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DEMOCRATIC COORDINATION OF SCIENTIFIC EFFORTS[1]

COOPERATION and coordination are the very essence of all evolution and progress, biological, social, political, moral, industrial or what not. We acknowledge without controversy the fundamental rôle of these factors in the evolution of living things. They constitute the woof and warp of the social fabric, without them political machinery can not function, and the wheels of industry cease to turn; they condition every ethical and moral principle. It is the glory of science that it has uncovered and made clear this fundamental fact of organic evolution. But in the organization of its own activities how little has it profited by its own discovery. The Honorable Elihu Root has well said:[2]

> Science, like charity, should begin at home, and has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the difference from the past seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the effective power of a great number of laborers may be increased by military discipline.

It may well seem strange to the layman that

[1] Presented in the symposium on "Our present duty as botanists" before the joint session of the Botanical Society of America and the American Phytopathological Society, December 26, 1918, at Baltimore, Md.

[2] SCIENCE, N. S., 48, 532–534, 1918.

scientists have not applied to their own profession the doctrine of cooperation and coordination so vigorously and successfully preached to others. Yet the fact remains that while the rest of mankind has gone far along the way which we have discovered and pointed out we still remain largely isolated and intrenched in the feudal towers of our individualism. Here behind moat and wall we shape and fashion those intellectual darts with which at our annual tourneys we hope to pierce the haughty pride of some brother baron. Yet common sense, the common-good, the very progress of our profession demands that we abandon this ancient outworn attitude.

For more than four years now we have been witnessing one of the greatest convulsions in the inexorable march of human evolution. Again the intrenched autocracy of individualism has gone down before the invincible march of democratic socialism and we look with longing expectation for the consummation of that age old dream, a true league of mankind, free from the blighting menace of individual selfishness.

How then shall scientific men, who often and in so many ways have pointed out the path along which mankind shall realize its vision of common brotherhood, perfect in their own relations the doctrine which they have so persistently and effectively taught. How shall we truly cooperate and effectively coordinate our efforts and discoveries. While I must admit the obstacles and the difficulties which confront us, frankly I see none that are fundamental or insurmountable. They are in nowise of a different sort or more formidable than those which confront other men. Every honest scientist must admit the desirability, yes the very necessity of scientific cooperation, if we are to maintain that lofty position of disinterested leadership in the economic affair of mankind which we so long have held to be our natural heritage.

But one short year ago this body of men acknowledged this grave necessity by their common effort to organize themselves for more effective participation in the gigantic struggle then at its zenith.

What then are some of the specific difficulties with which we are confronted. One says, "This is my idea, how shall I be protected in my possession and exploitation of it" and he hoists aloft the bugbear of priority, at once the reward and the curse of scientific work. "What," cries another, "shall I share my immature conclusions with my intellectual inferiors," and then proceeds to contribute another half-baked fragment to the crumbs that litter scientific publication. Is any truly scientific man so poor in ideas that he can not afford, forsooth, the loss of a crumb or two if that the common good be better served by the free and open display of his wares? I have been ever free to expose my own discoveries and ideas on scientific matters for the consideration and criticism of my colleagues nor am I aware that any of them has ever been intentionally filched or appropriated. It may well be of course that all of them have been like the contents of the proverbial purse. No man shall thus greatly lose, for by the very display itself he most protects that which is truly his; for who will steal cakes from the common table and hope to get away with it? Another invokes the shades of a jealous director to justify his selfish doubts of the possibility of cooperative action. Well, have we not ever boasted of our academic freedom, and if we choose to pool our ideas shall autocratic administrators rise to say us nay? Real administrators most recognize the value and advantages of cooperation and will be the first to approve our efforts in this direction. The common good alone deserves consideration. Will any one gainsay the fact that more than half the words with which we dress our darlings for the press are so much padding old and soiled with wear? How immature and verdant too, too many of them are. Then why not bring them forth in all their nakedness and let the eyes of all the tribe appraise them at their worth, discuss them, test them, fit them in their proper place and stamp with general approval that which posterity may use with confidence and gratitude. Think of the weary hours we now must give to burrowing in literature. Then shall we not forswear our

selfishness and join to make an end of a condition unscientific and unsound?

"It can't be done!" It has been done, is being done to some degree right now among us. And you will pardon me, I trust, if I bring forward in proof of this assertion a piece of cooperative research in my own field. Under the auspices of the War Emergency Board of American Plant Pathologists, workers in fifteen states and in the federal department have planned and carried out cooperatively a most extensive investigation on cereal seed treatment with the result that in one year we have approached general agreement upon a single simple safe and most effective method, of wide application, for the control of externally-borne, seed infesting cereal smuts. I need not dwell upon the advantages thereby accruing to science and to practical agriculture.

Once more I beg your indulgence. In a single conference of two days duration the potato disease pathologists of the continent in August, 1918, in free and open exchange of facts and ideas made more progress toward the solution of the difficult problems of leaf roll and mosaic, than would have been accomplished in five years of individual reflection in solitary confinement.

It is evident, of course, that cooperation and coordination of our scientific activities can not be accomplished without organization. The character of this organization is a most vital consideration. It can not be imposed upon us, it must be of our own making. It must be truly democratic and without autocratic possibilities. Moreover, it must directly affect only those individuals who of their own free choice are willing to associate themselves together to this end, nor shall any one be excluded who is prepared to enter this association with zeal and unselfish purpose. But organization alone, no matter how democratic, can not succeed without good leadership; leadership of the highest order, strong, vigorous, of broad vision, wholly devoted to the common good, above reproach. We must demand that the ablest shall lead and we must give them our fullest confidence, our heartiest allegiance and our unqualified support in the undertakings.

Having now set forth what I believe to be the most fundamental factors for success in cooperative undertakings in scientific work, I may be expected to present something concrete respecting the *modus operandi* by which we may hope to realize this success. In presenting for your consideration the following plan I am not without experimental data upon which to base my opinion that it will be found exceedingly workable. It is essentially the method by which the American plant pathologists have, during the past year, sought to speed up accomplishment within their own field. The results have been so remarkable, so indicative of what cooperative effort may be expected to accomplish, and the methods by which this has been effected, so generally approved amongst us, that I venture to predict that the machinery which we have evolved will, in its essentials, best serve to promote in other fields of science the true spirit of cooperation and coordination. The thing about which all cooperative effort in science must center is the solution of some definite problem, be it one of research, of teaching or of extension. For the solution of this problem a number of workers voluntarily agree to associate themselves. The ideal condition is that in which all workers in any way interested in the problem become co-partners in the attack upon it. Not only that but there must be a general understanding that any person who in the future becomes interested may, without hesitation, claim the privilege of associating himself in the undertaking. In short those uniting for the conduct of a given project, constitute the *project committee*. Each project committee selects from among their number some one to be their leader, note I say leader, for only under real leadership can the work be carried to a successful consummation. If the committee finds that it has been mistaken in its choice the evident and democratic expectation is that it will promptly choose another to lead. Just what is expected of the committee chief is clearly implied in the word *leader* and I therefore need not dwell upon

his qualifications or his duties. It should be clear, however, that neither planning of the project, nor partitioning of the field nor assignment of work is to be a function of the leader or of any group within or without the committee. Each individual must be free to undertake that which his inclination and his facilities dictate. Nor shall any one reserve to himself alone any phase of the problem whatsoever. Each must feel free to duplicate, to test or to try the work of the other. The solution of the problem is the thing and personal aggrandizement at the expense of one's colleagues must give place to personal service and its more lasting rewards, for I am convinced that there will be more of glory and renown for each participant in a cooperative accomplishment, complete and well rounded, than in the best fragment which any of them alone might pass down to posterity.

You will next demand to know how effective cooperation and coordination within the committee is to be assured without personal contact and exchange of view. I reply, it is not. This brings us to a consideration of the *project conference*. A conference of at least a considerable majority of those proposing to associate themselves together in the work will be requisite for the very organization thereof; and the selection of a leader will be by no means the only business. At the initial conference there must be the freest and fullest exchange of data already in the hands of each member, of all the ideas, yea, of all the "hunches" which each may have upon the subject. Every man's cards, all of them, must be upon the table, faces up. They must in the very beginning pool, in the fullest sense of that word, their combined resources and then there must be an exhaustive examination and discussion of every item presented, with finally a summarized inventory of their stock in hand. With this before them, plans for future work will be agreed upon and each will return to his post to carry forward to the best of his ability that portion of the work which he himself has chosen to do, feeling that he has a vital part in a vital problem worthy of his best endeavors. Nor will he be tempted to dissipate his time and energy on other phases of the problem which he feels are necessary compliments to that upon which he desires to concentrate his efforts. He will know that another seeks their solution and will bring them eventually for fitting together with the parts which he himself has shaped.

Succeeding conferences on the project must be arranged. They should at least be annual for while much may be accomplished by correspondence it is only in the heat of personal discussion that the various parts can be effectively welded into a coordinate whole.

There is much virtue in conferences of real cooperators. They are not the "talk-fests" and sparring matches of competing individualists. They are the business meetings of an open corporation. They are not for the reading of preliminary papers, they are for the making of comprehensive contributions. They require days not hours. Two solid days including the intervening evening were required to organize the project work on potato mosaic leaf roll and seed certification in the Buffalo conference of potato disease pathologists last August; and no time was wasted. These conferences must be arranged for and the cooperators must be gotten to them. The necessary traveling funds must be found.

And now I hear some skeptic mutter to his neighbor, "But how about publication." The answer is simple. A group of men who will cooperate in the solution of a scientific problem will also cooperate in the publication of their work. That too is their problem, and different groups will solve it differently.

It is apparent that some organization or association of the units, the project committees, is not only desirable but perhaps imperative. They need the stimulus that comes through association; each needs to coordinate its own problem with the related ones. This has been accomplished to some extent by the phytopathologists in the formation of general project committees consisting of the leaders of the committees on closely related projects, as for example the general potato disease project committee, of which Dr. W. A. Orton is now leader.

Within each well-defined field of science, where cooperative projects of the kind I have indicated are in operation, there should be and naturally would be provided a general coordinating board of strong, aggressive but tactful leaders, small in numbers, but alert and far seeing, who would guide, not direct, the effective organization and development of the cooperative idea.

Such a board must be constituted through the free and well considered choice of a democratic electorate. I believe that the plan which will insure most satisfactory and effective results is the selection of a leader by vote of all the cooperating workers in the field. The leader to select, subject to their approval the remaining members of the board. The size of the board, tenure of office and other details of a like nature are of relatively little importance so long as they remain subject to the control of a live democracy.

To hold that such a program as I have here outlined can be carried through easily and without difficulties would be to acknowledge ignorance of human nature. The selfishness of individuals has always been the chief obstacle to cooperative undertakings and selfish ambition is not uncommon among scientific men. Yet the measure of the success of true democracy will always be the extent to which this human weakness is suppressed and eliminated. Cooperation among scientists for the solution of problems must come. In no other way shall we be able to rise to the demands and the opportunities of the age. The pioneer days of science are largely over and progress is to be made only by organized and united effort. Why shall not the botanists of America lead? Already one group among us has indicated the possibilities in this direction. Botany in its broadest sense must justify itself in an economic world even as chemistry is doing and there is no want for opportunities. Colleagues shall we organize, shall we cooperate, shall we coordinate, and shall we show the way?

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ON DUTY-FREE IMPORTATION

BEFORE the great war, the practise of importing duty free many things required by educational institutions had become so thoroughly established as to be regarded as part of the normal course of events. What had first been regarded as a special privilege came to be looked upon as a special right; and institutions, justly or unjustly, considered themselves entitled to purchase anything required for their maintenance in the lowest world market and to do this quite regardless of any conditions of high tariff or low tariff. Prohibitive tariff; protective tariff; tariff for revenue only had little or no interest for them. "Made in Germany," "Made in Japan," "Made in England," were more familiar inscriptions on laboratory apparatus than "Made in America."

In August, 1914, duty-free importation was stopped and now for the first time it is possible to resume it again. The question of whether or not it is desirable to do so is to the mind of the writer a pertinent one.

That it was the part of wisdom and good policy in the early days of our country when "higher education" was represented by a few denominational institutions, mainly supported by private contributions to grant them the privilege of importing without duty the instruments necessary for their research, is beyond question.

Science was practically unknown in this country; in fact, science as we know it to-day was almost unknown in the world. The amount of apparatus required by all the world was but a small fraction of that now utilized by America alone. An astronomical telescope, a compound microscope, a spectroscope was a rare instrument for which the world must be sought over, and having located an instrument of scientific interest, what more natural than that the pioneers of science in this country should be allowed to import it duty free? They were furthering the development of science and education and helping to create the demand that now exists for enormous quantities of such instruments, many of which have developed entirely out of the class of scientific