we can not imagine it improved? The question is a suitable conclusion to our Scientific Retrospect.

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RESEARCH STANDARDS IN ANIMAL HUSBANDRY[1]

THE applications of science to the problems of agriculture are of relatively recent date, both in America and in Europe. Although sporadic attempts at agricultural research had been made in earlier times, it was not until the middle of the last century that formally organized agencies were created in which the methods of science could be brought to bear upon the problems of this, the oldest field of human endeavor.

In 1843 an English gentleman organized at Harpenden, England, the first agricultural experiment station to be created in any nation. Sir John Lawes at that time, largely through his own private means, gathered together the essential features of a modest chemical laboratory and set to work upon a study of the soil as a medium of plant growth. Under the leadership of Lawes, followed subsequently by Gilbert, Hall and Russell, this station has attained an outstanding position of leadership in the field of soil science and has made noteworthy contributions to our understanding of the complex reactions of the soil.

A few years later, in 1853, a group of Saxony farmers organized an experiment station in the little German village of Möckern near Leipzig and called a young German chemist, Emil Wolff, as director of its work. Wolff's efforts were largely devoted to a study of the problems of animal husbandry with particular reference to the food requirements of farm animals. This institution, still in existence and still doing important work, may be regarded as the first animal husbandry experiment station of the world.

From these modest beginnings, one in the field of animal industry, the other in that of plant industry, the movement for the establishment of institutions for the scientific study of agricultural problems has spread into all civilized nations of the world. In the more advanced countries of western Europe and America such institutions have become both numerous and extensive, and great progress has been made.

Under the stimulus of the Federal Land Grant act and subsequent acts of Congress, the United States suddenly called into being, soon after the movement was started in Europe, a nation-wide system of agricultural colleges and experiment stations, when there were few precedents for guidance, no qualified teachers and no organized body of knowledge with which to make a fair beginning. The inevitable result was much mediocre introductory work from which escape has only recently been marked. In Europe the development has been somewhat longer in process, more gradual in growth and, particularly in the older scientific centers, more firmly grounded in the basic sciences. Such development has been the result of various factors. In the older countries of Europe many problems of agricultural practice have been solved through the cumulative experiences of farmers themselves, extending over a period of many centuries. Trial and error methods have indicated the wisdom of certain procedures and the folly of others. Furthermore, the vocational aspects of agricultural education and much of the more empirical type of investigation, such as variety tests, animal-feeding trials, fertilizer trials, plant and animal breeding, control work and other investigations of a less exacting character have been left to agricultural schools of the lower grades and independent experiment stations designed and established for this particular type of work. The agricultural colleges and research institutes of the higher types have thus been free to direct their efforts to more definitely scientific studies. In America, agricultural experiment stations have generally been established and conducted as integral parts of agricultural colleges. They have been regarded as agencies both for studies of an immediately utilitarian character and for fundamental researches requiring scientific ability of the first order. These two purposes have not always harmonized. Under the pressure for immediate results the less scientific work has too often prevailed.

While private initiative and private means established and fostered the first stages of agricultural education and research on both continents, the new movement early came to be recognized as a legitimate function of government and ever since has depended largely upon public grants for its support. This procedure finds its justification as well as its necessity in the fact that it is a primary responsibility of government to do what it can to insure an adequate supply of food and clothing for the growing needs of expanding populations. What is commonly called "aid to farmers," indeed, what is even called "farm relief" (a term to which I must confess some aversion) is primarily protection for urban populations, inasmuch as the farmer unaided can supply from the land most of the minimum necessities for human existence. Such aid to agriculture is at the same time

[1] An address delivered at the dedication of the Animal Science Building, of the University of California, College of Agriculture, at University Farm, Davis, California, November 12, 1928.

a contribution of great importance to the development of commerce and manufacture, by which millions gain their livelihood, in that it helps to guarantee a constant supply of raw materials on which commerce in part, and certain manufacturing industries wholly, depend for their existence. It is not difficult to demonstrate that aid to agriculture is a collective contribution toward the development and maintenance of one of the primary sources of national wealth and employment in the direct and indirect benefits of which all participate. This conception has entered into public policy in all civilized countries. Upon its continuance depends the welfare not alone of rural people but that of urban populations as well. So one finds the educational and research agencies of agriculture throughout the world being fostered by public opinion and drawing their major support and incentive from governmental sources.

But herein lies a weakness. Governments, fostered and stimulated by public opinion, have generally been more interested in immediate aid to production and distribution, or in meeting some pressing emergency, than in the fundamental requirements of a permanent agriculture, or the development of those phases of agricultural science, particularly the more theoretical aspects, which become finally the preconditions of further advance. Hitherto there has been much justification for emphasis on efforts promising results of immediate utility; farmers have needed help and the less difficult scientific problems have come properly into the foreground. Nor have we wholly passed this stage yet. There are still many pressing problems demanding immediate solution, if possible, particularly in the newer regions of the world where agriculture has not yet reached a stable condition. There is still some pioneering to be done.

But this period of pioneering in the more advanced countries of the world is passing. Much of the less exacting work which always accompanies the opening up of a new field of human thought has largely been done. Progress in the future lies in another direction. The demand now is for work of a more fundamental character and for teachers and investigators possessing scientific preparation of the first rank. Since the requirements of an advancing agricultural research run ahead of public opinion, policy and grant, there is a very real need and a very great opportunity for private benevolence to enter, and, through the training of men, the development of facilities and the support of research, to foster the higher and more remote, but now already imperative, fundamental and theoretical aspects of agricultural science. This involves the laying of a firmer scientific basis in agricultural research and the bringing to bear upon agricultural problems the modes of attack, methods and techniques of the physical and biological sciences basic thereto. It also involves the more rapid expansion of the underlying sciences into those newer areas of discovery which a fuller knowledge of plant and animal biology requires.

Fortunately both in Europe and America private funds are beginning to enter the field of agricultural research. Cambridge University, not only the leading center for agricultural research in Great Britain and the British Empire, but also one of the world's most outstanding centers for general science, has recently embarked upon a program of development of the physical and biological sciences in relation to agriculture that represents a new point of view and a new method of procedure in the advancement of agricultural knowledge. The Cambridge program involves, not the further development of horticulture, agronomy or animal husbandry as such, but the strengthening of facilities and staff of that university in such fields as general physiology, plant and animal physiology, plant and animal pathology, plant and animal genetics, nutrition, entomology, experimental zoology, biochemistry, biophysics and the like. This program involves an estimated cost of approximately six million dollars.

In our own country similar development is taking place. One of our great eastern universities is likewise engaged upon a similar program of development of the physical and biological sciences in relation to agriculture to the end that these sciences may be made to serve more effectively the ever-growing needs of agriculture and their methods and techniques brought to bear upon the problems of the agricultural industries. It is estimated that this scheme will cost at least nine million dollars.

Within the past five years, at least three other private benefactions to agricultural education and research in the United States, involving over a million dollars each, have been announced, and smaller amounts for specific projects have been appropriated from time to time by different educational foundations to aid agricultural colleges in their work.

Coming nearer home we have the example of the splendid opportunity that has recently come to our own university through the generosity and far-sighted wisdom of Mr. Giannini to establish a firmer basis for our studies of the economic problems of California agriculture.

These new developments and others of a similar nature which are now taking place in some of the more important agricultural centers of the world mark the dawning of a new era in agricultural research. This era could only have come after the splendid work of our predecessors who opened up this great field of human knowledge. We honor them to-

day as we set our faces toward the new goal. They have pointed the way by their explorations, superficial though many of them may have been. They have been mining the surface layer—we must extend our operations deeper.

And in this we shall find no more fruitful field for more thoroughgoing scientific exploration than that of animal husbandry, which Emil Wolff and his colleagues began three quarters of a century ago. But animal husbandry is not a science in itself; it has no effective technique of its own. Rather is it a field of human endeavor dependent for its advancement upon the sciences of physics, chemistry and biology, together with the newer outreaches, specialized branches and interrelations of these basic fields, such as genetics, nutrition, physiology, bacteriology, pathology, biochemistry and the like. These are the essential experimental sciences with which the future animal husbandry worker must be familiar and in whose disciplines, methods and techniques he must be trained. In short, these are the tools with which the future problems of animal husbandry are to be solved.

To the advancement of these sciences in their relation to animal life, to the utilization of their methods and techniques in the study of the practical problems of animal husbandry, in a word, to the highest scientific training of men and the advancement of truth, this building is reverently dedicated.

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ALFRED MAURICE WAKEMAN

THE death of A. Maurice Wakeman on March 2 adds another to the list of those who have given their lives unselfishly in the cause of science.

A. Maurice Wakeman was born in New York City on March 30, 1897, the son of Alfred John Wakeman and Harriett Pierson (Taylor) Wakeman. He received a B.A. degree from Yale University in 1919, graduating with honors; his M.D. degree, *cum laude*, from the same university in 1923. On June 28, 1926, he was married to Genevieve Rachel Bartlett, daughter of Dr. and Mrs. C. J. Bartlett, of New Haven.

From February 1, 1924, to October 1, 1925, he was intern at the Presbyterian Hospital in New York City; and from November, 1925, until July, 1926, was medical resident at the New Haven Hospital, New Haven, Connecticut.

At the termination of his duties as resident he accepted the position of instructor in the department of internal medicine, attached to the division of chemistry and metabolism, a position which he held until his death. In the succeeding year he was chosen by the International Health Board of the Rockefeller Foundation to spend eighteen months in the investigation of the chemical and metabolic aspects of yellow fever in Nigeria, and received leave of absence from Yale to undertake the work.

He sailed in February, 1928, for the African coast. The result of his studies in Nigeria can not yet be told in detail. When he reached Lagos the epidemic among the natives had already ceased. Fortunately, an adequate supply of monkeys, which had been proved susceptible to the disease by the work of the martyr, Stokes, afforded material for investigation. What is as yet known of his work, gathered from correspondence and brief preliminary report, reveals important contributions to the pathogenesis of the symptoms of yellow fever and, what is more important, to our knowledge of the function of the liver and the effects of its destruction by disease. He also found time to make the first study of the chemical and metabolic disturbances in a case of blackwater fever.

The story of his illness is still only partly known. In January, 1929, he was forced to bed by a stubborn phlebitis, which relapsed when he resumed activity. By the end of the month as the condition continued and his chief work was completed—he had contemplated leaving Lagos in the summer—a return to this country seemed advisable. On March 1 he was reported seriously ill, with cerebral complications, and two days later word was received that he had died at sea on the night of March 2.

A high sense of responsibility and service, without austerity; a warm sympathy and a keen humor won the respect and affection of all his associates. Intellectual courage and honesty, imagination and fine critical judgment, combined with extraordinary industry, allowed him to achieve a rare measure of success in scientific investigation in a short life.

JOHN P. PETERS

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SCIENTIFIC EVENTS

THE FARADAY CENTENARY

IT is reported in *Nature* that, in response to the invitation of the Royal Institution, representatives of many scientific and technical societies met in the famous lecture theater in Albemarle Street on February 5, to consider the preliminary arrangements for the celebration of the centenary of Faraday's great discovery of electromagnetic induction, which he made on August 28, 1831. Sir Arthur Keith was in the chair, and in opening the proceedings reminded those present that the Royal Institution was not only the scene of Faraday's labors, but it was also for more