has an influence on fertility, the whole question may be greatly complicated. But such complications seem to be irrelevant to the simple issue raised by Mr. Yule's remarks.

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Trinity College, Cambridge,
April 5, 1908

P. S. I understand from Mr. Punnett that he has submitted the substance of what I have said above to Mr. Yule, and that the latter would accept it as a satisfactory answer to the difficulty that he raised. The "stability" of the particular ratio 1:2:1 is recognized by Professor Karl Pearson (*Phil. Trans. Roy. Soc.* (A), vol. 203, p. 60).

PURE CULTURES FOR LEGUME INOCULATION

In the 1907 Report of the Biologist of the North Carolina Agricultural Experiment Station, Dr. F. L. Stevens and Mr. J. C. Temple report some work upon cultures of the nodule-forming organisms of legumes. The cultures used were obtained from the United States Department of Agriculture. The investigators have presented their data in such a manner that the value of pure cultures for inoculating legumes appears questionable and their conclusions emphasize their attitude of disapproval. In carefully reviewing their report, a very brief outline of which appeared in Science, Vol. 26, 1907, p. 311, I have been impressed with the fact that the inferences drawn by the casual reader would almost certainly be unwarrantably antagonistic to the use of pure cultures for inoculating legumes. The investigators' objections to the actions of cultures supplied by this department are briefly as follows:

A considerable number of the cultures hermetically sealed in glass were sterile at the time they were examined by Dr. Stevens and Mr. Temple. The misconception in regard to the viability of cultures distributed by the department at the present time could have been prevented by the insertion of a footnote explaining that since July, 1906, small bottles with wax seals have been substituted for small tubes hermetically sealed in the flame of a blast lamp. It is surprising to me that four out of seven of the old-style cultures examined by Dr. Stevens should have been sterile, as my own investigations previous to adopting this method for distribution indicated that about one half of one per cent. of the cultures sealed in this way in routine work would be injured or sterilized by the heat of sealing. The law of chance must perhaps be invoked to explain the discrepancy in our figures. It must be remembered, however, that the cultures spoken of at this time are the old-style liquid cultures, and that the cultures distributed since July, 1906, are not open to criticism of this sort.

It is surprising to me also to learn that during the multiplication period conducted in the practical manner outlined for use on the farm such great contamination should have become manifest. Two years ago I had small samples of these gross cultures prepared on the farm returned to me by farmers in various parts of the country for examination, the sample being taken and mailed to me at the time the culture was applied to the seed. This, of course, allowed for greater development of contaminations than would have taken place at the time the culture was applied to the seed. Even with this handicap about two per cent. of the cultures received from the farmers were apparently pure, and if contaminated the contamination was evidently very slight indeed. About sixty per cent. were contaminated, but not excessively so, it being easy in all of these cases to isolate large numbers of *Pseudomonas radicicola*. The remainder were in rather bad condition, although I doubt if ten per cent. of the entire number received were so seriously contaminated as to be worthless.

The description of the pot experiments conducted by Dr. Stevens and Mr. Temple is confusing. In the first place, the sterilizing of soil by heating is well known to injure the soil seriously, and, regardless of the condition of the nodule-forming bacteria introduced, it is an open question whether soil sterilized by heating would allow nodule formation until a normal bacteriologic flora and normal soil conditions generally had been reestablished. It is impossible to determine whether any

attempt has been made to find out if injurious effect is produced by sterilizing this soil, unless we are to understand that pots Nos. 4 and 5 in tables Nos. 1, 2, 3, 4, 5, 6, 7, 8, 11 and 12 are inoculated with a mixture of culture and unsterilized soil. If this premise is correct it is evident that neither culture nor soil inoculation was able to produce nodules in the sterilized soil. If, on the other hand, one is to understand that pots Nos. 4 and 5 in tables Nos. 1, 2, 5, 7 and 11 are inoculated with culture mixed with sterilized soil then we must admit that no true parallel exists between the two series of experiments, and that it is impossible to determine what the effect of the use of pure cultures has been. There is also a contradiction between the headings and subheadings of some of the tables, making it impossible to determine whether that particular series was inoculated or uninoculated.

For the above reasons I would take exception to the summary of results reported by Dr. Stevens and Mr. Temple, and return the Scotch verdict of not proven to their strictures upon pure cultures and the pure culture method of inoculation. The note following the summary referring to Farmers' Bulletin No. 315, "Progress in Legume Inoculation," issued January 11, 1908, quotes the figures reported in that publication in a way that is very misleading. It is obviously impossible to determine whether or not a culture produced nodules if the entire crop is withered by drought or carried away by floods or if other uncontrollable factors entirely apart from the question of inoculation have destroyed the crop. It is, therefore, unfair to compare the 2,037 doubtful results with the 1,770 successes. As stated in Farmers' Bulletin 315, "the successes credited to the culture have been so recorded only when a clear gain was shown to be due to inoculation. A less strict interpretation of the doubtful reports would place many of them in the column of successes, and undoubtedly many classed as failures to secure inoculation would prove upon adequate investigation to have been failures from causes other than deficient nodule formation." If one must express the result in percentages it would be necessary to consider only the failures and successes, making the percentage of successes 78, instead of less than 50.

In closing, I wish to emphasize the necessity in experimental work of paying more attention to the soil conditions which may affect nodule formation. Some reasons for this Mr. Robinson and I have clearly indicated in Bureau of Plant Industry Bulletin No. 100, Part VIII., "Conditions Affecting Legume Inoculation."

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A STUDY OF THE REMARKABLE ILLUMINATION OF THE SKY ON MARCH 27, 1908

ON the night of Friday, the twenty-seventh of March, 1908, between the hours of 7:45 and 8:30, there was an unusual illumination of the heavens. The display was noted by many observers at Sandy Hook, N. J., and at Montclair, N. J. Some of the New York papers stated that the phenomenon was also visible at Hartford, Conn. Beyond a casual and unscientific reference to the matter in the daily press at the time, I have not been able to find any further reports or study of the phenomenon.

The 27th of March was a remarkably clear and warm day, the temperature mounting well above 70 degrees. The evening was also clear, but decidedly cooler. There was no moon, but Venus shone unusually bright in the western sky. This last fact is mentioned particularly, because the best authorities state that the light of a brilliant evening star is sufficient to preclude any marked illumination like that observed. Every one whom I have interviewed informs me that he had never before witnessed any such display. With the exception of one eye-witness at Millburn, N. J., all of my information has been obtained from observers at Sandy Hook, N. J. I was so unfortunate as to witness the last part of the spectacle, only. Details beyond my own knowledge are furnished from accounts given me by army officers stationed at Sandy Hook and members of their respective households.