LETTERS TO THE EDITORS

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Freedom for Scientific Research

IN these days of 'planning' there seems a general desire by many, little qualified, to put science in its place.

The horrible threat that science was no longer to be international has been protested against, very rightly, by all that is best in the United States, Britain and elsewhere.

The idea that there should be two classes of men of science, one knowing government secrets and research work, and those outside the sacred fold, was, and is, a very shocking proposal. Now, I notice a school of thought that wants to plan fundamental research, forgetting that once you instruct anyone as to what they are to study, you are *ipso facto* imposing *ad hoc* research upon them.

I think it was the great J. J. Thomson who once said after the Boer War that if you had planned and organized science to explore the best way of finding bullets located in the human body, certainly probing might have become an art and the human body a pin-cushion, but not that way would there have been brought about X-rays. Mr. Herbert Morrison, I was delighted to see, speaking at the British Association, appreciated the point, and said you could not dragoon men of science relative to fundamental research. Well spoken.

Much remains to be done in planned *ad hoc* research by capable men to exploit (unpleasant word) for the good of all the discoveries of the laboratory. Here much can and should be done, for it is only by producing the most up-to-date and advanced design and technique that we can hope to export our goods in a world where every country is seeking to become industrialized.

We must appreciate that the pure scientist is a creative artist. No one must boss him. No one drive him. We are lucky in the production of these great men. Certainly arrange that their lives be free of monetary worries, but let us remember that their life interest and pleasure is research, and leave them to carry on undisturbed by the stormy blasts and distractions of a world licking its wounds and quarrelsome after a protracted fight. Do not of all things plan their lives. Some will produce future miracles no doubt, but most perhaps may not be so lucky. That should not worry us; our duty is to have given them the chance, and although many of their names may not be handed down to the future praised by all, yet they will have done good and noble work, for which we should all be no less grateful.

BRABAZON OF TARA.

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Dec. 10.

Lognormal Distributions

IN pointing the way towards easier manipulation of non-normal distributions, Prof. J. H. Gaddum's recent article¹ should act as a heartening stimulus to geologists. Sedimentary petrologists in particular will welcome it, for the efficacy of Prof. Gaddum's

main theme is already established in certain parts of their domain.

We are indebted chiefly to the American school. Up to the present, most attention has been paid to the normalization of size distributions. The 'phi' and 'zeta' scales of Krumbein^{2,3,4,5} are illustrative in this connexion, representing logarithmic transformations of the Wentworth and Atterberg geometric grade-scales. The transformations are carried out by substituting logarithms of the grade-scale limits for the appropriate diameter-values (ξ mm.) through

$$\phi = -\log_2 \xi, \text{ and } \zeta = 0.301 - \log_{10} \xi.$$

They yield, of course, scales having arithmetic intervals; hence the 'normal phi curve' (ref. 5, p. 252), and the direct application of conventional statistics to problems of sedimentary distribution. But one needs to recall that moment-analysis shows that sediments yield many local size-distributions which are not rendered significantly (or even approximately) normal through the simpler logarithmic transformations. The indiscriminate use of a particular function is consequently to be deprecated, and a preliminary attempt should always be made to discover that one which will either give the 'perfect' measure directly, or at least ensure the greatest chance of obtaining it. Should such treatment prove vain, then recourse must be had to 'post-mortem' search (often the simpler of the two) succeeded by individual transformation of the variates. It must not be forgotten, too, that the skewness and kurtosis of certain sedimentary variables (such as particle size measured in terms of diameter) probably have considerable geological significance, and must not be lost to sight.

Distributions of sedimentary composition may be approached in the same way. Within geologically 'synchronous' horizons, the areal variation may be considerable (for example, up to 500 per cent per 700 sq. miles in certain Lower Cretaceous rocks). Its underlying variates (specific and varietal proportions), however, are seldom lognormal. A contributory cause may be the complex relation that seems to exist between the compositional standard deviation (σ_h) and the compositional mean (ρ_m). For actively sorting, eroding or aggrading currents (providing the mean patchiness they impose is not widely different from ρ_m) this may be of the form

$$\sigma_h^2 = \rho_m^2 \left(J + \frac{1 - 2\rho_m}{L\rho_m^2} S \right) + \sigma_r^2,$$

where S is variable and related to the numbers of particles removed and added locally, σ_r is the random deviation and J and L are horizontal constants for all allogenic minerals⁶. If experiment should confirm this, then a general transformative panacea appropriate to each horizon may be proved to exist. On the other hand, a few mineral species and varieties do occasionally yield to transformations of the type $X = \log(x_0 - x)$. (This is inevitably the premier alternative to $X = \log x$ for those minerals which are liable to absent themselves locally.)

Neither can Prof. Gaddum's pertinent remarks concerning variance be overstressed to the geologist. No assumption of homogeneity of the variance within sedimentary universes should be lightly made, but be based where possible on rigorous test^{7,8}. This is particularly urgent during detailed studies of 'patchiness' by the analysis of variance when differences of locality are used as differences of 'treatment'. The