

# SCIENCE

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THE FORTHCOMING SITUATION IN AGRICULTURAL WORK<sup>1</sup>

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THE American Association for the Advancement of Science represents the recognized and organized sciences. One by one new groups have been added to it, as those groups have won public recognition and have demonstrated that they are interested broadly in the enlargement of human knowledge. Half the letters of the alphabet are required to designate these groups represented in organized sections, indicating the breadth and vitality of our scientific inquiry. The last of these sections is agriculture—not the occupation agriculture, but the assembly of scientific research that deals with the problems of the occupation and of the living resulting from the occupation. We begin the work of this section to-day. It means much, I think, for this work that it has now been recognized as worthy to occupy a place on the programs with the older and the better standardized groups. I hope that we shall be worthy of the fellowship; and I trust that the Association itself will gain something by what we and our successors may bring to it in the future.

There is no field of scientific research that belongs exclusively to agriculture and not to other groups. The peculiarity of the research in this field lies in its association for the purpose of improving a great industry and of making a particular contribution thereby to the national life. The

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

<sup>1</sup> Address of the Vice-president and Chairman of Section L, American Association for the Advancement of Science, Philadelphia, December, 1915.

problems may be physical, chemical, biological, meteorological, mechanical, economic, social and otherwise; and therefore they are in themselves historically worthy the recognition of men and women engaged in public and scientific work. Nor are they contaminated by contact with the earth, seeing that they come out of the earth; nor again by contact with men who work, seeing that men are useful and worthy when they work.

And yet, by common consent and in the process of evolution, there is a field that is known as agricultural science. It would be vain for me to define it; probably I should succeed only to confine it. You shall learn what it is as the programs of Section M are placed before you in the succeeding years. This year, aside from the required address of the vice-president, the program considers some of the problems of economics as related specially to agriculture; those subjects are underlying, and the addresses will be interesting and important.

The subject of the symposium of this section suggests the general line of effort that Section M may profitably pursue. The section will not find it to its advantage, I think, to discuss the technical problems of the production of crops and animals. It will rather devote itself to questions that relate agriculture to public welfare and to problems of general interest, dealing with policies and the large social, economic, educational and political results. It is important that the attitude of all the sciences be brought to bear on these questions, and I look for the greatest usefulness for Section M in bringing together the agricultural work with the other work of the association. I hope that as time goes on there may be joint discussions of Section M with other sections or groups represented in the

Convocation Week. Such discussions should result in much mutual advantage.

The agricultural situation is now much in the public mind. It is widely discussed in the press, which shows that it has news value. Much of this value is merely of superficial and temporary interest. Much of it represents a desire to try new remedies for old ills. Many of these remedies will not work. We must be prepared for some loss of public interest in them as time goes on. We are now in a publicity stage of our rural development. It would seem that the news-gathering and some other agencies discover these movements after the work of many constructive spirits has set them going and has laid real foundations; and not these foundations, but only detached items of passing interest, may be known of any large part of the public. I hope that we shall not be disturbed by this circumstance nor let it interfere with good work, however much we may deplore the false expectations that may result.

It has been my privilege for one third of a century to have known rather closely many of the men and women who have been instrumental in bringing the rural problem to its present stage of advancement. They have been public-minded, able, far-seeing men and women, and they have rendered an unmeasurable service. The rural movement has been brought to its present state without any demand for special privilege, without bolstering by factitious legislation, and to a remarkable degree without self-seeking. It is based in a real regard for the welfare of all the people, rather than for rural people exclusively.

Great public-service institutions have been founded in the rural movement. The United States Department of Agriculture has grown to be one of the notable governmental establishments of the world, extend-

ing itself to a multitude of interests and operating with remarkable effectiveness. The chain of colleges of agriculture and experiment stations, generously cooperative between nation and state, is unlike any other development anywhere, meaning more, I think, for the future welfare and peace of the people than any one of us yet foresees. There is the finest fraternalism, and yet without clannishness, between these great agencies, setting a good example in public service. And to these agencies we are to add the state departments of agriculture, the work of private endowments, although yet in its infancy, the growing and very desirable contact with the rural field of many institutions of learning. All these agencies comprise a distinctly modern phase of public activity.

Now, the problem is to relate all this work to the development of a democracy. I am not thinking so much of the development of a form of government as of a real democratic expression on the part of the people. Agriculture is our bottom industry. As we organize its affairs, so to a great degree shall we secure the results in society in general.

I desire to discuss certain questions that bear somewhat on this underlying problem. I shall approach these questions mostly from the point of view of our present public-service institutions for agriculture, leaving the other or non-public phases of the problem for consideration one year hence. I do not presume to make specifications for the institutions; but the questions may be discussed and perhaps we can do something to protect the institutions from demands that should not be made of them. Perhaps you will make some mental applications of the discussion to other public work than that which is specially agricultural.

It is auspicious, and perhaps it is fortu-

nate, that this new section comes into being at a time when a vast new organized movement in the interest of agriculture is taking hold of this country. This movement is connected very intimately with government, and therefore with policies affecting all the people; and it is possible, even in a democracy, that such a trend, or even such a formalizing, may arise in the beginning as can not be greatly modified, or much changed if change should be necessary, in any number of years. You know that I refer to the Agricultural Extension Act which was signed by President Wilson on the eighth of last May. No such national plan on such a scale has ever been attempted; and it almost staggers one when one even partly comprehends the tremendous consequences that in all likelihood will come of it. The significance of it is not yet grasped by the great body of the people.

We are at the parting of the ways. For years without number—for years that run into the centuries when men have slaughtered each other on many fields thinking that they were on the fields of honor, when many awful despotisms have ground men into the dust, the despotisms thinking themselves divine—for all these years there have been men on the land trying to see the light, trying to make mankind hear, hoping but never realizing. They have been the pawns on the great battlefields, men taken out of the peasantries to be hurled against other men they did not know and for no rewards except further enslavement. They may even have been developed to a high degree of manual or technical skill that they might the better support governments to make conquests. They have been on the bottom, upholding the whole superstructure and pressed into the earth by the weight of it. When the

final history is written, the lot of the man on the land will be the saddest chapter.

But in the nineteenth century, the man at the bottom began really to be recognized politically. This recognition is of two kinds, the use that a government can make in its own interest of a highly efficient husbandry, and the desire to give the husbandman full opportunity and full justice. I hope that in these times the latter motive always prevails. It is the only course of safety.

We have developed the institutions on public funds to train the farmer and to give him voice. These institutions are of vast importance in the founding of a people. The folk are to be developed in themselves rather than by class legislation, or by favor of government, or by any attitude of benevolence from without. And now, the great extension law, for which so many men and women have worked so long, is a fact, and means are to be provided whereby the farmer may find help at his own door. A new agency in the world has now received the sanction of the people, and we are just beginning to organize it.

It is a noble expression of confidence in the persons who have prepared the people for this departure, that the legislation should have been so generous and so complete.

The days of our propaganda are passed. No longer are we agricultural crusaders, seeking to get a hearing with the powers that control, making the work felt in the nation, energizing the farming people to express themselves. I fear that this changed relation is not understood by some persons; and hereupon we come to a crucial and perhaps to a dangerous situation. Some of us have not expected the recognition to come so soon or so completely, and it may be difficult for us to understand what has happened or to readjust our activities.

There are three phases of the situation that seem to call for special consideration at this turn in affairs, one of which has no novelty, and the second and third of which appear not to have received sufficient attention.

#### I. THE NECESSITY OF FUNDAMENTAL KNOWLEDGE

Although there has necessarily been something of the effort at conversion, the country-life movement is not a propaganda. It is the expression of a rapidly crystallizing desire to make rural life all that it is capable to become, and to understand and to utilize in the best way all the natural products of the earth.

All this requires knowledge; and knowledge of this kind demands careful inquiry. There must be a certain relation or equation between the research effort and the teaching effort. The enlargement of one ought to be conditioned on the enlargement of the other; and certainly we ought to know before we teach. I hope that the new extension work will demand a great stimulation of research. No subject makes great headway, no people makes great progress, unless it rests on investigation and discovery and feels the stimulation of exploration in fresh fields.

Particularly do we need the balance and the check in extension teaching in agriculture, where the field is so diverse, the people so numerous and so scattered, the teachers so variously trained, and the traditional errors so many. Extension work is not propaganda; it is teaching where the people are rather than where the matriculated students are; and while it may not go so deep, it must be as true and as well standardized to ascertained fact as is the other kind of teaching. The vitality of the extension teaching, as of any other teaching in natural science, will depend on the body of exact knowledge that lies behind it.

This being true, then we must see that appropriations for extension teaching in the years to come are not out of proportion to appropriations for research. I hope that we shall soon find a wide-spread expression amongst the people for a more complete endowment of fundamental investigation in subjects related to our agricultural industries.

I will digress to say that not everything is research, in agriculture or elsewhere, that happens to bear the name. Undoubtedly research, as such, has been over-glorified. There is no sanctity in research that does not inhere also in any other good and honest effort requiring equal ability. The teacher is as worthy of honor as the investigator.

Neither is research a refuge. Certain persons who bear something of a disdain for the affairs of the world are likely to be set at more or less interesting problems under the denomination of "original investigation" and "research," and "pieces of work." Here they may find shelter and protection, and a certain deference that is very conducive to peace of mind. They are supposed "to publish," whereupon their standing is established among their fellows. It may not be necessary to raise the question as to the significance of the publication or whether it reaches any result.

We are so insistent on technical accuracy that we are likely to eliminate the imagination; and without imagination no man can accomplish real research. Result is that undoubtedly we have worthy young persons in the institutions of many kinds who are practically accomplishing little beyond receiving support.

So I am thinking of research that follows a program looking toward a solution. Each of the items of such work is in itself a contribution. Not one is meaningless, and not

one is made *in vacuo*. Such investigations constitute the very beginning and basis of our accomplishments. The very rapid and really significant progress accomplished in the agricultural field within recent years has been possible because of the basis of research, which has been such a conspicuous part of it. The contributions to knowledge in this department have been astounding in variety, remarkable in their applications to human welfare, and many of them worthy to rank with research of highest excellence in other fields. We have a notable momentum toward original inquiry of a high order in the agricultural subjects, and we should be zealous to see that it is not halted, overlooked or eclipsed. We must consider that research does not have within itself the elements of publicity, and that it must be guarded by the good opinion and the activity of such persons as frequent conventions like this.

It is not necessary to the broad results we seek that this research shall all be directly or immediately applicable to the arts of life. It does not matter if much of it remains practically unknown to the public. The effect of the accumulation of it, if it is good, will be beyond all price, establishing a foundation, providing a reservoir from which we may draw at will, giving us a sense of conquest and of power, developing a literature, and training many men whose judgment will be of the greatest value in the control of our rural affairs. Research in agriculture should look toward a solution, but not necessarily toward a definite application, although the purpose to apply does not make it any the less research or any the less worthy of respect.

Knowledge applies itself in the end. The best and the final application of it is in a new approach to the subject and a better philosophy of action. This is well illustrated in the great work of Darwin, which

we have now learned to apply in a thousand ways, because it has entered into our philosophies. So the accumulation of knowledge touching agriculture will give those who come after us a new grasp on the rural condition, a readjustment of ideas, and confidence in our ability to handle the situation. Good research, maintained continuously and without haste by the ablest men, will make its own application.

## II. THE QUESTION OF PUBLICITY

Extension work in many kinds of subjects has seemed to some persons to be of the essence of publicity. This is a damaging error. We have already agreed, I hope, that it is not propaganda; nor is it publicity, or promulgation, or advertising, or exploitation. It is properly not work to be governed merely by expediency. It is educational work performed elsewhere; and as such it should have its own orderly program.

As newspaper popularity is dangerous to a person who engages in serious and productive work, so in future will a popularizing press-service publicity, under whatever name it may be called, raise against the colleges of agriculture and the experiment stations, and the extension teaching—or other similar enterprises—a presumption that it will be difficult to live down. Remember that the situation is changed. Consider also that the American is oversupplied with what is called news, and is likely to over-estimate the value of press publicity. The agricultural education work has again met the approval of the people as expressed in a piece of great legislation. It should no longer be necessary to make public sentiment.

It is said that only a certain rather small percentage of the farming people read the bulletins of the institutions, and that, therefore, there must be some means of publicity,

some making over of the literature, some new agency invoked, some peptonizing of the work, that shall interest every person. The fact as to percentages may be correctly stated, but the inference is very dangerous. The colleges and stations are not engaged in the dissemination of news; they are not in the press-bureau business. They have ample means of reaching the people through their students, their staff, their publications and their visitors. They should control their own avenues of dissemination, of course giving information and advice freely whenever requested. The reaching of all the people must come about very gradually and without haste. If one fourth of the farming people are informed, there need be no fear, and the remainder will be reached by regular and natural means as soon as they are ready to profit by the work.

It is doubtful whether any great movement or benefit is understood by more than one fourth of the people; and the knowledge of it passes very much from person to person in a hundred informal ways that are not known of the newspapers. The rise of public sentiment for a better agriculture does not depend on the numbers of persons who read the experiments at the institutions.

It is much to be desired that the bulletins shall be readable. It is presumed that all publications should be readable, seeing that they are published to be read. Good English, clear and attractive composition, lucid subdivision, the elimination of unessential parts, should make a bulletin readable by any person who has an interest in the subject; and it is not necessary that it be attractive in the newspaper sense. Such publications should be circulated widely, so far as persons seem to want them, and with the purpose ultimately to reach the entire constituency; and if some

fall to the waste-basket, it must be remembered that even the best seeds may fall on stony ground. I hope that the demand among the people for a greatly popularized bulletin literature—if such demand exists—may soon cease; at all events, we need not cater to it. The essential values and also the best scientific mode of presentation should be preserved. It must be remembered that the mode of presentation has teaching value in itself; the subject-matter may have only information-value.

Other agencies than literature, particularly than news-agency literature, must be found to carry the work to the people and to apply it there. The best results will come in the localities when the people begin to organize to receive the help. The people need more than pieces of information: they need stimulation and guidance. We look on the farm-bureau movement to accomplish very much in this way, if the motive power in it is kept with the people.

The natural and rational unfolding of the work as it issues from the institution, by means of its own agencies under its own control, will in time cover the field effectively. It is a great gain when any public institution or establishment, while still serving the people feelingly in a spirit of true democracy, passes the restless fever of publicity before the restlessness becomes chronic, and lays out a plan calculated to reach the results and then lets the process work itself out.

### III. THE ORGANIZATION OF THE NEW WORK

The great Extension Act brings what is essentially a new policy into American educational procedure. Only in the mechanic arts and agriculture, as they are founded on the Land-Grant Act of 1862, do we have a national system of education; but even in this case the federal super-

vision in the states was at first none or nominal. With the passage of subsequent acts the federal control has become more pronounced.

Undoubtedly we have profited very much as a people by the many political, educational, legal and other experiments of the different states. We now have forty-eight of these great experiment stations—the forty-eight stars on the flag—each one attempting to work out a government that shall best meet the needs of its people. We should have gained much in regularity of procedure, and perhaps in economy of funds and in what is called efficiency, if our educational system had at first been nationalized; but we should have missed much more than we now have gained. This nationalized extension work proceeding in detail in every community in the Union will raise essentially a new principle, for us, in educational policy.

It is the common assumption that if congress appropriates money, congress (or the federal government) should control all the expenditure of it. I think this is a doubtful, if, in fact, not a dangerous doctrine. The money belongs to the people, and there should be no reason why congress may not appropriate some of it back to the people. It may be expended in the people's interest quite as well by states as by the federal government. Of course it should be honestly expended and for the purposes for which it is appropriated, but these are matters of detail that ought not to be difficult to arrange. Specially do we need some centralized power for the control of delinquencies, an office that the United States Department of Agriculture has sometimes been called upon to exert with much benefit; but this is a very different matter from controlling or making the programs in the beginning. It is very important in our great experiment in

democracy that we do not lose sight of the first principle in democracy, which is to let the control of policies and affairs rest directly back on the people.

Some enterprises should be much centralized, whether in a democracy or elsewhere; an example is the postal service: this is on the business side of government. Some enterprises should be decentralized; an example is a good part of the agricultural service: this is on the educational side of government.

Whether there is any danger in our new nationalized extension work, which we are all so glad to have and from which we expect so much, I suppose not one of us knows. But for myself, I have apprehension of the tendency to make some of the agricultural work into "projects" at Washington. If we are not careful, we shall not only too much centralize the work, but we shall tie it up in perplexing red-tape, official obstacles, and bookkeeping. The merit of the projects themselves and the intentions of the officers concerned in them are not involved in what I say; I speak only of the tendency of all government to formality and to crystallization, to machine work and to arm-chair regulations; and even at the risk of a somewhat lower so-called "efficiency" I should prefer for such work as investigating and teaching in agriculture, a dispersion of the initiative and responsibility, letting the coordination and standardizing arise very much from conference and very little from arbitrary regulation.

In the course of our experience in democracy, we have developed many checks against too great centralization. I hope that we may develop the checks effectively in this new welfare work in agriculture, a desire that I am aware is also strong with many of those who are concerned in the planning of it.

Twice I have spoken as if not convinced that the present insistence on "efficiency" in government is altogether sound. That is exactly the impression I desire to convey. As the term is now commonly applied, it is not a measure of good government.

Certain phrases and certain sets of ideas gain dominance at certain times. Just now the idea of administrative efficiency is uppermost. It seems necessarily to be the controlling factor in the progress of any business or any people. Certainly, a people should be efficient; but an efficient government may not mean an efficient people—it may mean quite the contrary or even the reverse. The primary purpose of government in these days, and particularly in this country, is to educate and to develop all the people and to lead them to express themselves freely and to the full, and to partake politically. And this is what governments may not do, and this is where they may fail even when their efficiency in administration is exact. A monarchic form may be executively more efficient than a democratic form; a despotic form may be more efficient than either. The justification of a democratic form of government lies in the fact that it is a means of education.

The final test of government is not executive efficiency. Every movement and every circumstance that takes starting-power and incentive away from the people, even though it makes for exacter administration, is to be challenged. It is specially to be deplored if this loss of starting-power affects the persons who deal first-hand with the surface of the planet and with the products that come directly out of it.

If it is important that the administration of agricultural work be not overmuch centralized at Washington, it is



equally true that it should not be too much centralized in the states. I hear that persons who object strongly to federal concentration may nevertheless decline to give the counties and the communities in their own states the benefit of any useful starting-power and autonomy. In fact, I am inclined to think that here at present lies one of our greatest dangers.

A strong centralization within the state may be the most hurtful kind of concentration, for it may more vitally affect the people at home. Here the question, remember, is not the most efficient formal administration, but the best results for the people. The farm-bureau work, for example, can never produce the background results of which it is capable if it is a strongly intrenched movement pushed out from one center, as from the college of agriculture or other institution. The college may be the guiding force, but it should not remove responsibility from the people of the localities, or offer them a kind of co-operation that is only the privilege of partaking in the college enterprises. I fear that some of our so-called cooperation in public work of many kinds is little more than to allow the cooperator to approve what the official administration has done.

There is no occasion for misunderstanding here. It is exactly because I want the college of agriculture to hold and to extend its leadership that I warn you against its assuming any dictatorship. I think the situation at this moment demands special caution. The college comes into new consciousness of power. Great forces are put in its hands. There is at present more promise of great results for the people on the land than in any other movement or situation within my recollection. It is just the moment to give the people in the neighborhoods all the freedom and all the responsibility they ought to have for their

own best development. The future will care very little for the mechanism of administration, but it will care very much for the results in the training of the folk.

There is a vast political significance to all this. Sooner or later the people rebel against intrenched or bureaucratic groups. Many of you know how they resist even strongly centralized departments of public instruction, and how the effectiveness of such departments may be jeopardized and much lessened by the very perfectness of their organization; and if they were to engage in a custom of extraneous forms of news-giving in the public press, the resentment would be the greater. In our rural work, we are in danger of developing a piece of machinery founded on our fundamental industry; and if this ever comes about, we shall find the people organizing to resist it.

Of course, we want governments to be efficient with funds and in the control of affairs, but we must not overlook the larger issues. In all this new rural effort, we should maintain the spirit of team-work and of co-action, and not make the mistake of depending too much on the routine of centralized control.

In this country we are much criticized for the cost of government and for the supposed control of affairs by monopoly. The cost is undoubtedly too great, but it is the price we pay for the satisfaction of using democratic forms. As to the other disability, let us consider that society lies between two dangers—the danger of monopoly and the danger of bureaucracy. On the one side is the control of the necessities of life by commercial organization. On the other side, is the control of the necessities of life, and even of life itself, by intrenched groups that ostensibly represent the people and which it may be impossible to dislodge. Here are the

Scylla and the Charybdis between which human society must pick its devious way.

Both are evil. Of the two, monopoly may be the lesser: it may be more easily brought under control; it tends to be more progressive; it extends less far; it may be the less hateful. They are only two expressions of one thing, one possibly worse than the other. Probably there are peoples who pride themselves on more or less complete escape from monopoly who are nevertheless suffering from the most deadening bureaucracy—the insistence on mere governmental accuracy and efficiency.

Agriculture is in the foundation of the political, economic and social structure. If we can not develop starting-power in the background people, we can not maintain it elsewhere. The greatness of all this rural work is to lie in the results and not in the methods that absorb so much of our energy. If agriculture can not be democratic, then there is no democracy.

L. H. BAILEY

#### *MICROBIAL ASSOCIATIONS<sup>1</sup>*

SOCIOLOGY, as it is generally conceived, conveys a knowledge of the human as a social and ethical creature and maintains for him an harmonious relation to his social environment, as well as considers human society in its ensemble. As an individual, man's composite is different from what it is as a social factor. His attitude toward self is not his attitude toward society at large. Perhaps primitive man was concerned with self only, but with the development of society this limitation was not possible. Man, as he at present exists, has multiplied his individual and social functions. He has developed highly ethical relationships. Under existing conditions, too, he would be wholly helpless without his social ties.

<sup>1</sup> Address of the president, Society of American Bacteriologists.

To the biologist, this situation with man, aside from his ethical nature, may be regarded in large measure as material, biological, and may be pertinently designated as special functional development. To the human sociologist, however, the avenue of approach is through the human as a transcendent being in possession of other characteristics than material, and in no sense an animal, but a creature divested of brutish instincts. The spiritual is given command over material functioning. Biological materialism apparently yields to the enshrouding and directing forces of humanism or human ethics. Notwithstanding, the biologist feels and beholds as such a sociology of plants and animals that is very similar, and, furthermore, he sees written in their histories and associations most of the directive agencies operative in human society, only with less ethical exaltation.

This larger sociology, for such it is if we study human sociology biologically as well as through its superficial subjective manifestations, has much interest which is of useful significance. It would not be so difficult to establish parallelisms and expressions of man as an animal in every field of biology, if that were our object. This would, moreover, be a comparative study which can not occupy our attention, for it would lead us far from our purposes. The microbial world, our own province of study, offers itself for specific consideration and is of peculiar and paramount interest to a microbiologist. The possible extensive field of biological sociology just hinted at is used rather to open our minds for the possibilities contained therein.

The microbe, by itself or in pure culture, is only one phase of its existence. In company with other species quite another phase is presented, and this is determined by the associated species and by the many conditions under which these associations may be