Correlation Coefficients in Meteorology.

IN NATURE for Mar. 17, Mr. E. V. Newnham, in an interesting letter on "Correlation Coefficients in Meteorology," points out that if we wish to test if an observed value could reasonably have occurred in a sample from uncorrelated material, ρ should be put equal to zero in the formula

$$\frac{1-\rho^2}{\sqrt{n}},$$

and not equated to the observed value, r. So far as it goes, this advice is correct, but without other warning, and especially in conjunction with the example chosen, it is not a little misleading. The correction may be considerably greater, or less, than that required to give a reliable value.

Using $(1-r^2)/\sqrt{n}$, the probability that a correlation derived from 16 pairs of observations should exceed 0·70, would appear to be 0·000,000,02, or only one in 50 million trials; this, as Mr. Newnham indicates, would make the odds in favour of a genuine connexion "overwhelmingly great"; using the corrected formula, $1/\sqrt{n}$, it would appear to be 0·00256. However, if the odds are calculated by an exact method, it is found that the probability is actually a little more than 0·00127; the real odds happen in this case to be nearly double those which Mr. Newnham advocates.

The fact is that the distribution of the correlation coefficient from small samples is so far from normal that the use of any formula for the standard error is misleading. This is not to be regretted, since the exact test of significance is no more difficult to apply than the use of the standard error; indeed, special tables have been available for some time from which the level of significance of an observed correlation can be read off at a glance, and similar tables for the multiple correlation have already been prepared for publication by Dr. Wishart in this laboratory.

Since in nine cases out of ten only the small sample formula is exact enough for practical purposes, the formula for the standard error of the correlation coefficient may soon be classed among the things "which students have to know, but only a fool would use."

R. A. FISHER.
Rothamsted Experimental Station,
Harpenden, Herts.

The Golgi Bodies of Plants.

I RECENTLY directed attention to the discovery of Golgi bodies in plants, which was made by Bowen, and is of interest to all botanists.

In this laboratory two of my senior students, Miss Patten and Miss Scott, have gone over a part of Bowen's work, and I have therefore had the opportunity of studying slides of plant tissues prepared according to the methods which Bowen has used. In hyacinth root, and pea root and stem, we have been able to conform Bowen's results, especially in material prepared by the Kolatchev method. Bowen's bodies are discoidal structures, or osmiophilic platelets as he calls them, and very like the hæmatids of mammals. There is a stainable cortex and a thinner, or at least less chromophile, central area. They are very small, but stain very sharply by the Kolatchev method, and there can be no doubt as to their presence. They are not osmium granulations.

For the benefit of those students of botany who may care to investigate these bodies, I give full details of the Kolatchev method; if it is carried out properly it never fails: Slit up root tips, etc., and fix in Champy's fluid, or the following modified Champy. Equal parts of 6 per cent. bichromate of potassium, 1 per cent. chromic acid, and 2 per cent. osmic acid. After 24 hours the material is washed overnight in a gauze-covered vessel, under a running tap. Transfer to 2 per cent. osmic acid, and keep at 30° to 35° C. for from 3 to 7 days, 4 days usually being enough. Wash in running water for several hours, transfer to 30 per cent. alcohol, upgrade and embed in wax. Cut sections thinly and mount unstained. The Golgi bodies are black discs, while the cell and nucleus are a more or less uniform yellow colour. As a control one may add to the pieces of plant tissue, fragments of mollusc ovotestis (in which Golgi bodies can be seen *intra vitam*), the intestinal tracts of centipedes, and pieces of dorsal root ganglion, or guinea-pig testis (in which Golgi bodies have been stained *intra vitam* by Subba Rau and Brambell (*Jour. R. Micr. Soc.*, 1925, p. 438)).

Thus in one operation it is possible to show Golgi bodies in a protozoon (Coccidium or Adelea, in the gut wall of the centipede), in an insect (gut cells), in a mammal, and in plant cells. The fragments, which must be small ($\frac{1}{8}$ inch in diameter), can all be carried through together, and cut in the same wax block.

Careful details of techniques suitable for plant tissues will be found in the last-mentioned of Bowen's papers: *Science*, vol. 64; *Anat. Record*, vol. 34, 1926; *Biol. Bull.*, vol. 53, 1927; *Zeit. f. Zellf. u. mikr. Anat.*, vi. Band 6, Heft 5, 1928.

J. BRONTË GATENBY.
Trinity College, Dublin,
April 16.

Milk Pasteurisation and the Tubercle Bacillus.

MY attention has been directed to a paragraph in NATURE of Mar. 31, p. 513, referring to my recent research into the effect of pasteurisation on the bovine tubercle bacillus in naturally infected tuberculous milk. The note concludes with the words "we still seem to lack experimental information of the efficiency of a *commercial* pasteurising plant for destroying the tubercle bacillus in naturally infected milk."

While this statement is correct, I feel that it needs some amplification. In the laboratory experiments it was possible to maintain a constant temperature of 145° F., which in the commercial process is almost an impossibility—the temperature usually fluctuating from 1° to 5° F., which fluctuation usually tends towards the lower temperatures in an effort to use the minimum temperature in order to conserve the cream line of the milk. In addition to this tendency to subject the milk to the minimum temperature, there is the further possibility of mechanical defects in commercial plants—defects that were shown to be present in certain machines that were tested in connexion with an American investigation in 1924, the results of which are published in the *United States Public Health Bulletin, No. 147*.

In view of these facts, I think it is fair to assume that laboratory experiments may be taken as applicable only to perfect commercial pasteurisation, and that given perfect commercial pasteurisation at 145° F. for 30 minutes, we are still forced to the conclusion that this combination of time and temperature does not invariably kill the tubercle bacillus.

LEONARD J. MEANWELL.
The National Institute for Research
in Dairying,
Shinfield, Nr. Reading,
April 2.