And finally a word as to the second point I mentioned some lines back.

Our young people should get their sanitary instruction from thoroughly competent sources, or they would do better to have none at all, because false teaching is dangerous. Books are often much out of date and it is always better to rely upon the freshly accumulated experience of those who are in touch with the active problems of the day. Even though the hours must be few during which the student is in contact with some one who is master of his specialty, yet the benefit derived greatly surpasses that obtained during a longer period of second-hand teaching.

There is no branch of instruction that lends itself more readily to what has been termed the "alumni lecture course" than does that of sanitary science.

Subsequent to the lecture a thorough quiz could be readily carried on by a person detailed for that purpose, but it should be based upon the points developed by the lecture and the latter should be given by a man who is thoroughly competent and actively engaged in his profession.

W. P. MASON

THE FUTURE OF AGRICULTURAL CHEMISTRY[1]

IT may seem uncalled for at a time when agricultural chemistry has been undergoing such rapid evolution and expansion in the United States, to enter upon a discussion of its future. It is, nevertheless, true that conditions are now developing in this and other countries and have reached their culmination in Germany, which make a discussion of this subject not only desirable and timely, but practically imperative.

There is no time when it is so important to bring out correct views as to the nature of the development of an educational movement as when it is feeling some new and enormous impetus. When building progresses slowly and by stages much time is afforded for changes of plan as the work progresses, but where the progress is rapid and one stage follows another in quick succession it is of vastly greater importance that the plans shall have been fully perfected at the outset. The latter situation is certainly now before us so far as concerns agriculture and the sciences closely related thereto. The agitation for the teaching of nature study in its application to agriculture in the primary schools, the introduction of elementary agricultural instruction into the high school, the rapidly increasing demand for collegiate agricultural instruction and the imperative and almost unmet demand for university training as a proper preparation of teachers for the agricultural college and of investigators for the work of the experiment stations, have created a new and unique situation which should be met not only immediately, but most wisely. The present difficulty is not encountered solely at a single stage, but is more or less acute, as concerns the school, college and university. It is therefore of vital importance to recognize the first and most pressing need in order that by meeting it the whole situation may be relieved most quickly and satisfactorily.

The teacher of nature study in the elementary school would naturally be trained in the high school or normal school, but in this line of instruction these schools are lacking; hence there is now coming a demand upon the agricultural college to supply such teachers. The necessity under these conditions for sound instruction in the agricultural college and for men with thorough university training to teach in them, is greater than ever before.

[1] Address of the chairman of the Section of Agricultural and Food Chemistry, delivered at the Baltimore meeting of the association.

This new demand, supplementing that for men to conduct agricultural research in the experiment stations, is creating, in turn, a demand upon the university which is to-day met only in an utterly inadequate degree; and which has forced the Association of American Agricultural Colleges and Experiment Stations to provide in a slight measure for the need, by the establishment of a short, itinerary, periodic graduate school of agriculture. It is obvious that one can no more lift himself by his boot-straps than that this entire situation can be met satisfactorily without an immediate, adequate and wisely planned agricultural educational movement emanating from the university. It must give inspiration to the college, the college to the high school and normal school, and these in turn to the elementary school teacher.

The national government is now lending its aid to collegiate training in agriculture and to agricultural research, but no adequate step has been or is now being taken in the United States to provide the funds for adequately meeting this new demand upon the university. The recent organization of the Graduate School of Applied Science at Harvard University is in line with a gradually growing movement in a number of agricultural colleges and universities.

Private munificence has been wisely lavished to provide university training in theology, medicine, pure science and law, but as regards agriculture the situation is that of neglect. It is indeed surprising that the great basic industry upon which all others depend, which would seemingly be one of the first to receive support, has been almost utterly ignored, neglected or forgotten by our wealthy philanthropists. There are also certain great agricultural research problems like respiration calorimeter studies which are so complex in their nature, so exacting as to expense and the period of years necessary in which to reach definite results, that the experiment stations can at present hardly grapple with them, and still meet the other urgent demands which are made upon them; hence it is hoped that for such work satisfactory, permanent provision may soon be made. In this regard absolutely abstract research has been placed, through private munificence, on a far better plane. In fact this country now needs and awaits the advent of men who feel that these great problems, which by their final solution give promise of direct or indirect aid to agriculture, are also worthy of endowed support; and especially that provision for high-grade university training, in its application to agriculture, and of a pension system for experiment station research workers by which they may be placed on a par with the teachers, would be among the most fundamental, far-reaching and humanitarian projects for endowment.

Sufficient has been said to emphasize the great extent of the present movement for agricultural education and to show that somehow and from somewhere must come far greater support of highly complex agricultural research and especially of agricultural training of a university grade. Indeed, the movement from below is so general, so impulsive, and so powerful, that the situation from the standpoint of the university can not be much longer overlooked. It becomes important, therefore, to consider the place of agricultural chemistry in the university plan. In this connection it is of historic interest to recall that the American student who looked over the field of agricultural chemistry in this country twenty years ago could learn of but five or six teachers of this subject, most of whom were giving only collegiate courses of instruction which were often only partially commensurate with the university courses then offered in Germany. Indeed

it is a noteworthy fact that one of these men (Goessmann) is a German, while among the others were Atwater, Storer, Caldwell and Johnson, who had all derived their inspiration from study at German universities. Thus this country owes a debt of gratitude to Germany which may not be sufficiently appreciated; and notwithstanding the splendid agricultural chemical work done in France, England and elsewhere, Germany has long been looked upon as the mecca for the agricultural chemists of the entire world.

Such having been the case, the situation to-day is of particular interest in view of the attitude of Dr. H. Thiel, of the German Ministry of Agriculture, who at the International Congress of Agriculture at Vienna in 1907 presented and supported a scheme of agricultural education which shall entirely eliminate agricultural chemistry as such, which he designates as a "bastard" of various sciences, a subject essentially dragged in to fill a temporary gap. The effect of such powerful influence is already becoming strikingly evident in Germany, where the professorship of agricultural chemistry in certain cases, as in Göttingen and Halle, has been reduced in grade. Two other universities, Giessen and Kiel, now offer no facilities for the study of the subject under specialists. In Leipsic agricultural chemistry, formerly represented by men like Knop and Stohmann, has now been entirely banished. In certain universities the professors of agricultural chemistry are now given no seat nor vote in the faculties and no less prominent a teacher than the late Dr. Emmerling, of Kiel, was never promoted beyond the grade of "Privatdozent," and even this position has now become vacant. Fortunately at the agricultural "Hochschulen" and "Akademien" the situation is not yet so grave. Nevertheless, Professor Pfeiffer, to whose presentation of the subject I am indebted for the foregoing facts, states that to the best of his knowledge there is not now a single "Privatdozent" in the subject of agricultural chemistry in the entire German empire, from which it would appear that in a few years, if the present policy of Director Thiel is upheld, the student of agricultural chemistry will certainly no longer look to Germany for instruction and inspiration. This view-point of Thiel's appears to be analogous to that of a former president of a purely agricultural college in the United States, who held that when botany, chemistry, physiology, geology, mineralogy, zoology, etc., had been taught, agriculture, essentially a "bastard" of these sciences, had already been taught, and hence agriculture should be utterly eliminated from the curriculum of the agricultural college. Indeed, it is hard to see, if this logic is correct, why chemists should be trained especially in the chemistry of dye-stuffs and dyeing, or indeed in any particular department of chemistry. This same view relative to agricultural chemistry appears to be held by the dean of the college of agriculture and mechanic arts of at least one large university in this country. An even more dangerous and insidious assault upon the field of agricultural chemistry is the encroachment, in the United States, of the field of agronomy, which is becoming more and more apparent with the establishment of independent chemical laboratories in such departments.

"To be, or not to be, that is the question!" Surely if agricultural chemistry has filled its little niche temporarily and has now become superfluous and useless it should be cast adrift without delay; but on the other hand it is well to consider if this is the case. No one will probably dispute that a reasonable familiarity with the whole field of organic, inorganic and physical chemistry should be prerequisite to a course in agricultural chemistry, as well as

in any other special field of technical chemistry, and that a well-trained agricultural chemist should have had fundamental training in physiological botany, physics, geology, mineralogy, general biology and other sciences. This is obvious since the investigator in agricultural chemistry is likely at any moment to be in need of the special knowledge which may be afforded him through other sciences. He may even find it desirable or necessary to associate with himself a specially trained physical chemist, bacteriologist or physiological botanist in the solution of a problem which, approached by a man trained only in any one of those lines, would be as incapable of solution as by him. If for such a cause agricultural chemistry is to be called a "bastard" science and should be eliminated from the university these other sciences deserve it equally. Instances are by no means rare where subjects have been studied from the view-point of a given science and even indeed from that side which would have been considered unquestionably the easiest and most promising line of approach, and yet it has remained for some other man approaching the subject from the point of view afforded by a remotely related science to reach the final solution of the problem. These thoughts lead to the question: Can we afford to lose the view-point afforded by agricultural chemistry, and is not the fundamental fault with it, if such fault exists, that its field has grown to be too wide? In other words, it seems probable that not less, but more, agricultural chemistry is needed in the university and in more concentrated form. In fact, a complaint was made to the writer ten years ago by one of the leading thinkers and workers in this line in Germany, that the field was already so broad, the demands so great, and the literature so voluminous, that it was becoming a mistaken policy in Germany to oblige a professor to cover the whole subject.

In fact, that department of agricultural chemistry which deals with animal nutrition offers by itself a sufficiently wide scope in the special chemistry of the carbohydrates, fats, proteins, gums, resins, enzymes and metabolism, involving as it does so much of the field of the physiological chemist. Presumably, from the position taken by Thiel a study of nutrition from the standpoint of the physiological chemist would be considered sufficient to meet all the necessities of agriculture. It is nevertheless absurd and hopeless to expect the physiological chemist, who approaches his subject more from the view-point of medicine or human hygiene, than of agriculture, to pursue nutrition and metabolic studies with ruminants and other farm animals, excepting in so far as the special problem is calculated to bear upon general principles or upon certain features in their relation to man. On the other hand, it can hardly be expected that the agricultural chemist will fail to concentrate his energies upon the study of these problems very largely in their relation to the nutrition of farm animals. It is important that the subject should be studied independently even notwithstanding the close relationship of the work and the fact that each at many points may touch upon the field of the other. That such close points of contact exist is no suitable argument for discontinuing the work of one or the other, but on the contrary furnishes the strongest reason for the support of each, since by this contact each receives mutual assistance.

There would also seem to be an ample field for the specialized teacher in the line of agricultural chemical technology, for example in the manufacture of fertilizers, sugar, wood pulp, alcohol, vinegar, beer, wine and the vast number of other materials which might be enumerated. In

addition, the field of the chemistry of soils, fertilizers and plant nutrition, entirely aside from the usual scope and direction of the work of the agronomist, is amply broad for one man to cover if he becomes properly familiar with the past literature of the subject, and keeps abreast of the times in connection with the many experimental and analytical features involved. The fact that this field will lead him into touch with, or even at times to encroach upon, that of the bacteriologist, physical chemist, physiological botanist or agronomist, furnishes no ground for the abolishment or restriction of one or the other, but rather emphasizes the importance of maintaining these different points of view, since they are likely at any time to furnish a special vantage ground, or new avenue for the attack upon some difficult problem, which, approached from any other direction, might not admit of solution.

The most hopeful feature connected with the teaching of agriculture in the United States at the present moment is the rapid rate at which the subject is being divided into specialties, for it is only in this way that it can ever be hoped that its students can acquire the best knowledge of the theory and practise in any given line, and no alarm need be felt if these subjects have a close "touch of elbows." When a teacher covers too large a field he is sure to be weak in his knowledge of either the theory or practise and a condition thus arises which interferes with science taking its true place in its relation to the advance of the practise of agriculture in its several departments. Indeed there is little ground for wonderment that the classically educated man who saw, a few years since, a single "professor of agriculture" struggling to cover superficially the whole of his broad field, with little if any of his subject-matter reduced to pedagogic form, should not have been moved to feel that he was merely placing a cheap and useless veneer over the other sciences. If agricultural chemistry is today in a somewhat similar position then surely the time has come when, instead of its being thrown overboard because of its breadth, it should, like general agriculture, be properly subdivided and given the fullest opportunity for its development. It may be claimed that agricultural chemistry covers partially the same field as agronomy and hence should be eliminated; but the attempt to place such artificial barriers between the different sciences and to provide that one shall not encroach upon the field of the other prevents the greatest progress and interferes with the organization of effective and sound research. The need in such cases is provision for sympathetic and hearty cooperation. Indeed, the erection of such barriers is no less pernicious than the elimination of view-point which would come from the pursuit of pure science by itself, in the university, unaccompanied by any attempt to study and teach its application, since each furnishes a stimulus to the other. The additional point of view of the professor of applied science is too valuable to the university to be lost. It is not only vital to the welfare of agriculture and to most of our great industrial undertakings, but is helpful and even inspiring to those pursuing pure science as such.

Apparently the result of the present general movement as represented by Thiel is to remove the higher teaching and research in science as related to agriculture, entirely or largely from the universities and to concentrate it in connection with purely agricultural institutions, such for example as "Landwirtschaftliche Hochschulen." If such a general policy were adopted in this country it would mean adding to our present agricultural colleges the highest grade of university instruction in the sciences related to agriculture, rather than adding

such instruction to the university, where it could be the handmaid of pure science in its highest aspect. It is indeed possible that the former course may yet be followed in this country in consequence of the attitude of the university toward applied science, but if so, it would seem to be in consequence of following the lines of least resistance instead of adopting the wisest, broadest and most effective policy. It would seem that a divorce of science as applied to the great industry of agriculture, from the close and intimate touch with the highest and best in pure science, and from the finest academic atmosphere which the country can supply, would be an equally great misfortune to science in both its pure and applied form. In this connection, it is of the utmost importance that the college and university teacher of science, in its relation to agriculture, as well as men in training for research positions in the agricultural experiment stations, should have approached the university through an agricultural college of as high standing educationally as other institutions of collegiate grade, and that they shall not enter this university field without the close touch with agriculture and with the allied sciences which such agricultural colleges afford, since this is essential to their highest usefulness.

That which is most needed at the present time is to provide university education from the view-point of agriculture, and this ought to have immediate and splendid support.

At a time when agricultural chemistry is "under fire" it is especially fitting to consider its requirements and to judge it by its fruits. The very nature of the subject brings the teacher of agricultural chemistry in the college, and the experiment station investigator in close touch with the farmer and hence a knowledge of practical matters is indispensable to his highest success and usefulness, a requirement which has forced from the ranks some of the general chemists who have tried to enter the field of agricultural chemistry. The conditions imposed have made the field a particularly favorable one for the young man who has been reared on the farm, who has had an agricultural college education and who is thus in position not only to give the farmer the advice and counsel which he seeks, but also to be governed by sound judgment in his scientific deductions in their bearing upon agricultural matters. The very fact that a more or less general knowledge of several sciences, and thorough training in general chemistry are required, has forced the student in this line to prepare himself more fully for his work in the past, than in many of the other sciences related to agriculture. These combined features furnish a splendid preparation for the administrative duties devolving upon the director of an agricultural experiment station. In fact it is doubtless due to these considerations that a great proportion of the agricultural experiment station directors in this country and in Europe have been chosen from the ranks of the agricultural chemists. Thus this science has yielded special fruit by way of leaders in agricultural investigation in addition to its vast number of other contributions to our general agricultural progress.

It is needless to cite what the agricultural chemist, from the time of Liebig to that of Hellriegel, has contributed to agriculture; since the men and their work are too well known and appreciated to require enumeration. It can not be disputed that without the aid of agricultural chemistry modern agricultural progress would have been impossible and the world would now be crying for food. Indeed, even a casual survey of the fruits of agricultural chemistry and of its benefactions to the people justify not only its past existence, but for

the future far greater and more general recognition in the universities, where it should receive at once magnificent support and endowment. Now is the time for us to seize upon this inheritance which Germany seems about to relinquish!

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SCIENTIFIC NOTES AND NEWS

THE two volumes containing "The Collected Papers of Joseph, Baron Lister," will shortly be issued from the Clarendon Press. They were planned as a memorial of Lord Lister's eightieth birthday, celebrated two years ago. The committee formed for the purpose has had the advantage of Lord Lister's advice, and the two volumes contain all the papers and addresses which he considers to possess permanent value.

PROFESSOR H. F. OSBORN, of Columbia University, has recently been elected one of the twenty-five foreign members of the Zoological Society of London, and also an honorary member of the Royal Academy of Sweden, as the successor of the late Professor Albert Gaudry.

PRINCE ALBERT OF MONACO has been elected a foreign member of the Paris Academy of Sciences in succession to Lord Kelvin.

EDINBURGH UNIVERSITY has conferred the honorary degree of LL.D. on Mr. J. G. Bartholomew, hon. secretary Royal Scottish Geographical Society; Professor A. Crum Brown, F.R.S.; Professor W. Burnside, F. R.S., Royal Naval College, Greenwich; Sir Alfred Keogh, K.C.B., director-general of the Army Medical Service, and Professor C. H. Kronecker, University of Berne.

SIR RICHARD D. POWELL has been reelected president of the Royal College of Physicians of London.

DR. CLEMENS VON PIRQUET, of Vienna, has been appointed physician-in-chief to the Harriet Lane Home for Invalid Children, affiliated with the Johns Hopkins Hospital and professor of pediatrics in the university.

DR. OLIVER L. FASSIG, of the U. S. Weather Bureau, Baltimore, and the Johns Hopkins University, has been placed in charge of the Porto Rican station with headquarters at San Juan.

PROFESSOR H. E. GREGORY, of the geological department of Yale University, will, on behalf of the U. S. government, undertake an expedition to the Arizona desert to seek a water supply for the Navajo Indians living on the Arizona reserve.

THE annual business meeting of the Phi Beta Kappa Alumni in New York will be held in the Hotel Savoy on the evening of May 4, when Dr. Simon Flexner, director of the Laboratories of the Rockefeller Institute for Medical Research, will address the association on the subject "The Service to Medical Science of Independent Institutions for Medical Research."

PROFESSOR JOSEPH BARRELL, of Yale University, gave a series of lectures in the department of geology at the University of Wisconsin from March 31 to April 6, dealing especially with sedimentation in some of its more modern aspects.

AT the 353d regular meeting of the Middletown Scientific Association, held in the Scott Laboratory of Physics, Wesleyan University, on April 13, Dr. Arthur Eugene Watson, assistant professor of physics in Brown University, gave an illustrated lecture on "Some Mile-stone Marks in Electrical Engineering."

A MEETING of instructors and advanced students at Harvard University for the discussion of a recent chemical research will be held in Boylston Hall at 5 o'clock on the following Thursdays: April 29, May 6, 13, 20 and 27, and June 3. The next meeting will be open to all members of the university, and the special subject will be "The Rusting of Iron," by Dr. Allerton S. Cushman, of the U. S. Department of Agriculture.

UNDER the auspices of the department of physics of Columbia University a course of lectures on "The Present State of the System of Theoretical Physics," will be given by Max Planck, Ph.D., professor of mathematical