anxiety, especially among biologists, who are used to checking the adequacy of their methods by control experiments. The difficulty of obtaining decisive results often flows from heterogeneity of material, often from causes of bias, often, too, from the difficulty of setting up an experiment in such a way as to obtain a valid estimate of error. I have never known difficulty to arise in biological work from imperfect normality of the variation, often though I have examined data for this particular cause of difficulty; nor is there, I believe, any case to the contrary in the literature. This is not to say that the deviation from "Student's" t-distribution found by Shewhart and Winters, for samples from rectangular and triangular distributions, may not have a real application in some technological work, but rather that such deviations have not been found, and are scarcely to be looked for, in biological research as ordinarily conducted.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, July 26.

Nuclear Association in the Æcium of *Puccinia graminis*.

IN a letter to NATURE (July 23, 1927, p. 116) Craigie announced the discovery of heterothallism in the rust fungi. In a second letter (Nov. 26, 1927, p. 765) he showed that the æcial stage of *Puccinia graminis*—the parasite which causes the black stem rust disease of cereals—can be produced on the leaves of the common barberry at will simply by applying to the pycnia of a monosporidial pustule of one sex some of the pycniospore-containing nectar excreted from the pycnia of another monosporidial pustule of opposite sex.

A series of experiments on *Puccinia graminis*, recently made by me, has yielded some information as to the manner in which the change from the haploid to the diploid condition in this fungus is brought about.

The sporidia are uninucleate. In a pustule of monosporidial origin, the mycelium and the pycniospores produced by the mycelium are also uninucleate. In such a haploid pustule there appear, near the lower epidermis of the barberry leaf, numerous sterile wefts of mycelium. These wefts, which appear to be crescent-shaped in transverse sections of the leaf and are made up of hyphæ with uninucleate cells, are evidently haploid rudiments of æcial cups waiting to be stimulated into further developmental activity.

When nectar which contains pycniospores of one sex is applied to the pycnia of a monosporidial pustule of opposite sex, the wefts of hyphæ situated along the base of the pustule soon undergo a change from the haploid to the diploid condition. About 48 hours after the pycniospores have been applied, the nuclei at the base of each weft become enlarged. Neighbouring hyphæ then fuse in pairs in a manner similar to that described by Christman for *Phragmidium speciosum*, and two nuclei become associated in each fusion cell. The fusion cells, which initiate the diplophase, elongate and cut off chains of binucleate cells which later divide and thus form intercalary cells and æciospores. Sections through pustules fixed 65 hours after the application of pycniospores have shown young æcial cups with as many as four æciospores in several of the æciospore chains.

The part which the pycniospores play in bringing about æcial development is not yet completely understood. Some of the pycniospores have been observed to germinate, and, in one instance, the germ-tube from the spore had attained a length of 15 μ. In view of the fact that binucleate hyphæ are to be found only at the base of the æcium, it seems probable that, when pycniospores of one sex are applied to a pycnium of opposite sex, the pycniospores are stimulated to germinate and to produce haploid hyphæ which grow down to the hyphal wefts near the lower epidermis and there fuse with cells of opposite sex. The solution of the problem of tracing the hyphæ from the germinating pycniospores to the base of the æcium must await further investigation.

W. F. HANNA.

Dominion Rust Research Laboratory,
Winnipeg, June 24.

The Crystal Structure of Solid Nitrogen.

RECENT researches on the luminescence of solidified gases have shown that systems consisting of mixtures of nitrogen with inert gases give a great variety of oscillatory bands, which are intimately connected with the oscillations which the nitrogen atoms are able to perform in the crystalline state. As pointed out in previous papers, the determination of the crystal structures of these systems will be of fundamental importance for the interpretation of the oscillatory bands characteristic of the solid state.

Researches on the structure of solidified gases have already been taken up by W. H. Keesom and his collaborators at the Cryogenic Laboratory of Leyden (*Comm.*, Leyden, 178). For pure argon they find a face-centred lattice. In the case of nitrogen, which is the most important substance for our purpose, they merely state that they have obtained powder diagrams, which, however, are so complicated that they have not been able to interpret them by means of a definite unit cell and a corresponding crystal system.

As the oscillatory bands mostly originate from nitrogen, it is indeed the nitrogen structure which is of the greatest importance for the interpretation of the luminescence phenomena, and we have therefore also attacked the problem at the Physical Institute of Oslo. We obtained good powder diagrams with a conveniently constructed apparatus, and after having tried a number of crystal classes, we finally succeeded in showing that the spectrum could be interpreted by a unit cell belonging to the cubic system.

The side of the unit cube was found to be 5·65 A. units, and the density measurements of Dewar lead to the result that the unit cell contains 8 nitrogen atoms.

In these investigations I have been most ably assisted by Mr. Alf Maurstad, Mr. S. Stensholt, and Mr. E. Tønsberg.

L. VEGARD.

Physical Institute, University,
Oslo, June 28.

Nature of Disease-Producing Viruses.

TWICE recently I have noticed in the columns of NATURE criticism of the hypothesis that disease-producing viruses are intermediate between molecule and living cell because no non-parasitic forms are known. Until viruses can be known other than by the effects of their parasitism, it would seem to be quite impossible to detect corresponding bodies that are not parasitic. I agree with the critics that if such bodies exist they may be much more numerous than the viruses, but until some method is devised by which the constituents of the viruses can be recognised, it would seem to be useless to look for them. For the hypothetical intermediate combining molecular structure, metabolism, and reproduction, I have been using the designation *vitamol*.

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July 9.