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CONTENTS.

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THE PROMOTION OF AGRICULTURAL SCIENCE.

THE Society for the Promotion of Agricultural Science was founded in the year 1880, largely through the efforts of a few men, most of whom have now passed to their reward, who saw clearly the necessity for some such organization.

At that time the workers in agricultural science in the United States were few and scattered. While the oldest of the agricultural colleges had been in existence for some twenty-five years, these institutions were still comparatively feeble, with, in most cases, few students, and struggling for recognition. The first agricultural experiment station in the United States had been established but five years before and had been fully taken over by the state two years later. At the date of the foundation of this society, there existed in the United States three state experiment stations, two university stations and one private station, and few means were available for personal contact or exchange of ideas between investigators or for the publication of their results. The U. S. Department of Agriculture was a comparatively small affair, presided over by a commissioner, and its scientific work was chiefly that of its chemist, entomologist and veterinarian.

The twenty-six years which have since elapsed have witnessed a phenomenal development of agricultural education and investigation, and the young student of the present day can hardly realize the conditions which existed a generation ago. Now,

instead of half a dozen experiment stations, with an aggregate income of about twenty-two thousand dollars, we have, in the United States proper, sixty institutions, with a total income for the year 1904–5 of over one and a half million dollars. The U. S. Department of Agriculture has grown from a staff of one hundred and eight persons and an annual income of somewhat over two hundred thousand dollars, in 1881, to a great executive department with a total appropriation for the present fiscal year of nearly ten million dollars. The land grant colleges, too, from feeble and more or less destitute 'cow colleges' have acquired an acknowledged and honored position among the institutions for technical education, with a total endowment of ever eighty-one million dollars and an annual income of over eleven and three fourths million, with faculties aggregating two thousand six hundred and seventy-two and giving instruction to a total of nearly sixty thousand students, of whom nearly nine thousand are students of agriculture. In place of a few scattered bulletins and reports, issued in small editions, the experiment stations and the Department of Agriculture have become great publishing agencies, and instead of its being difficult to find a medium for the presentation of the results of investigation, the difficulty more often seems to be to find suitable material for the numerous publications called for by law or popular demand. Finally, the organic unity of these institutions as a class has been secured through the Association of American Agricultural Colleges and Experiment Stations. Surely this is a magnificent record for a little over a quarter of a century, and the end is not yet.

With this stupendous change in the situation, it might almost seem as if there were no function remaining for a society like this. Are not all these public institutions agencies for scientific investigation in agriculture on a scale and with resources such as to make a private organization superfluous? Is it still necessary to promote agricultural science?

Let us at the outset define our terms. By agricultural science we understand that body of scientific principles, known or discoverable, which underlies and conditions successful agriculture. By the promotion of agricultural science, we may understand the support of any measures calculated to give us a deeper and more comprehensive knowledge of these principles. In other words, it is equivalent to the promotion of scientific investigation in the field of agriculture. Investigation is scientific, as distinguished from practical, when it is undertaken with the prime object of enlarging our knowledge of principles and without immediate reference to practical application. Its incentive is the desire to know more rather than the ambition to do more.

Few members of this society, certainly, will question the fundamental importance of such investigation. They realize the truth of a recent remark by Dr. Welch,[1] of Johns Hopkins University, at the dedication of the new buildings of the Harvard Medical School, that, "The same phenomenon is exhibited in (medicine) as in all science that the search for knowledge with exclusive reference to its application is generally unrewarded." Research forms the ultimate basis of all agricultural as of all other progress, whether in the school, the college, the correspondence course or on the farm. I may be permitted to further emphasize this truth by quoting the words of one whose standing both as a scientific investigator and as a successful administrator is universally recognized."

[1] Science, October 12, 1906, p. 460.

At the jubilee of the University of Wisconsin, in 1904, Professor T. C. Chamberlin, of the University of Chicago, said:

> The fundamental and ulterior sources of education do not lie in the conventional schools, but back of them. These sources can not here be defined at length, but, in a simple phrase, they may be said to lie in the great stock of ideas possessed by mankind. This phrase inadequately embraces the whole, but let us agree that it may stand for the whole. In so far as the stock of ideas of a people is narrow, defective and erroneous, on the one hand, or broad, demonstrative and exact, on the other, in so far the fundamental subject-material of education partakes of these qualities. In so far as the sentiments, beliefs, attitudes and activities of a people are narrow, loose and perverted, on the one hand, or free, generous and ethical on the other, in so far education inevitably shares in these qualities. For these are the fundamental sources of education. The basal problem of education is, therefore, concerned with the entire compass of the intellectual possessions of a people, and, in a measure, of all mankind. The special selections propagated in the schools are but a miniature reflection of the total possession, and this selection is usually noble or mean, as the whole is noble or mean.
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> If these considerations are true, the fundamental promotion of education lies in an increase of the intellectual possessions of a people, and in the mental activities and attitudes that grow out of the getting, the testing and using of these possessions.
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> The education of the individual does not necessarily lift the education of the aggregate, for if we convey to the rising generation only such ideas as we have inherited, the summit level of education is not raised. There may be diffusion, there may be an evening up, but no lifting of the upper levels. If the intellectuality of the new generation does not rise above that of the old, there is only a Chinese dead level of ancestral propagation.
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> To secure laudable progress in the fundamental conditions of education, systematic provision for scientific research is necessary.

Granting now the need of scientific investigation in agriculture, as in other branches of human activity, let us inquire what are some of the conditions which favor or hinder it. A recent writer,[2] describing the 'needs of scientific men,' says:

> We neither expect scintillating 'success,' nor do we look forward to any prizes in the way of highly paid positions. Our needs are mainly two: (1) adequate time for work and (2) a living wage.

After mentioning two instances of the lack of time for scientific research among his acquaintances, he continues:

> The difficulty is intimately connected with the other one, that of the living wage. There is no living wage for *research;* research in pure science is at present a parasitic industry, to borrow a term from the economists. Both of the men I have just referred to get their salaries for doing economic work, and whatever they do in pure science is supported and made possible by the other. A still larger body of researchers lives upon the proceeds of teaching, while those who *actually get a living by research* are very, very few. The experiment stations, even, do not disobey the general rule, for the demand for immediate results of economic value is such that the workers are almost obliged, in the majority of cases, to desist from work of a broad and fundamental character, while most of them, of course, have to do a large amount of teaching.

In this last sentence there is indicated the serious danger that threatens agricultural research in the United States. Even a very cursory review of the changes of the last twenty-five years shows a wonderful record of progress on the material and practical side. We have vastly increased our equipment for agricultural investigation and added many-fold to the numbers presumably engaged in it, but it is the output of real scientific results, which will stand the test of time, commensurate with the increased facilities.

The agencies for agricultural investigation which have made such a phenomenal growth in the last quarter of a century were at first looked upon with suspicion or distrust by the public. They had to demonstrate their right to be supported from

[2] Cockerell, SCIENCE, August 11, 1906, p. 178.

the public purse, and to do this were compelled to take up first the pressing practical problems and to give research a secondary place. But their very success in demonstrating their usefulness, as shown by their increasing appropriations and by the change in the public temper familiar to all of us, threatens to be their permanent undoing as agencies of scientific research. From an attitude of skepticism the public has passed to one of undue credulity, and the experiment stations today have need to heed the ancient warning, 'Woe unto you when all men shall speak well of you! for so did their fathers to the false prophets.' Indifference has given place to urgent demands for assistance, and the pressure upon these institutions for facts of immediate practical utility, which shall justify to the public the liberality with which they are supported and lay the foundation for greater appropriations in the future, is so intense as to require unusual courage and breadth of vision on the part of him who will stand for the needs of real scientific investigation.

The ever-present tendencies toward premature and sensational exploiting of results and towards officialism in science are likewise dangers which need constantly to be guarded against. A recent writer, speaking of the reasons why agricultural science is often discredited with the practical man, says:

> Science, too, is sometimes responsible for another form of apparent contradiction (between the results of science and those of practical experience), many of her representatives being only too much inclined to generalize the results obtained in a special case, and in particular to publish prematurely. This error is more or less fostered both by officials and by agricultural organizations. When a report must be published yearly upon all sorts of scientific work, whether completed or not, in which case 'results' are naturally expected and planned for, there is produced a literary ballast that is a burden upon scientific work and which carries with it the serious danger that the agricultural public, before which these unripe fruits are zealously spread by the agricultural press (especially in the case of official reports), will feel the evil effects in its purse and will lose its appetite for all scientific results. The subsequent continuation of the investigations then develops the limitations, corrections and specializations and the unripe conclusions are altered or sometimes even entirely overthrown and admitted to be erroneous. This is most injurious to practical agriculture, and has already led to great losses and brought science into deserved disrepute.

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In my opinion it is not at all essential to bring new achievements before the general public with the utmost promptness and to publish as much and as speedily as possible, but rather that all which is published shall be trustworthy and securely grounded, not only by individual investigation, but, as far as circumstances demand, by the due mention, consideration or critical discussion of whatever other investigators have previously said and discovered concerning the subject. Nowadays, the haste for publication has made it actually the fashion in many circles to ignore the available literature, or to pirate it, and to act as if one were the first who had laid this egg. It is often the case, too, that the reader is supplied only with summaries or other average or final figures, while all deeper insight into the course of development and the details of the investigation is prevented by their silent omission. This method of publication is unscientific and superficial, and he who uses it, especially when he avowedly substitutes the authority of his name, does not perhaps realize how great is the presumption toward the reader of which he is guilty in such a method of presentation.

The unholy thirst for notoriety, too, has alas struck deep root in agricultural science and has developed such vigorous shoots that it has become a shame for those who are guilty of it and has fairly compromised our science. Unfortunately, no one has yet been found to duly scourge and pillory the false and unscientific nature of these methods.

All these growing evils are signs of degeneration. Let us guard ourselves against further cultivation of appearances and externalities. It is high time that modest, quiet, genuine work should take the place of this haste and false ambition, for agricultural science, as a relatively young science, stands in much too exposed a posi-

tion, in relation both to other sciences and to agricultural practise, to permit itself such laxities.

I quote these words from an article[3] by Professor von Rümker, of the University of Breslau in Germany.

Moreover, the agricultural experiment station in the United States has developed to a degree almost unknown in the land of its birth.

Twenty-five years ago the conception of an experiment station was that of a comparatively small institution exercising a police control over the manufacture and sale of certain agricultural products, notably fertilizers, and carrying on scientific research largely by laboratory methods. To a considerable degree this conception still obtains in foreign countries, but in the United States the stations have had an unexampled development. They are rapidly growing into great departments, touching the practise of agriculture in their several localities at all points, and the leaders in a vast propaganda for the elevation of rural life. We feel a just pride in this peculiarly American development of an adopted institution, and in the large measure of success which has attended it, but it would be foolish to shut our eyes to the accompanying dangers, and not the least of these is the drying up of the sources of power and inspiration by the failure to duly promote science along with practise. Not only does the pressure for results tend to the subordination of the scientific to the practical, but the management of these great institutions is making heavier and heavier demands on the time and energy of some of our best men. In fact, we seem to be developing a new type of leader in agriculture, comparable with the university president, who is primarily an administrator and whose chief function is to set other people at work. All honor to the successful administrator. Through his administrative work he is often a most efficient promoter of science. But let us not forget also to see to it that our system provides due honor and reward for the successful scientist and investigator. While the American type of experiment station is an admirable institution, and while the popular work of the stations and colleges is of vast importance and benefit, we must not forget that it all rests on the truths of science, and that unless science makes progress the popular work will soon be marking time.

[3] 'Landwirtschaft und Wissenschaft,' Berlin, Parey, 1905.

The year 1906 has witnessed a notable forward step in the development of agricultural investigation. The passage of the Adams act has doubled the United States appropriation to experiment stations, nominally in five and practically in four years. This fund differs from the Hatch fund in that the act specifies that it is to be used only for 'conducting original research or experiments.' It is not too much to say that the great opportunity offered by the passage of the Adams act, which has been the occasion for so much congratulation, will, like every other opportunity, prove also to be a day of judgment for the stations, in that it will reveal to all men their conception of original research, and demonstrate whether or not they have a broad fundamental grasp of the idea of investigation. Differences of opinion regarding the application of this fund are already apparent. The stations stand at the parting of the ways. Will they simply add demonstration to demonstration, propaganda to propaganda, or will they grasp the opportunity to dedicate this new fund sacredly and irrevocably to original scientific research, broadly conceived and liberally executed.

I shall, no doubt, be characterized as an idealist, as failing to recognize or appre-

ciate the need and the demand for popular work. An idealist I am and such I hope to remain, but I too know something of that desire for results and of that lively sense of appropriations expected which seldom fails to make itself felt by the station administrator. The situation is by no means without its difficulties, especially for those stations which exist to so large an extent under pioneer conditions. Were it otherwise, there would be little occasion for these remarks. The problem calls for strong men with an abiding faith in the fundamental and ultimate importance of scientific research. There is still need for the promotion of agricultural science. Times have greatly changed since a dozen gentlemen met in Boston in August, 1880, and founded this society, and some of the functions on which emphasis was then laid are now of less importance or have been otherwise provided for, but the great underlying purpose of the society, as expressed in its name, far from diminishing in importance has become even more vital to real progress.

What, then, may a voluntary organization, such as this, hope to do to promote agricultural science?

At no time since the society was founded has there been greater need for maintaining and raising the ideals of what science is and of what constitutes research. We are suffering to-day from a low and inadequate conception of scientific investigation. Now the conception of scientific investigation which is popularly current at any time depends very largely upon the attitude and ideals of the men of science themselves. The stream rarely rises higher than its source. It is of prime importance, therefore, that those professionally engaged in investigation in agriculture, whether in the experiment stations or elsewhere, should cherish a high ideal of their function in the body politic, and a high standard of professional and personal obligation. How can such ideals be more effectively maintained than by association. Scattered over three million square miles, and more or less isolated, we inevitably feel in our daily work the drag of the commonplace, the tediousness of the necessary drudgery which makes up such a large part of investigation, the temptation to cater to popular applause. What greater inspiration can we have than that which comes from an annual gathering such as this, where we meet, not as chemists or botanists, or entomologists, or directors, but simply as seekers after truth? Is not the mutual support, the discussion, the friendly criticism, which we encounter here a priceless factor in promoting agricultural science? In the conventions of the Association of American Agricultural Colleges and Experiment Stations, we meet officially, and seem tending more and more to the discussion of official and administrative problems. It is well to retain a meeting place frankly devoted to idealism.

But I believe the society may have other functions besides maintaining the ideals and strengthening the enthusiasm of its members. While it is essential that we maintain right ideals ourselves, it is equally important that we secure their acceptance by others. Few of us are so fortunate as to be able ourselves to defray the expenses of our own investigations. Most of us are dependent for the necessary funds upon the approval of boards of trustees or other superior officers, or, since these usually represent the public, we may say that we are dependent upon popular approval or at least tolerance. That research may take its rightful place, the public must come to understand better than it does the nature of research and its importance from the point of view of the general welfare.

Should not individuals and societies which stand for the promotion of science, while giving no less attention to specific results of investigation, take greater heed to the formation of an enlightened public opinion? We listened with pleasure and profit this afternoon to a discussion upon agricultural science in the experiment stations. Might it not be possible in the future to attract greater audiences to such discussions, and by means of suitable publication to bring them before the larger public? I feel sure that all legitimate influences ought to be brought to bear, whether in this or in other ways, to secure a generous and proper recognition of the importance of real scientific investigation in the work of our institutions for agricultural education and experimentation.

But such education of public opinion can not be effected in a month or a year; it must be a work of time, a gradual leavening of the lump. For the present, we can hardly expect otherwise than that the practical, so called, will predominate over the scientific in institutions supported by public funds. We are led to ask, therefore, whether any more immediately effective measures for the promotion of agricultural science can be devised.

Our minds naturally turn, in this connection, to the much-discussed question of the endowment of research. During the last few years we, along with others, have applauded the devotion of vast sums to this purpose, such as, to name two conspicuous examples, the endowment of the Carnegie Institution of Washington and of the Rockefeller Institute for Medical Research. We have rejoiced at the testimony afforded by these magnificent gifts to the estimate put upon the value of science and scientific investigation by hard-headed, successful men of affairs. We would not, if we could, subtract one dollar from the sums assigned by these and other like foundations to the support of any line of scientific inquiry, however abstruse. At the same time, we can not but regret that the great basal industry of this, as of every civilized country—the one which not only overtops all others in magnitude as measured in terms of money, but the one whose followers constitute the great conservative force of our national life—has thus far practically failed of recognition, and that the claims of agricultural science as a field for research have not thus far seemed to appeal to our men of wealth. I can hardly believe that this state of things will continue indefinitely. Wealth almost incalculable is being created annually by the American farmer, not for himself alone, but as well for the great transportation and manufacturing interests whose prosperity depends so directly upon his. Is it not reasonable to anticipate that if the importance of fundamental research in this field were properly set forth, free from the suspicion of personal interest, as it might be by a society like this, the Carnegie or the Rockefeller of agriculture would in due time appear, and that the great endowed universities would find a place for it in their programs?

These, then, are some of the larger objects which, as it seems to me, a Society for the Promotion of Agricultural Science should set before itself:

1. To aid in maintaining among our investigators in agriculture the highest ideals of scientific research, and to help to furnish the inspiration for the pursuit of these ideals.

2. To seek to educate the public to a greater appreciation of the need for scientific investigation into the underlying principles of agriculture and to a realization of the practical benefits flowing from it, and thus to promote the cause of agricultural

science in the experiment stations and kindred institutions.

3. To seek to impress upon university authorities, and upon wealthy donors, the claims of agricultural science to recognition as a most promising and attractive field for the endowment of research.

Is it not by setting before ourselves ends like these, even though they may seem somewhat utopian, that we shall most effectively promote agricultural science under existing conditions, rather than by simply meeting annually to read a few technical papers, too often prepared from a sense of duty or at the solicitation of the secretary, and paying a tax of two or three dollars to cover the cost of publishing them to an unappreciative world?

Finally, if the ideas which I have been advancing be not entirely quixotic, they suggest, to my mind at least, a radically different basis of organization from that which has prevailed hitherto.

At the outset, membership in this society was limited to forty, and the avowed purpose was to include only those who had already attained some degree of distinction in agricultural science. The idea in the minds of the founders, although nowhere perhaps clearly expressed, seems to have been to make membership in the society a distinction to be coveted. It was to be an American academy for agriculture, a sort of 'forty immortals.' Subsequently, the limits of membership have been greatly enlarged, yet in general the original conception has been adhered to, although not without struggles and heart burnings.

That conception was a high and worthy one, and that it has contributed notably to the promotion of agricultural science none can doubt. All honor to the men who at that early day embodied it in a concrete form.

But there is no impiety to their memory in asking whether the original form of organization is that best adapted to the changed conditions of the present day. Personally, I do not hesitate to say that I question this. The spirit of science is democratic and not aristocratic. In upholding her interests we need the help of everyone who has seen and loved her fair face. The man who has devoted half a lifetime to her service may be assumed to know and prize the modest rewards she offers. It is the young man, at the threshold of his career, dazzled by the glittering promises of business or commercial life, that we need to reach. If the society's influence is worth anything—if it affords any stimulus to worthy endeavor in the search after truth for its own sake—should not he especially have the benefit of it?

Moreover, why should we despise the aid of the man of affairs? If the promotion of agricultural science is also the promotion of the general weal, should we not rather welcome him as a new and powerful force through which to influence public opinion?

In brief, if the society accepts a comprehensive view of its mission, should it not make its basis of membership correspondingly broad, imposing no test except that of belief in the purposes of the organization and willingness to aid in forwarding them? It would still be possible to make a distinction, which need not be invidious, between those professionally engaged in agricultural science and those merely interested in its promotion on broad grounds of public policy, while the effectiveness of the society as an agent of propaganda would be immeasurably increased by such a broadening of its membership. The advantages of mere numbers, too, are not altogether to be despised. A larger membership, and more ample means, would bring within the range of possibility various

means of advancing the purposes of the society which now are entirely beyond our reach. The question of publication, for example, might present quite a different aspect under such conditions. The offering of prizes for the investigation or literary discussion of specified topics, the recognition by medal or otherwise of specially deserving investigations, even small grants in aid of research, loom up dimly on the horizon of possibility, but can not be further discussed here.

I am well aware that these suggestions may appear revolutionary. I have little faith in revolutions as a means of progress, but they have occasionally been unavoidable. We may as well frankly face the fact that for several years our society has been groping for a mission and that its meetings have been supported more or less from a sense of duty. I am not so presumptuous as to assume that I have found that mission. If my words serve to stimulate discussion and reflection concerning the functions of the society, they will accomplish all that I have any right to hope. True, we should beware of losing the substance while grasping the shadow, but, on the other hand, tradition should not blind us to the changed conditions confronting us. Are we not imperatively called upon to attempt in some way to make the work of this society such that the leaders of agricultural progress shall feel it worth their while to contribute to it liberally of their time and energy? If we can solve this problem we need have no apprehensions regarding the promotion of agricultural science.

HENRY PRENTISS ARMSBY.
THE PENNSYLVANIA STATE COLLEGE.

SCIENTIFIC BOOKS.

Soils. Their Formation, Properties, Composition and Relation to Climate and Plant Growth, in the Humid and Arid Regions. By E. W. HILGARD, Ph.D., LL.D., Professor of Agriculture in the University of California and director of the California Agricultural Experiment Station. The Macmillan Company. 1906. 8vo. Pp. xxvii + 593; 89 figures, including 37 photographic illustrations. $4.00 net.

In the production of this volume on soils Dr. Hilgard has enriched agricultural science throughout the domain of its most basal problems, and to a very notable extent. Moreover, its appearance at this time is extremely opportune, coming as it does with the initiation of more rigid research work by the agricultural experiment stations, before the Bureau of Soils has been able to fully discern what should be its own precise problems, and when the materials for agricultural education have yet to be definitely brought together in proper pedagogic form. It is now more than fifty years since Hilgard began the application of rigid research methods to the elucidation of the processes and principles which underlie and determine the productive power of soils. During most of this long period soil problems have been uppermost in his mind and have drawn from him, to their illumination, a large measure of his research effort. With mental traits of the highest research type; broadly and thoroughly trained at Zurich, Freiberg and Heidelberg before the days of extreme specialization in education, he entered upon this, his life study, with the best of equipment. Thrown directly into the field upon the humid, washed and leached soils of the south, from 1856 to 1872, in his agricultural and geological survey of Mississippi; then transferred to the glacial soils of Michigan from 1873 to 1875; and finally, for more than thirty years, studying the arid soils of the Pacific slope, during which time he was also attached to the agricultural division of the Northern Transcontinental Survey, and again brought back to reconsider the humid soils of the south when making his extended report upon cotton production for the tenth census, it is doubtful if any man living has been brought so persistently, widely and intimately to the personal study of soil types and soil conditions as he. And when it is