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BOTANICAL PARTICIPATION IN WAR WORK[1]

FROM the subject assigned me in this symposium, which, by the way, was before the armistice was signed, one naturally would suppose that what was expected was a catalogue of the achievements of botany during the war. From the amount of time allotted for this effort it becomes equally obvious that no such thing is possible. I therefore find myself in the delightful position of being free to disregard the subject (for no one can disregard the time limit) and shall discuss some aspects of the way in which botany may be regarded as having accomplished its full share in the world struggle, as well as attempt to point out the overwhelming importance of a recognition of the place the subject should occupy in any peace plan. This I shall hope to do without encroaching unduly upon the subjects assigned to those in this or other symposiums which have been announced, although I am inclined to think that at this time there cannot be too great a reiteration of the fundamental facts calculated to impress the public at large with some of the reasons which justify the existence of the science of botany.

Of course, one might attempt to point out the achievements of botanists, who, because of their special interests or training, have been of invaluable assistance in suggesting various botanical raw materials for which the commercial man was seeking, or in obtaining the right kind of sphagnum for surgical dressings, or their part in the work of the Bureau of Air Craft Production or the Sanitary Corps or in the perfection of the gas mask and similar strictly war work. Then if one were permitted to dwell upon the far-reaching effect of the agricultural application of botanical investi-

[1] Read at the Symposium of Section G, American Association for the Advancement of Science, Baltimore, December 26, 1918.

gations, not forgetting the activities of the plant pathologist, there would be no difficulty whatsoever in making a case for botany of which none of us need be ashamed.

The botanists of the world apparently left it to the Germans to devise the ultimate way in which a knowledge of plants could be adapted for purposes of war. At least the following incident given by a war correspondent, which appeared in print but not vouched for by me, may be accepted as an illustration of a method of applying taxonomy, which, to say the least, is capable of wide use. A man in a German uniform was brought into a German camp, suspected of being a spy. He claimed to have come from a certain part of the front and to be the bearer of an important verbal message concerning the movements of troops, the ordinary methods of communication having been shot away. Immediately the camp algologist was summoned and samples of mud from the boots of the prisoner as well as dirt from his finger nails were examined microscopically. The botanist reported finding *Conferva utriculosa* Kurtzing or *Tribonema utriculosum* Hazen, according to the nomenclatorial code approved by the General Staff, together with certain blue-greens and diatoms which constituted a characteristic flora of a region quite different from that from which the prisoner claimed to have come. In fact, by consulting the charts prepared by botanists for this purpose it was possible to indicate that the man had been in Russia. Confronted with this overwhelming evidence the victim of applied botany confessed that he was a Russian spy and was shot at sunrise.

The rôle that the ecologist might play in connection with camouflage and the aeroplane service was suggested at the meeting a year ago and need not be amplified here, although the temptation to do so is great. But with the close of the war, which obviously was not expected at the time this symposium was arranged for, such things considered from the standpoint of military effectiveness seem more or less out of date and we need to turn to more vital matters.

For the past four years and more, science has been subservient to war needs. The importance of any investigation has been distorted and magnified. A trivial piece of work conceived and finished in a week might be more useful in waging war than a lifetime spent in producing fundamental results which have no military value. Thank God, however, we are not always at war.

It is likewise well to bear in mind that one should be cautious in citing too freely, as has been common in the past, the supposedly favorable attitude which Germany has held for all things scientific. May it not be that this tendency held up as a model for all the world and manifesting itself in most substantial subsidations, was merely another form of propaganda, or at least primarily for the purpose of receiving every possible aid from every science which could contribute in the slightest way to building up a perfect war machine? In view of all that has transpired one is justified in questioning whether the underlying idea of the Teutonic mind was not science for science's sake—but science for war's sake.

When the Botanical Committee of the National Research Council was first formed it was apparently expected by some that this aggregation of botanical lights would assemble and after solemnly mentalizing on the whole situation would announce some discovery which would illuminate the world and win the war. Nothing could have been more absurd. So far as I know the only two suggestions which were made along the line of using botanical weapons for the direct destruction of life were rejected because they savored too much of Teutonic barbarity. Naturally the chief function of this or any other botanical committee could only be to have referred to it military problems requiring a knowledge of plants and their possibilities, in order that the most rapid and satisfactory solution be reached. That this was not always done until much valuable time was lost was not the fault of the botanists concerned, although it may have been the result of the general attitude of botanists, who, since they were freed from the demands made by *materia medica*, have regarded the birth of any botanical idea of prac-

tical importance as illegitimate, to be turned out into the cold to perish. These foundlings, however, were not infrequently rescued by some more enterprising member of a sister science and occasionally grew into most flourishing children of their foster parent.

Again we are all familiar with the fact that many of the most practical aspects of botany have grown to be of so much importance that they now assume the place of independent sciences, and are no longer recognized as having any connection with their mother science. In fact botany unadorned now stands in the minds of most people—including many scientists—as a synonym for the impracticable and the useless. The minute it becomes of value to man, either in peace or war, it must be called bacteriology or forestry or phytopathology. As a result of this wide-spread opinion we have a much-advertised achievement of another research council committee depending not only upon plants for the source of the product but also upon the application of botanical methods for the actual process of manufacture, yet with no reference whatsoever to botany. Another similar case is the recent establishment of a concern at present turning out more than seven tons a day of a product used in munitions, derived from corn. Although called chemical distillation, the process is one of fermentation, produced from pure cultures of an organism which is manipulated according to the practises devised in botanical laboratories.

Examples might be multiplied indefinitely of those who, working in other sciences, ask: "Can you tell me of a plant containing a certain kind of substance, where it grows, what is its name, whether it can be obtained in large quantities, and how to distinguish it from related plants? If so I can use the information in the solution of a problem upon which I am engaged." And after the questions are answered there appears an article based almost entirely upon the results of botanical investigations, for which the science chiefly concerned receives no credit whatsoever. This is no imaginary case. All botanists have had at least a few such experiences and were there time I might quote from letters received during the past year which would emphasize even more strongly this aspect of giving no credit where it is due.

It is probably true that botanists themselves are largely to blame for such a condition of affairs. Whether it be modesty or lack of interest or a failure to realize the importance of asserting themselves and emphasizing various aspects of science, the fact is self evident that altogether too much time in the past has been spent in criticism of others rather than attempting to correct their own faults. Perhaps we need a criterion by which botanical work may be definitely distinguished. We are obviously at a disadvantage in being confined to but one kingdom, while the chemist and physicist know no such limitations. But the plant kingdom certainly affords a reasonably wide field of endeavor, and presumably botanists are those concerned with plants—even plant physiologists. We calmly sit by and see aspects of our subject, which, according to present-day standards, make a thing worth while, appropriated for the benefit of other sciences because it is too much trouble or it is nobody's particular business to attend to such things.

Even the very name botany is avoided under the slightest pretext. New titles for branches of this science, usually with the prefix "chemical," are coined so fast that one can hardly keep up with them, and if to-morrow the cause of influenza or any human disease were proven to be due to a species of *Laboulbenia* or *Thelephora,* Dr. Thaxter or Dr. Burt, although at once taking first rank as applied botanists, possibly, much against their will, would over night lose all association with botanical science and become at the very least a Laboulbeniaceæologist or a Thelephoraceæologist. It may be too late to correct much of this sort of thing which already exists or to hope for a bureau in the Department of Agriculture that bears the name of botany, but why allow it to continue without a protest and taking steps to prevent similar efforts to smother our science in a multitude of misleading and detrimental names? If a man spends nine tenths

of his time working with plants why not call him a botanist, instead of—to take at random one of the most recent titles which has come to my notice—"assistant in horticultural chemistry and bacteriology?"

One difficulty in the past has been that the commercial man and the botanist have been too far apart. The war has helped to correct this situation, but much remains to be achieved. A few years ago there was published in the *Missouri Botanical Garden Bulletin* a short popular article by Dr. von Schrenk on "The lightest known wood—half the weight of cork." Because anything that is the lightest or biggest or most expensive in the world will gain the attention of the press, the article was widely reprinted. Consequently the Garden was besieged, by manufacturers in this country and abroad for information as to where the wood could be obtained. One might have supposed that the business man had exhausted every effort in an attempt to obtain such a product. As a direct result of the article there now exists in New York City the American Balsa Wood Corporation which does a large business in supplying this wood to those who need it. The botanist had had the information for years, but there was no adequate means of bringing it to the attention of those most concerned. Of course, had the account appeared under the title of "*Ochroma Lagopus*" the probability is that the industry in this wood would still be undeveloped, for the fact remains that botanists have been entirely too remiss in making known to the technical man the practical worth of his science. Much more important examples might be given, but I will refer to but one other experience in order to illustrate another phase of the matter.

Soon after the war broke out, one of the largest mail-order houses in the country sent to the Garden three umbrella handles for the purpose of having the wood identified. It being no longer possible to import these handles, the concern wished to see whether the word could be obtained in this country in order to have them manufactured here. When I tell you that one of the handles proved to be osage orange you will recognize that there was no great difficulty on this score. The point I wish to make is that had it been three chemicals or three ores to be examined and sources from which they could be obtained indicated, much would undoubtedly have been made—and rightly so—of the ability of the science concerned to help the commercial man. But because only a knowledge of botany was needed no publicity or no credit for the work was expected. Hundreds and possibly thousands of determinations of plants by botanists have been made since the outbreak of the war for the purpose of giving the manufacturer definite knowledge of the source and value of fibers, drugs, condiments, gums and other useful plant products. Some most fundamental and far-reaching results have thus been realized, but the standing of the botanist as a benefactor of mankind has been little if any changed. Perhaps if we returned to the old term of "plant analyst" and charged at the same rate a chemist would for making an analysis of an unknown, it might help to rehabilitate the botanist in the eyes of the business man. At any rate some means of obtaining the recognition due to the science concerned should be devised before all the work and benefit accomplished is forgotten. Similar instances from other lines of botany occur to all of you. Are we to continue along the same old path for the want of a definite plan calculated to improve the situation? I hope not.

But before I refer to this aspect of the subject, I wish to hasten to point out that all I have said must not be regarded as implying that the only aim of botanical science is to be of direct practical application. On the contrary, I would regard it as the greatest catastrophe which could befall botany and calculated to place it in a much worse position than it is—to neglect what is sometimes called pure botany or research. Still further, I am in hearty agreement with an opinion recently expressed in Science that it is a grave mistake to attempt to justify research by claiming that it may possibly lead to some practical result. "Research for research's

sake" is a motto which might well be posted in every botanical laboratory, and I believe we would all be the gainer by following such a precept. I have no patience with a worker who oscillates to and fro in an effort to include both pure and applied science in one single investigation. It reminds one of the correspondent who wrote to Harvey and described *Oscillatoria* as "fluttering back and forth on the borderland of the plant and animal kingdom." While some of us would like to think that a bit of our botanical research might be of practical importance, we can not hope to gain either one thing or the other by any deliberate effort to make an investigation pay for itself by any commercial standard. That abstract research sometimes brings concrete returns is true, but it generally requires a second part to make the practical application. When Naegeli wrote "On Oligodynamic Phenomena in Living Cells" he had no idea of solving the problem of a cure for certain bad odors and tastes in water supplies, although the necessity for a remedy for such conditions existed then as well as when the application of his work was made. Nor was it probable that any representation of a certain large corporation ever read Clark's paper "On the Toxic Effect of Deleterious Agents on the Germination and Development of Certain Filamentous Fungi," although the application of this research was the means of saving thousands of dollars and helping out a situation, which, because of the war, promised to be disastrous. It is an admission of weakness which no true student should grant for an instant—that *cui bono* must be the test of all botanical research.

Of course, when I refer to research I mean something worthy of the name. Perhaps there is no one thing about which so many harbor a delusion as that mystic form of scientific endeavor which is supposed to lift one above the common herd and land him in the very bosom of the scientists' heaven, namely research. It is sometimes referred to by the neophyte as "having a problem." Heaven knows, we all have problems enough—most of them very unscientific—but if they were no more real than the subjects for investigation of some of our scientists they would give us little concern.

Let us take an example: Suppose the Department of Scientific Restauranting in one of our large institutions of learning assigns to one of its graduate students the research problem of how many ham sandwiches may be obtained from a hog. Or if the president has not succeeded in shaving enough off of existing departments to add this important branch to his curriculum, the department of domestic science, or zoology, or, since the hog is normally vegetarian, the botanical department might undertake the investigation. In the first place it would be necessary to decide upon the standard size and weight of the ham to be ensandwiched. This would probably necessitate the granting of a traveling fellowship readily obtained from the representatives of one of the large packing houses in order that restaurants throughout the world might be visited and first-hand information obtained on which to standardize the slice of ham. Returning to the laboratory after perhaps a year's travel, the investigator would have accumulated innumerable bottles containing various samples properly preserved in alcohol or formalin and duly labeled with date and place of collection and such other environmental information as seemed necessary. It would then devolve upon the scientist to weigh and measure and plot curves until he had definitely decided upon the amount of ham which should be the basis of his investigation. This determined, he would then be free to turn his attention to the hog. I will not weary you with the details of the laborious and erudite investigation necessary to determine the amount of pure ham, suitable for sandwiches, which may be obtained from this animal. Of course, the easiest way would be to kill the hog, cook him and make him into sandwiches, but this would not be research as it is often practised—besides any one could do that and there would be no chance for scientific investigation. Nor need I dwell upon the discouragements and disappointments which the ardent seeker after truth would meet before the conditions of his problem were met.

A sudden fluctuation in the weight of the hog might upset all his calculations and the final answer be obtained only in time to hand in his thesis at the twelfth hour. After graduation there remains, of course, the investigation of the size, shape, consistency, etc., of the bread used in ham sandwich-making, whether rolls are permissible or not, the origin and history of the use of mustard, until at last, after years of labor, the most complete, the most exhaustive and the most learned monograph on the ham sandwich is given to the world, and the author is hailed as one of its leading scientists. He may then devote himself to the monographing of other sandwiches, finally becoming the world's authority on this group, having specimens sent for identification from every railroad station in every sandwich island and continent of the civilized world.

Absurd as the foregoing may seem, you all know that actual examples of so-called research work might be cited which would be not a whit more sensible. A serious examination of the countless papers published in any one of the sciences will reveal an appalling number of trivial, inconclusive, unscientific effusions, at the most mere petty records of hypotheses and haphazard observations, which far from being contributions to knowledge, are but a means of disclosing the ignorance of their authors of the first principles of science.

That such work should be bolstered up by the claim that possibly it might be turned to some practical application, is calculated to bring all research, good or bad, into disrepute. I do not believe that any member of a board of trustees or a prospective philanthropist is fooled by the attempt to justify herbaria or libraries or laboratories solely on the grounds of definite, practical usefulness to mankind in general. If botanical research is not of enough importance to sustain itself regardless of any incidental benefit that may arise through it, the greater portion of it would better be dispensed with in order that the time and effort and money now wasted be turned to something capable of standing on its merits.

It is to be hoped that either through the perpetuation of the Research Council, or better, through some committee representing all botanical interests, there may be an organized attempt to raise the general standard of research work in botany at least. But why stop here? Is it not time that botanists recognize in a tangible way their obligation to the public at large, and that we see to it that our profession takes a worthy part in the world work of the future? Perhaps it has in the past. If so, it behooves us more than ever to stand firmly for our rights and the recognition due us. In spite of the shudder that may pass over some of you present I venture to suggest that a committee of the Botanical Society of America on publicity might not be out of place. Other sciences which apparently need it less, have not hesitated to adopt such modern methods. There might also be added a committee on botanical raw materials, with sub-committees on economic or applied phases of certain special topics, or, if it seemed best, a general development committee which would deal with botanical ideals and ideas in a way calculated to crystallize the more essential activities of the science and make more tangible the benefits and achievements resulting from a fundamental knowledge of plants. Surely the need for something of this kind is quite as great as the object of committees already in existence. Perhaps too much attention can not be paid to the details of the multitudinous ramifications which sprang from the parent trunk, but we cannot afford, either for our individual or professional good, to neglect the subject as a whole. No time could be more propitious for accenting the place which botany holds. It may have been a "chemical war" which the world has suffered. I for one am perfectly willing to let it go at that. But should we not do something definite towards making it a botanical peace upon which we are about to enter?

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[1] Based on the author's article in *The Journal of Geology*, November–December, 1918.