

the western part of the state. Information from western South Dakota, where sugar beets are being raised on a large scale, shows that the price of land has greatly increased. The loss of so many sugar factories in Belgium and France is reported as stimulating efforts to produce more sugar in this country.

UNIVERSITY AND EDUCATIONAL NEWS

DR. HENRY FREEMAN WALKER has bequeathed \$100,000 to Middlebury College, to provide full salary for a professor on Sabbatical leave, any balance is to be used as an emergency fund for members of the faculty.

THE *Experiment Station Record* states that provision has been made by the Texas legislature for establishing a third junior agricultural college, to be known as the Northeast Texas Agricultural College. An appropriation of \$250,000 has been made for its establishment and maintenance. The board of directors of the State Agricultural and Mechanical College is given control over the institution. State appropriations have also been made for the station and substations aggregating \$225,095 for the year beginning September 1, and \$181,270 for the following year.

A CHAIR of aviation has been founded in the London University by M. Basel Zaharoff, who before the war had established similar professorships in the universities of Paris and of Petrograd.

ROSS AIKEN GORTNER, Ph.D. (Columbia), associate professor of agricultural biochemistry in the University of Minnesota, has been appointed professor and head of the division of agricultural biochemistry in the university and chief of the division of agricultural biochemistry in the Minnesota Agricultural Experiment Station, succeeding R. W. Thatcher who becomes dean and director of the department of agriculture in the same institution. R. Adams Dutcher, assistant professor of agricultural chemistry in the Oregon Agricultural College, and Clarence A. Morrow, professor and head of the department of chemistry in Nebraska Wesleyan University, have been appointed assistant professors of agricultural biochemistry in

the University of Minnesota. Clyde H. Bailey, cereal technologist and assistant professor of agricultural chemistry in the University of Minnesota, who for the past year has been on leave of absence and has been employed as chemist for the Minnesota State Board of Grain Appeals, Minneapolis, has resumed his duties in the university and has been promoted to an associate professorship in the division of agricultural biochemistry.

C. W. HOWARD, associate professor of entomology and parasitology of the University of Minnesota, has accepted the position of professor of biology in Canton Christian College, Canton, China. Professor Howard will sail from San Francisco the middle of October, visiting Hawaiian Islands, Manila and Japan *en route*. Canton Christian College is the only institution of collegiate rank in South China. The rapid growth of the agricultural and medical departments has made necessary the organization of a department of biology.

DR. L. B. AREY has been promoted from instructor to associate professor of anatomy in the Northwestern University Medical School.

DR. RAYMOND FREAS has been appointed adjunct professor of chemistry in the University of Virginia.

DR. J. ARCE has been appointed to a newly established chair of tropical pathology in the University of Lima, Peru.

DISCUSSION AND CORRESPONDENCE

THE INTERPRETATION OF THE RESULTS OF FIELD EXPERIMENTS WITH DIFFERENT PHOSPHATES

THE interpretation of results of field experiments with different phosphates is of present interest, especially as the conclusions reached by several investigators are being challenged by Dr. C. G. Hopkins, of the Illinois Agricultural Experiment Station.¹ As is well known, Dr. Hopkins has for several years been the ardent champion of raw rock phosphate as a fertilizer. He has been largely dependent, however, on data secured by others. In fact, not until very recently had he published re-

¹ Hopkins, C. G., "Phosphates and Honesty," Ill. Agri. Exp. Sta., Circular 186.

sults of his own experiments in which different phosphates were compared.

Statements² recently made by him in regard to the conclusions drawn in Bulletin 90 of the Tennessee Agricultural Experiment Station even go so far as to impugn the ability of an author who would draw the conclusion that bone meal proved to be, in those experiments, superior to rock phosphate. In view of the detailed data contained in Bulletin 90, the writer is surprised that there should be any serious differences of opinion in the matter. Careful consideration has convinced him that Dr. Hopkins has laid unwarranted stress on a single table (XIII.), which gives some averages from the three longest-continued experiments, and that he has failed to give due weight to the results of the individual series. This raises a question as to the value of such a table, especially to the casual reader, for it is evident that if a short number of series be averaged a preponderance of a single series may distort or mask the true findings. Such a table, therefore, is open to criticism, and evidently should be used with discretion, but is justified as one way of presenting a summary.

Table XIII. of Bulletin 90 gives as stated, a summary from three series of experiments each conducted on a different type of soil. Series 1, as is pointed out on pages 69 and 70 and again on page 87 of the bulletin, was conducted on a soil which proved to be naturally too well supplied with phosphoric acid to be at all well adapted to the comparison desired, so much so that rock phosphate in the last four years of the five-year period proved unprofitable in three of the eight experimental conditions. Excessive growth with lodging reduced the yields of wheat on one half the bone-meal plots, and even acid phosphate was used with only a narrow margin of profit. The soils of the other two series proved, however, to be poor in phosphoric acid and hence well suited to a comparison of phosphates.

In series 2 the evidence is unsatisfactory because of the lack of agreement between the results of the two rock phosphate plots, one of

which shows a slight loss and the other a good profit from the use of rock phosphate. If the latter be compared with the near-by bone-meal plots the rock phosphate shows more profit. In series 3, which was conducted on a soil especially poor in phosphoric acid, the evidence is decidedly in favor of bone meal as compared with rock phosphate. Under every one of the four experimental conditions of this series bone meal made a large increase in yield—equal, in fact, to the best obtained from acid phosphate and averaged 5.6 bu. of wheat per acre more than that obtained from rock phosphate. Even when calculated on the dollar-investment basis used by Dr. Hopkins, the average acre profit from \$1.00 invested in bone meal was \$3.05 as compared with \$2.79 for rock phosphate. In this connection it should be mentioned that a comparison between bone meal and rock phosphate where the cowpeas were removed for hay was omitted in Table XIII. because only in series 3 was such a comparison made, the results being especially favorable to bone meal.

Series 4, which was not included in Table XIII., is also worthy of consideration. This series was conducted on a greatly impoverished type of soil, well known to be naturally poor in phosphoric acid. As measured by the yields of wheat, acid phosphate proved highly profitable, but both bone meal and rock phosphate were used at a loss. However, the writer's records and observations of these experiments, during the two years of their continuance, convinced him that bone meal could be used profitably in the reclamation of land of this character. On the other hand, rock phosphate appeared next to worthless. By way of confirmation, bone meal plots 9 and 11 produced in the second year an average of 1.41 ton of cowpea hay to an acre. The near-by rock phosphate plots 7 and 8 produced only 0.80 ton. The value of the difference between the two yields of hay would pay for the bone meal used and leave a good profit. The hay data were not given in Bulletin 90, but serve as a good illustration of the advantage in the interpretation of results that rests with the person conducting the experiments.

² SCIENCE, November 3, 1916, p. 652.

In drawing his conclusions with regard to the showing made by the different phosphates, the writer was governed chiefly by a consideration of the soil conditions and results of the individual series and, as he thinks, very naturally placed acid phosphate first, bone meal second, and rock phosphate third in profitability.

With all the individual series in view, let us see the kind of formula Dr. Hopkins must use in order to arrive at his conclusion with regard to the relative standing made by bone meal and rock phosphate. The formula and his conclusions may be stated as follows:

Disregard series 4, omit one half the bone-meal data of series 3, include series 1 (conducted on a soil not poor in phosphate), and with the acid of series 2 obtain averages which show that, as used, the bone meal returned more profit than the rock phosphate. Now, make the unwarranted assumption that the profit from bone meal would decrease in direct proportion to the quantity used, and obtain the result that a dollar invested in rock phosphate made a profit of 39 cents more than a dollar invested in bone meal, or, the rock phosphate was superior to the bone meal.
Q. E. D.

In *SCIENCE*, March 2, 1917, page 214, Dr. Hopkins says: "The calculated profits mentioned in Professor Mooers's *SCIENCE* article³ are evidently based upon different valuations than those reported in the bulletin." The writer finds that the calculated profits for both acid phosphate and rock phosphate, as given in the *SCIENCE* article referred to, should be divided by 2. This, of course, does not affect the relative standing of the two materials. One dollar invested in acid phosphate shows an average profit of \$2.14 per acre where the cowpea crops were turned under, and of \$2.71 where removed, but one dollar invested in rock phosphate gave an average return of only \$1.29 under either condition. The writer has assumed that Dr. Hopkins could give a simple explanation for his conflicting estimates, as given in *SCIENCE*, November 3, 1916, p. 652, and in *SCIENCE*,

March 2, 1917, p. 214. In the former article he says, "For each dollar invested rock phosphate paid back \$2.29," but in the latter article he says, with regard to the same data, "Easy computations show profits per \$1.00 invested of . . . \$1.29 from phosphate rock."

From correspondence with dealers in rock phosphate, the writer is informed that until about six years ago the usual guarantee of fineness for the rock phosphate sold to farmers for fertilizer purposes was that 90 per cent. would pass through a 60-mesh sieve, but that the present guarantee is for 90 per cent. to pass through a 100-mesh sieve. Dr. Hopkins seems to have this in mind when he says, "Raw rock phosphate is now procurable in very much better mechanical condition than when these experiments were conducted."⁴ That he was in error with regard to the rock phosphate used in the experiments referred to may be seen by reference to page 59 of Bulletin 90, where the following statement is made: "90 per cent. was found to pass through a 100-mesh sieve."

In conclusion, the writer will add, that on page 60 of Bulletin 90, the content of total phosphoric acid in the rock phosphate was stated to be 33.9 per cent. The usual guarantee and expectancy for this material, as sold to farmers for fertilizer purposes, is a little under 30 per cent. With perfect fairness the calculations for phosphate rock used in the experiments might have been placed on the latter basis, and an increase of 13 per cent. can be properly allowed—as was referred to on page 59 of the bulletin—to the estimated cost of the applications made. This change would appreciably increase the unfavorable showing made by the phosphate rock.

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A METHOD FOR OBTAINING AMCEBA

IN common with many teachers I have found it necessary, at the opening of college in the fall, to provide large numbers of the indispensable amœba. I venture to set down a method which I have found successful during

³ *SCIENCE*, January 5, 1917, pp. 18 and 19.

⁴ *SCIENCE*, March 2, 1917, p. 214.