A Shortened Method of Estimation of Mental Factors by Regression

A TYPE of problem of estimation with which one meets in the theory of mental factors is this : a team of n tests z_i $(i = 1, 2, \ldots, n)$ has been analysed into r common factors $f_{0\alpha}$ $(\alpha = 1, 2, \ldots r)$ and n specifics f_{1i}, all of which are normalized and uncorrelated, but otherwise unknown. The observed test-scores (in standard measure) can then, in matrix notation, be represented as follows .

$$z = M_0 f_0 + M_1 f_1,$$

where the column vectors z, f_0 and f_1 indicate the tests, the common factors and the specifics respectively. The matrices M_0 and M_1 whose elements are the loadings of the tests with the hypothetical factors, are regarded as known. When it is desired to estimate the common factors in terms of the test-scores, the usual regression method leads to the formula :

$$\hat{f}_0 = M'_0 (M_0 M'_0 + M_1{}^2)^{-1} z, \ldots (1)$$

where $\hat{f}_0$ is the estimate of f_0.

If the number of tests, n, is large, the evaluation of this expression is very laborious, since it involves calculating the reciprocal of the n-rowed matrix $M_0 M'_0 + M_1{}^2$. However, according to L. L. Thurstone, the number of common factors, r, is in most practical cases much smaller than the number of tests ; in these circumstances it is more convenient to use the formula :

$$\hat{f}_0 = (I + M'_0 M_1{}^{-2} M_0)^{-1} M'_0 M_1{}^{-2} z, \ldots (2)$$

in which now only the reciprocal of an r-rowed matrix is required.

Formula (2) is an extension to multiple factor analysis of a formula which Prof. C. Spearman has derived for the estimation of the 'general factor' g in the theory of two factors.

A more detailed account of this will be given elsewhere.

WALTER LEDERMANN.

University,
Edinburgh.
Feb. 10.

Points from Foregoing Letters

IN an investigation of the capture γ-radiation produced by protons in carbon, P. I. Dee, S. C. Curran and V. Petržílka find that there are two resonances. One of these, at 400 kv., is due to ^{12}C, the other, at 500 kv., is due to ^{13}C. The energies of the capture γ-radiations have been measured, giving for ^{12}C the value 2·6 Mv. and for ^{13}C the value 7·4 Mv. These values agree with those to be expected from the known mass values.

From energetics considerations, Dr. F. London concludes that a spatial model of liquid helium II such as that proposed by Frölich to explain the λ-transition point is not possible. The author describes, instead, a kinetic model in which each helium atom moves in a self-consistent periodic field formed by the other atoms. He calculates the specific heat of such a system by applying Bose-Einstein statistics on the very rough simplifying assumption of 'ideal gas' conditions. The author considers that his view may throw light on the large heat conductivity and the small viscosity of helium II.

The cross-section for the total nuclear photo-effect of the deuteron for 2·64 Mev. γ-rays has been determined by Dr. H. v. Halban, jun. The relative contributions of the electric and magnetic effects were separated by counting the number of photo-neutrons projected in the direction of the incident γ-ray and at 90° to this direction. The cross-section found for the magnetic effect is lower than would be expected from the capture cross-section of protons for thermal neutrons.

Among some 10,000 proton tracks obtained by using D—D and Li—D neutrons and photographed in a Wilson chamber, S. Kikuchi and H. Aoki have found only six pairs, a smaller proportion than formerly noticed, and only one sixth of the expected number on the basis of the 'neutro-electric effect.'

An unusual intense nitrogen afterglow has been produced by Prof. J. Kaplan at pressures higher than 10 mm. Its spectrum is rich in bands of the Vegard–Kaplan intercombination system and contains a strong line at 3470 A. which is tentatively identified as the hitherto unobserved trans-auroral line $^2P - {}^4S$. There is a fairly strong line at this wave-length in the light of the night sky. A search is now being made for the $^2P - {}^2D$ lines in the high-pressure glow. These should lie around 1·0373 μ and would be the nitrogen analogues of the well-known green auroral line.

Further investigations towards elucidating the structure of the anti-sterility vitamin E are reported by Dr. F. Bergel, A. Jacob, A. R. Todd and T. S. Work. From the fact that a synthetic coumaran derivative behaves similarly to β-tocopherol upon thermal decomposition and from surface film measurements carried out by Dr. J. F. Danielli, they conclude that β-tocopherol is a coumaran derivative.

Dr. J. W. Hes finds that the complete removal of carbon dioxide interferes with the oxidation-reduction power (as shown by the methylene blue reaction) in the case of heterotrophic cells, that is, bacteria and other low organisms which cannot synthesize proteins and carbohydrates from inorganic constituents. This explains the indispensability of carbon dioxide for the growth of such organisms.

Prof. Jan Smit and B. van der Heide report on experiments showing that milk-wool, made from milk-casein, is readily attacked by many kinds of micro-organisms, which may thus affect durability of textile products made from that substance. The dissolving action was likewise shown by sterile pieces of the milk-wool agar, on which the organisms were grown, and taken from places where the wool had been dissolved by an exo-enzyme. The enzyme was destroyed by heating the agar.

A study of the formation of the calcareous tube of the serpulid worm *Pomatoceros triqueter* by the late Frank A. Potts, reported by J. D. Robertson and Dr. C. F. A. Pantin, has shown that the source of calcium for the tube is probably the sea water. Tube building in this polychæte extends from March to September.