys. 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. Iyer<sup>1</sup> 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