cent. of the total). At Vienna nearly two fifths of the medical students are women.

THE following promotions have been made at the College of the City of New York: From instructors to be assistant professors: Philosophy, Dr. Howard D. Marsh; mathematics, Dr. Paul H. Linehan; chemistry, Dr. Robert W. Curtis and Dr. William L. Estabrooke. From assistant professorships to associate professorships: Physics, Dr. Joseph G. Coffin.

AT the Iowa State College Dr. Charles A. Mann, of the University of Wisconsin, has been appointed associate professor of chemical engineering to succeed Professor George A. Gabriel, who goes into practical work.

DISCUSSION AND CORRESPONDENCE

A REPLY TO "METHODS OF CRITICISM OF 'SOIL BACTERIA AND PHOSPHATES'"

IN the issue of SCIENCE of November 3, 1916[1] Drs. Hopkins and Whiting have taken occasion to arraign me for having sent to certain editors of agricultural papers a letter headed "Confidential and Not For Publication." They also impugn my motives in writing the letter, for they say it was evidently done to "belittle" the importance of their work, whereas my reason for doing so is explained very fully in the second paragraph of the letter, appended below, and as stated, it was sent to the editors because the work of Hopkins and Whiting was "unfortunately being used by some writers for the purpose of making it appear that the same reaction will take place in the soil in connection with raw rock phosphate to essentially the same extent."

Instead of publishing my letter in full, Drs. Hopkins and Whiting quote only certain parts because of alleged lack of "space," but space was taken, nevertheless, to enter into a lengthy discussion of the validity of the work of Professor Mooers and of Director Thorne on raw rock phosphate, and the intimation was made that I had overlooked some work of the latter. This was seemingly not germane to the real issue, for instead of my having attempted to review their work, I wrote to each of them asking what their results actually showed, and merely quoted, with permission, from their letters. In fact, these letters were of a later date than the literature cited by Hopkins and Whiting in refutation of Mooers' and Thorne's conclusions.

It will be seen, therefore, that the attack by Hopkins and Whiting on these statements resolves itself into an allegation that Professor Mooers and Director Thorne were, in their opinion, incompetent to analyze their own work properly or had misrepresented it to me. This fact I regret exceedingly, for no agricultural investigators in the United States are held in higher esteem by their colleagues than Mooers and Thorne, and hence such allegations can only result in injury to those who make them.

Had my letter been intended as an unfavorable criticism of the work of Hopkins and Whiting, they would most assuredly have been favored with a copy immediately. It was, however, only intended, as stated in the letter itself, as a criticism of the improper use that other persons were making of their results.

I take pleasure in introducing below my letter of July 28, 1916. The reader is asked to note carefully if the letter constitutes an unfavorable criticism of the work of Drs. Hopkins and Whiting or if, as intended, it is merely an appropriate warning to the agricultural press not to draw too far-reaching and improper conclusions from it, for this is the real point at issue.

BOSTON, MASS., July 28, 1916

Confidential and Not For Publication

Dear Sir: My attention has been called within a few days to several articles appearing in the agricultural press which have been inspired by Bulletin No. 190 of the Illinois Agricultural Experiment Station. It appears that Drs. Hopkins and Whiting have experimented with the microorganisms which produce nitrous and nitric acid by the oxidation of ammonia. The work was done in water cultures into which artificially prepared and purified tricalcium phosphate had been introduced. They claim to have shown that the nitrite bacteria caused the lime and phosphoric acid of a highly insoluble phosphate to become soluble.

While this work is of much value as a scientific contribution, it is unfortunately being used by

[1] Vol. XLIV., No. 1140, p. 649.

some writers for the purpose of making it appear that the same reaction will take place in the soil in connection with raw rock phosphate to essentially the same extent. This, however, is not true, as will be explained.

All agricultural soils contain the bases soda, lime, potash and magnesia combined as silicates. Often these silicates are highly basic or, in other words, the proportion of base to the silica is so great that pure water will dissolve appreciable quantities of the bases. Furthermore, if soils have been limed heavily, especially with coarse limestone such as has been recommended by Dr. Hopkins, they are likely to contain in addition some carbonate of lime. The organic acids and the carbonic acid produced in the decomposition of vegetable matter or brought down in the rainfall, including also nitrous and nitric acid, produced as described above, tend to unite in the soil with the most readily attackable bases in the basic silicates and with the lime of the carbonate of lime before they can attack raw rock phosphate effectively. In other words, when nitrous acid is produced in a soil which has been properly limed and has, therefore, been rendered sufficiently basic for the best production of agricultural plants, it is incredible that all or most of it will react upon raw rock phosphate in the soil to the extent that it did in the water cultures used by Hopkins and Whiting in which there was nothing but phosphate which it could attack.

In this connection let me cite Lyon, Fippin and Buckman who, in their recent book on soils, say:

"It has been found, for instance, that calcium carbonate decreases the availability of raw rock phosphate and bone meal."

This action of the calcium carbonate is similar to the action of the highly basic silicates, and it corresponds to the action of the ammonia in stall manure when it is stored under the best conditions for its preservation, for the ammonia combines with the acid so readily as to interfere seriously with its solvent action on raw rock phosphate. In fact, it was probably because of this that Hartwell and Pember in Rhode Island and Hart and his coworkers in Wisconsin failed to demonstrate that composting manure and raw rock phosphate made the latter soluble or highly available to plants.

In this connection note what Director Thorne, of the Ohio Agricultural Experiment Station, says:

"Where we have used floats as a reenforcement of manure on this farm alongside of acid phosphate, the acid phosphate has given us a slightly larger net gain in the average of the 18 years' work, and a decidedly larger gain during the last half of this period—a result the opposite of what we expected when we started the experiment. The floats and the acid phosphate being used in the same quantity, or 40 pounds per ton of manure, we expected that the larger accumulation of phosphorus in the soil due to the floats would finally result in the floats exceeding the acid phosphates in total and net gain, but this has not happened."

If there were such a tremendous solvent effect of raw rock phosphate in the soil as some writers would make us believe after they have read and commented upon this bulletin, it is surprising that the Tennessee Agricultural Experiment Station should report as it does on raw rock phosphate, for Professor Mooers says:

"In reply to your recent inquiry will say that we have not published anything recently with regard to the comparative values of acid phosphate and rock phosphate, but we have conducted experiments with these two materials on various types of soil in different parts of the state for the past ten years. The results of our experimental work do not allow us to recommend raw rock phosphate for general use. In fact, we discourage its use anywhere in the state and recommend acid phosphate as the most profitable of all phosphates. In some of our experimental work the raw rock has given profitable returns, but in no instance clearly equal to acid phosphate. In all of the experiments the two materials have been used in approximately equal money values and in connection with green manuring, which is supposed by some to increase appreciably the availability of rock phosphate.

"In some of our experiments conducted on soils especially poor in phosphoric acid the returns from the rock phosphate have been very meager and not at all comparable with those from acid phosphate. For us to give the preference to rock phosphate would be to ignore all of our experimental data. I may add that when the land is limed the acid phosphate shows considerably greater superiority over the rock phosphate than where unlimed."

The work of Hopkins and Whiting was done on an especially soluble, artificial tricalcium phosphate, in a solution in a glass vessel kept at a high temperature where the acid could attack nothing but the phosphate, whereas the farmer has to deal with a soil containing far more readily decomposable silicates and carbonates, substances upon which the acid can react to a very large extent before it has a chance to attack the less soluble raw phosphate rock.

Let us appreciate this work of Hopkins and Whiting as an interesting contribution to the study of nitrification, but let us not draw too far-reaching and improper conclusions from it which are only partially applicable to field conditions.

In fact Hopkins and Whiting say in this Bulletin that:

"The addition of limestone with the insoluble phosphates prevents the detection of soluble phosphates."

They also say that:

"The nitrous acid produced may act upon compounds of iron, aluminum, potassium, sodium or magnesium which occur in soils, or it may act upon tricalcium phosphate, calcium silicate or calcium carbonate, if present."

In their hope of confining the solvent action of the nitrous acid as fully as possible to the raw phosphate rock, Hopkins has recommended that the phosphate be turned under in intimate contact with organic matter, yet when one realizes the even closer contact of the many soil particles with the organic matter at the same time, it will be obviously impossible for the nitrous acid to attack wholly or even chiefly the raw rock phosphate. This idea is fully supported by Thorne's practical field tests in Ohio, by the work of Mooers and others in Tennessee, and by the collective evidence of practically all of the agricultural chemists in the United States and Europe.

H. J. WHEELER

I gladly leave the judgment of the ethical and scientific questions involved to the impartial court of my colleagues at home and abroad.

H. J. WHEELER

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1916 OR 1816?

THE following announcement has appeared in the *Washington Times*, Wednesday, December 20, 1916:

PHRENOLOGIST TO SPEAK

Professor G. W. Savory, a graduate of the Fowler School of Phrenology of New York, will address the Enosinian Literary Society of George Washington University on the evening of January 15. His subject will be "Brains—How to Know and Handle Them." The lecture will be given in the assembly hall of the Arts and Sciences Department building, 2023 G street northwest.

Comments would seem superfluous.

A. HRDLIČKA

QUOTATIONS

SCIENCE IN GERMANY FROM AN ENGLISH VIEWPOINT

GERMANY has been held up to us so long as the model in all matters of state organization that most English students of institutions will read with surprise the letter published in another column, which has been addressed by the Committee of the Institution of German Engineers to Herr von Bethmann Hollweg in favor of the opening of the German civil service to men of scientific training. To-day the higher branches of the German civil service are reserved for lawyers, and are not open to graduates of the technical high schools. The evil of this system has long been felt in Germany. Ten years ago the German government admitted that the higher branches of their civil service were not manned in accordance with the requirements of the time. The training of those officials, even since the reforms of 1906, consist of a secondary-school course with a strong bias towards the humanities, followed by a short university course almost exclusively composed of legal subjects. The ordinary law course is the higher civil service course. Whatever a student's inclination or tendency may be, the legal training is a condition precedent to a civil service career. "Civil servants," the chancellor is told with pathetic force, "are called upon to deal with problems the expert solution of which calls for just the type of mental equipment that is provided by the technical high schools. . . . The forcible exclusion of the intellect that is available amongst these circles from participation in the higher civil service constitutes a waste of the intellectual powers of our nation."

The loss of the German nation under such an absurd system is not our concern; the point that we are interested in is that this nation, which claims to lead the world in administrative efficiency is in this instance, at least as dissatisfied with its achievements in the most important part of the organization of a nation as even England herself. Of course all the world knows now that Germany has long eked out her various weaknesses in administration by trumpetings that have brought down with a run the Jericho walls of foreign