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

A PLEA FOR CLOSER INTERRELATIONS IN OUR WORK[1]

IT is the plan of our secretary to depart from the usual symposium idea this afternoon. Instead of selecting a single topic upon the various aspects of which in turn our attention is to be focused, he has asked to have addresses on different topics, evidently with the idea that we may be led to realize more fully the diversity of interests now encompassed in Section G.

This at once suggests the problem which has been formulating more clearly each year in the field where my own chief interests lie, that of plant pathology. Most of the work in this field, at least so far as it presents the problem, is of two easily definable types, which, while in some ways widely different, nevertheless, have much in common. These are, first, the training of graduate students for professional work as phytopathologists, second, the direction of research work supported by public funds, either state or national. Outside of these two fields, we have only the limited activities represented, on the one hand, by undergraduate teaching, and, on the other hand, by research privately supported. I

[1] The paper as above published is a combination of two symposium papers read by the author at the recent Cleveland meetings, as follows: (1) "A Plea for Closer Interrelations in our Work." Read at the Botanical Symposium, Section G, December 31, 1912. (2) "Some International Aspects of Phytopathological Problems." Read at the Symposium of the American Phytopathological Society, January 2, 1913. The other papers read at this Symposium are being published in *Phytopathology*. In order to make the theme continuous, the second paper has been abridged and modified somewhat, but without essential change of idea.

omit, of course, public teaching or extension service as not concerning the higher aspects of the problem.

Directing our attention, then, to these two main lines of phytopathological activity—the effective prosecution of the higher lines of research and the best professional training of graduate students—the fact is becoming increasingly clear that in both lines it is of paramount importance to recognize that the complex interrelations with other departments of botanical and allied sciences are each year becoming more intricate and vital, and the need of deliberate correlation of endeavor is, therefore, becoming more imperative. Neither in research nor in graduate training can any man live by himself or to himself alone.

Many of us, in phytopathology at least, have been undergoing a transition in relations without perhaps fully realizing its significance. We shaped out individual or institutional ideals with reference to the purely local aspect of research problems or to the educational needs of the student of the more generalized type. This has meant that in the one department of one institution, and perhaps under the leadership of one man, the student has been introduced to the various aspects of botanical science, and work upon problems of widely different types has been undertaken. The futility of this having become evident with our higher aims and the increasing complexity of our modern scientific development, we have naturally substituted the university as the unit instead of the man or the department.

This seems to-day to be the dominant ideal in American university administration and departmental organization. We wish to make each great university *complete in all its parts and wholly sufficient unto itself*. At least if we are not doing so positively, we are negatively, by not clearly defining any higher or better ideal.

As a matter of fact, however, we have arrived at the stage where the highest efficiency and economy in research and the best training for graduate men alike demand the clear recognition of the importance of specialization, with correlation and cooperation, not only as between men and departments, but as between institutions.[2] No one man can be the best leader in all lines. No one laboratory has the best equipment for all purposes. No one library or herbarium is likely to be kept at the highest stage of working efficiency for all botanical problems. No one locality offers the natural or artificial environment best suited to meet all of the diverse needs of a single problem. *It is, therefore, both extravagant and futile to encourage the ideal of university completeness.*

For example, take the botanical gardens in America. All are, of course, agreed as to the usefulness of the moderate-sized garden for general college uses, or of the small but highly specialized garden for individual researches. But I think every one recognizes the tremendous cost, both in money and in executive skill, which is required to organize and develop the large botanical garden, planned and maintained as a general research center. I doubt not that most will agree, therefore, that it is better for botanical research in America to have the botanical gardens at Bronx Park and St. Louis equipped and kept at the highest possible degree of efficiency, sustained by the scientific recognition and moral support of the neighboring universities, rather than to encourage the ideal of an extensive botanical garden at every university.

[2] The need of better correlation in botanical work was also strongly urged by Dr. C. E. Bessey in his presidential address at the Cleveland meeting of the American Association for the Advancement of Science. See page 11 of the current volume of SCIENCE.

The same holds with other departments or their adjuncts. What we need in American university ideals to-day is clearly and definitely to substitute the idea of institutional preeminence secured by specialization for that of a uniform grade of mediocrity imposed by the attempt at all-round equipment and attainment. And whatever we say as to the abstract principle, we shall at once see, if we compare our university curricula and analyze the situation, that this is what we are more and more clearly tending toward in our institutional developments. Specialization is an essential corollary of scientific progress. This is a universal law and applies as well to institutions as to men. This being so, it follows that just in proportion as we recognize institutional specialization we must have *institutional correlation and cooperation as an avowed and approved policy.*

Let us consider what this may signify for the two lines of endeavor in phytopathology, viz., research and graduate training.

Research.—In so far as phytopathological or similar research is supported by public funds and aims to meet economic needs, as is the case with most of the research work in plant pathology, the arguments for correlation, and indeed for cooperation, are becoming increasingly pertinent and convincing. There can be no doubt that this is the only attitude morally or scientifically justifiable. But of course this is not a thing to be secured by official fiat or rule. Indeed, no definite modes of procedure may safely be formulated. Such correlation or cooperation to be properly helpful must, to a large degree, be a matter of individual initiative and personal relation and the details must in general be left to individual workers and developed to meet the exigencies of special cases as they arise. The fundamentally important thing, however, in order to pave the way for this, is the *general recognition of the propriety of such a course and the impropriety of any other.*

This implies the idea that state or nationally supported investigations should be so correlated as either to avoid duplication or to make the duplication of the highest scientific value. Every one experienced in any degree in such work recognizes the value of duplicated and repeated investigations. These advantages must not be sacrificed. On the other hand, every one recognizes also the prevalence of the wasteful type of work which has no such worthy aim or scientific justification. The details of accomplishing this, at least in a large degree, of eliminating the bad while saving the good, will, I am sure, present no insuperable difficulties if once the right principle is generally recognized.

Let us clearly define the ideal that *the facilities of any publicly supported institution are maintained primarily for the public good.* It follows at once that the courtesies of such experimental grounds, libraries, herbaria and laboratories are to be extended to men from other institutions with the utmost freedom compatible with non-interference with local work. If this is recognized by directors of laboratories and other administrative officers, and the ideal of correlation and cooperation as opposed to competition is commended, especially to our younger men, the balance may safely be left to the individuals concerned.

Graduate Training.—The other field in which there is the need of closer interrelations, and in some degree of correlations, includes our graduate schools. If the points already made are all well established, then it follows that we should in each of our graduate schools aim avowedly at *preeminence in certain lines*, rather than a uniform degree of excellence in all lines. If this is true then it follows again that any

graduate student seeking the best should look for leadership in more than one institution.

Most of us can recall the time when American graduate students in botany were turning to Europe for their higher training. To-day, we have the satisfaction of realizing that this is not necessary. In our American universities we now have the laboratory equipment, the libraries and a share of the personal leadership. Those qualified to compare testify that our standards are at least in as high a class as those of the European universities. Without going into familiar details, I wish at once to point out, however, that the most striking difference and defect in our American training, as compared with the German, is that it involves relatively less migration of our graduate students from university to university. All must at once admit this fact and all must lament it as unfortunate.

If this is so, we should earnestly ask why it is so and how is it to be remedied. There is neither time nor necessity for full analysis of the reasons for its existence. A partial list will suffice:

1. The geographical isolation of our botanical centers.

2. The lack of more definite recognition of the importance of institutional specialization.

3. Institutional loyalty or "college spirit" with its relative magnification of institutional prominence, rather than individual leadership.

4. The financial handicap of many a graduate student and, consequently, the attractiveness of the local financial inducements, scholarships, fellowships and assistantships, which, naturally, are offered to our own best students. This has been emphasized in recent years by the rapid institutional growth coupled with the great development of laboratory courses, which combine in demanding a large number of low-priced assistants.

5. The reluctance which every departmental head, of normal human constitution, feels at sending his best men to another institution before the completion of their graduate period.

6. The natural inertia on the part of immature students, which results from the American custom of staying by one institution: *A* stays because *B* and *C* stay, and they because *D* did the year before.

7. The fact that our graduate schools are not always so organized and managed as to make such a migration easy, simple and natural. The student can readily find out how he can get in as a beginner, but it is not so easy to learn what will be his status if he transfers.

If I have listed the more important reasons for lack of migration among our graduate students, then analysis of them shows clearly that the fault lies primarily, not with our students, but with our institutional and departmental directors—with ourselves as teachers.

To correct this we should do three things:

1. Prepare to welcome and provide for the transient student, the man who comes for one year or even one semester's work, with the same definiteness and the same departmental hospitality that we do for the man who is to stay two or three years.

2. Examine the administrative machinery and see that it is so designed, adjusted and lubricated as to make migration easy; that it is convenient for the doors to be swung both ways; that the able but transient student is admitted promptly and his work properly certified when he leaves; that attainments at other institutions are recognized at their full face value.

3. Finally, and hardest, remember that until the precedents are established and the

"habit" fixed the initiative may need to come from the instructor in charge rather than from the student. It may be a difficult thing, but it may be the right thing not infrequently, to send our keenest man to some one else for a semester or a year—even though it be the last year and the degree.

INTERNATIONAL RELATIONS

In addition to our home problems there are the international aspects of these matters of interrelation and cooperation. It is gratifying to realize that in some respects these have received more definite attention, and with better results, than those between our own institutions. This is especially true as relates to the two matters of individual research and graduate training. Dr. Farlow, in his delightful address,[3] has pictured the beginnings of American botanical student migration to Europe, and the majority in almost any botanical gathering have followed that lead. This matter needs no emphasis other than an expression of the hope that we shall not let provincial pride or overesteem of the value of our material equipments lessen the tide of student migrants to Europe, although it may well be that they continue to go with somewhat different aims than in former years.

There is, however, a broader aspect of international phytopathological problems which has not had adequate general recognition. The recent passage of the Simmons bill shows that, in some degree at least, this is dawning upon our national consciousness. This very bill, however, emphasizes the necessity for studying phytopathological problems in their international relations. Two things are especially needed to this end. First, administrators as well as investigators should recognize the importance of occasional visits by the American investigator to such foreign countries as will enable him to see his problems in their foreign setting. The relation of environment to the predisposition of the host, as well as to the virulence of the parasite, can not be over-emphasized and it is often impossible for the investigator of the local problem to realize this except as he may be temporarily translocated.[4]

Even more should our administrators see from time to time how great may be the gain from temporary or permanent employment of foreign experts. This has been done in the Department of Agriculture often enough and with sufficiently favorable results to justify its further trial. But there are inherent difficulties in the appointment of foreigners to permanent government positions and, moreover, the best of foreigners of mature experience can not be thus transplanted. Neither of these difficulties, however, arises in relation to the temporary employment of foreign experts. It seems to me that the time has come when this should be done with increasing frequency. It would result not only in giving us promptly the best expert advice for immediate application, but, what is scarcely less important, would give the foreign specialist such an understanding of the American problem as would make his further investigations more broadly inclusive of American conditions, and insure results proportionately more valuable to us. Every student of the history of plant pathology recognizes the gain to England directly, and to science indirectly, which came from the employment of De Bary by the Royal Agricultural Society as expert upon the problems which arose in connection with the potato disease.

[3] See page 79 of the current volume of SCIENCE.

[4] This aspect of the discussion was set forth in detail by Dr. C. L. Shear in the second paper of the symposium before the American Phytopathological Society, January 2, 1913. Dr. Shear's paper is published in *Phytopathology*, 3: 77–87, April, 1913.

Who will measure the advantage to American plant pathology could we have had a professional visit of inspection with obligation for counsel from Aderhold, when he was at the height of his understanding of German orchard pathology; or who will estimate the stimulus to our progress upon cereal rust studies could we have brought Ward to America for even a brief sojourn when he was probing deepest into their fundamentals, providing he came commissioned and committed not alone to see but to advise? Surely if exchange professorships are scientifically and economically justifiable in any field, they are in plant pathology.[5]

In closing, then, let me briefly summarize with particular reference to phytopathology. I must leave it for those whose chief interests lie in other fields to dissent if my conclusions are not generally applicable, as I myself believe they are.

The points I would make are:

1. An understanding of the complex interrelations of our subject with the various fields of science is becoming each year more difficult and more imperative.

2. Educational and investigational work, especially where supported by public funds, should be correlated as closely as practicable on the grounds of both economy and efficiency.

3. One step looking to this should be an attempt by both departmental heads and general administrators in our graduate schools to encourage and facilitate the migration of graduate students from school to school and to locate their field operations where most favorable to the progress of their work.

4. Another step in this same direction should be an attempt at better correlation in state experiment station and national agricultural department investigations, coupled with more freedom in change of location of investigators.

5. These principles apply still more broadly to foreign relations, both as to graduate students and as to mature investigators. We need not only to make it easier for our graduate students to go abroad and to encourage our mature investigators to continue to do this with increasing frequency, but especially do we need so to arrange as to secure the official visits of foreign experts, both for advice on particular problems and to secure their intelligent general cooperation in working out our American problems.

L. R. Jones
Department of Plant Pathology,
University of Wisconsin

[5] The American Phytopathological Society after discussion of these points adopted the following resolution:

Resolved, That the American Phytopathological Society, appreciating the fact that plant diseases do not heed national limits or geographical boundaries and also the evident limitations imposed upon investigations when restricted by national bounds, respectfully recommend that administrators of research institutions, whether state or national, as well as individual investigators, recognize the importance of establishing closer international relations and take such steps as may be practicable from time to time to this end, including not only more frequent visits of American investigators to foreign countries for field observations as well as research, but also the securing, either by permanent or temporary engagement, of the best of foreign experts in plant pathology.

REPORT OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

(1)[1] During its 1913 (Monaco) session, the International Commission on Zoological Nomenclature has held ten executive meetings.

(2) The following nine active commissioners were present: Messrs. Allen, Blanchard, Dautzenberg, Hartert, Hoyle, Jentink, Monticelli, Stejne-

[1] For convenience of reference, the paragraphs or subjects of this report are given serial numbers in parentheses, thus: (1).