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THE UNIVERSITY AND RESEARCH [1]

THE main sources of research in America have been, and must continue to be, the universities. We have a few first class special research institutes; and we have a good many laboratories of industrial research and development. There are more of these than is popularly known; five hundred, perhaps, counting many small ones. But their work is directed more towards the attack of specific problems of development in the special industries which support them, and less towards the fundamental science that underlies these industries. In some of the larger of these industrial research laboratories, however, able investigators are at work and fundamental research of a high quality is carried on. But in all of the few special institutes and the many industrial laboratories taken together the research output is much less than that which comes from the universities. In addition, of one thing very important to the maintenance of research in the country these special institutes and industrial laboratories do almost nothing at all. That is the development and training of new research workers. This is done almost exclusively in the universities and colleges. Anything, therefore, which lessens the interest and activities of the universities in research, and hence reduces their actual output of research and research workers, is a menace to our national strength and well-being. For this strength and well-being depend, in a very large measure, on scientific research and discovery.

The conspicuous role played by science in the war from its very beginning, and the pressing necessity for solving serious war problems involving scientific investigation, brought very

[1] A paper read at the educational conference, May 13, 1921, held at the University of Minnesota, in connection with the inauguration of President L. H. Coffman.

vividly to the attention of the world the advantage to a nation of large scientific resources, both in equipment and personnel, and of being able to mobilize quickly and effectively these resources to aid in meeting the great emergencies created by war conditions.

At the beginning of the war Germany revealed herself far better prepared than any other country to take swift advantage of her scientific resources. In my interesting conversations in 1915 and 1916 with officers of the German General Staff at their great headquarters in occupied France, where I had to reside for some months as chief representative for occupied France of Mr. Hoover's relief organization, I was much impressed by the reliance placed by these officers on the help they were receiving and could always expect to receive from Germany's scientific men. When things were going badly on the West Front they would say: "Well, just wait; our scientific men will give us something new. They are all organized; they are all working; they will have something new soon to make your eyes stick out."

It is familiar history now that Germany's science, brought to the aid of her armies and navy, did repeatedly make our eyes stick out, and it was necessary before the war could be won to meet German's science with English and French and Italian and American science. We and the Allies had to organize science, too, and, with a haste made desperate by necessity, it was done.

Out of the revelations and experiences of the war came a great recognition and stimulus to the development of science which has resulted in the setting up by America, and several other nations, of new scientific organizations for the encouragement and support of scientific research and its applications by methods giving special attention to cooperative and coordinated work. Such methods involve an attempt to introduce a certain degree of organization into scientific investigation beyond that heretofore usually attempted.

The phrase, "organization of science," produces an unfavorable reaction from some scientific—and some non-scientific—men. It seems to suggest to them attempts to control scientific genius, to dominate scientific endeavor. They say that genius can not be organized, that scientific research must, like creative art, be left absolutely free from restraint. They ask if Galileo and Darwin and Einstein could have done greater things, or even the great things they have done, if they had been "organized." The implied answer is an emphatic No. And it may be accepted as the correct answer. But the question implies something that is not necessarily implied in the phrase "organization of science."

I know of no one in the National Research Council, nor do I believe there is any one in the new Department of Scientific and Industrial Research in England, or in the Bureau des Recherches in Paris, or in the National Research Council of Japan, who dreams of suggesting the advisability of organizing, or in any way interfering with, the individualistic work of scientific genius. What is suggested as advisable, because it was proved to be possible and highly effective in our war-time efforts, is to arrange for planned concerted attack on large scientific problems, especially such problems as require numerous cooperating workers and laboratories representing, often, not alone one special field nor even one major field or realm of science, but several such fields, as chemistry and physics, or chemistry and biology, or chemistry and physics and biology, or biology, geology and engineering, any one of which, and other, combinations, may be involved in the solution of large scientific problems affecting the national strength and welfare.

But even the isolated, individual workers may profit by the attention and encouragement and material support that may be given them by a coherent body of scientific men bringing to bear their collective influence to ameliorate the too often difficult conditions under which the isolated scientific investigator has to work, and to develop a wider appreciation, and hence public recognition and support, of scientific research.

What is the significance to the universities of this increased attention and new impetus

to research? And what is its significance to education and its methods? I suggest that this matter is so important that it requires a new and particular examination of the university and general educational situation as regards research and training for research.

The National Research Council has tried to become acquainted in some more exact degree than could be achieved by a perusal of college catalogues, or even an extended question and answer correspondence, with the present research situation in the colleges and universities of the country by means of a protracted series of personal visits by representatives of the council to some of these institutions. Up to the present one hundred and forty colleges and universities have been thus visited. This number includes enough institutions and institutions of enough variety to give us a fairly clear idea of the status of research and training for research in the colleges and universities of the land. Some day we may be inclined to publish a report or discussion of this situation as based on the information derived from these friendly visits.

But, for the moment, we may assume that we are all sufficiently informed in general of the state of our institutions of higher learning and the state of American higher education to warrant me in expressing certain opinions about the matter of research in the universities which your own knowledge will enable you to reject or confirm.

In the first place university research confronts a serious difficulty inherent in the very make-up and method of the peculiar American institution we call university. This institution *is* a university because it does university work. It isn't a university because it does much work that is not university work. To house under the same roofs, mix in the same laboratories, lecture- and class-rooms, and have sitting at the feet of the same instructors both preparatory and university students, is to produce an educational situation unique and very difficult—I should call it impossible —of successful carrying on. It is carried on, but not too successfully.

In the second place to give most of the attention, energy and money available to this curious institution to the preparatory students in it, because there are more of them than of the advanced students, is to place in secondary position the real university interest and members of this institution.

In the third place to give more attention and effort, as we really do, to the less capable, the uninterested, the non-attaining students than to the more capable, the interested and the attaining students, both in preparatory and university groups, is a menace to the highest usefulness of the institution if it is to exercise its true university function, which is the development of thinkers and leaders for the country. We may all be equal in our right to receive a common measure of service from the state but we are not all equal in our capacity to give service. The state, which is simply all of us, needs the benefit of the best use of our best brains, and to get it we must see that these best brains have the best of training.

In the fourth place to encourage the non-intellectual activities of the institution, such as its mere expansion in size, its display, its prowess in athletics, at the expense of its truly intellectual activities and achievements, is not grateful to the eyes of believers in the great need and importance to the nation of a university system of highest standard.

All these conditions, characteristic of the present American university, as I believe all you who know our universities intimately will admit, are serious difficulties in the way of the successful prosecution of research and training for research in these institutions. And this is true even when we construe research not in the narrow sense to which a growing technical and reverential use of the word tends to limit it, but in the most generous way in which it is entitled to be used, namely, simply as a going on in the quest for knowledge from that which is now known to that which is now unknown.

These conditions to which I have just referred are not only difficulties in the way of the development and achievement of research, and specific training for research, as such, but

they are difficulties in the way of the highest development of the whole intellectual atmosphere and achievement of America. The "Failure of the College" about which Professor Chapman, of Yale, writes so vigorously in a recent number of *School and Society*, is not simply the idle or sensational phrase of a sick pessimist but it is a phrase that well expresses the thoughts of almost all of us and that makes almost all of us feel sick as we face the facts. Yet we all go on; the colleges and universities all go on the usual way, as if the whole situation were out of our hands and on the lap of the gods for outcome. We act as if we were helpless; but that we should really admit that we are helpless is incredible. It is not American. It is not what we did when we faced the enormous problems of war. Do we have to have war to be capable? I am every day growing more impressed with the simplicity of war. War, which is supposed to bring complexity, brought us to simplicity and directness of thought and action; while peace, which should bring simplicity, has brought us to a perfect maze of complexity. No thing was too bold for us to attempt and achieve when we were at war. No thing seems capable of direct attack and solution now that we are at peace. But that is the sick pessimist again. And sick pessimism must not rule us. I am sure it will not. It is incredible that in this all-important matter of getting our higher education straightened out right we shall go on indefinitely acting as if we were helpless. Let the college or university that wishes to do the greatest thing just now to be done for higher education and true learning in America step forward and boldly do the unusual thing. Let it devote the most of its energies to the most important part of its work. It will soon not be alone in its doing. It will become a prophet with honor in its own land.

The National Research Council has recently interested itself in an inquiry as to what is being done to discover and encourage the students of superior capacity and attainment in the colleges and universities. One of its representatives has visited, since the first of February, about fifty institutions on this quest and for the purpose of friendly suggestion. He finds a lively appreciation of the importance of the matter, but a rather faint heart about doing anything about it.

In an interesting report recently made by this visiting representative, Professor George W. Stewart, of the University of Iowa, to the Council's Division of Educational Relations, certain impressions gained from his visits were expressed as follows:

> Although each ambitious teacher is anxious to develop leadership, yet, on the whole, when judged by distribution of time his emphasis in fact is laid on helping the mediocre in ability and the deficient in attainment. At first consideration, a teacher is inclined to deny the accuracy of this statement, but the visitor has found that after a brief discussion there results a fairly unanimous assent to its truth. The individual encouragement of the student of ability is one of the delights of the professor, but his class-room efforts are of necessity gauged for the average and the presence of the passing mark attracts his attention automatically and constantly to those of low standing. In other words, the routine demands a constant interest in others than the most able.
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> None of the colleges visited is approximating its maximum service in the encouragement of superior attainment and in the detection and development of superior ability. The methods used by any institution have been adopted fortuitously rather than as a consequence of a definite sustained study of the problem. This is to be expected since the problem is really every one's business and concerted study and action is only given spasmodically when some one member has a single proposal that can be presented to the faculty in a form for action. This is not to be regarded as indicating a criticism of the professor but rather a weakness in our system.
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> Numerous colleges are utilizing mental tests in one way and another, but, because of the time and hence money required, such an activity is not as widespread as it should be. Obviously such tests would be helpful in detecting superior ability. The inactivity of other colleges in this matter can be accounted for by the fact that no individual has the time to devote to it and the administration or the faculty is not adequately informed concerning mental tests.

This matter of the utilization of mental tests in helping to discover the students of

superior capacity and hence possibility of superior attainment, involves a wider recognition than now exists of the positive use which modern psychologists are more and more making, in their development of the applications of psychological science, of the fact that not only are there such marked differences in native intellectual capacity or ability among persons as to permit the setting up, on a basis of intelligence tests, of such categories as idiot, feebleminded, sub-normal, average normal, superior and genius, but that within the group of so-called mentally normal human beings, which includes most college students, there still exist rather large differences in intellectual capacity. We all know this to be a fact, but few of us give it sufficient attention; few of us give it sufficient importance as an aid in guiding our practical activities. Now the value of the university's product is, as Terman well says, determined as much by the original quality of the raw material with which it works as it is by salary budget, instructional methods or curriculum. In an abundantly documented recent paper, this active exponent of modern psychology reveals the high significance which an analysis of the intellectual status of the student body of a university might have as a basis for positive action by any university determined to make the best use of its available resources for the advancement of American learning. He shows the positive economy in money, time and mental energy that could be effected by certain radical changes in university administration, and the highly desirable results which would come from these changes in the way of enabling the university to fulfil its highest function in the advancement of learning both through teaching and research. And only by such fulfilment can the nation make the most of its potential mental capacity.

I seem to have wandered somewhat from the particular subject which the title of my paper indicates to be especially mine this afternoon. But all of the things I have talked about have their definite relation to research in the universities. Yet one important phase of this subject I have alluded to by no more than a fortuitous juxtaposition of words. The relation between research and teaching is a subject which alone calls for another and longer paper than all of this present one, which ought to be inflicted on you some time by somebody. This is not the time nor am I the brutal body to do it. But I can not refrain from calling your attention, in my last moment with you, to the additional evidence of the curious and abnormal character of the institution we call university in America, which is afforded by the strange and highly injurious artificial opposition that has been created between research and teaching by the customs and methods of American higher education. Research and teaching are inseparable from, and indispensable to, each other in a real university. An institution which does radically separate or oppose them is not a university, however good and useful some other thing it may be. The University of Minnesota is a university because it is an institution which recognizes the intimate relationship and coincidence of teaching and research. And we may feel assured that under its new president it will continue, and with ever-increasing effectiveness, to fulfil its genuinely university function.

VERNON KELLOGG
THE NATIONAL RESEARCH COUNCIL

THE METRIC SYSTEM IN JAPAN

THE American Metric Association has received from the Decimal Association of London a brief statement by Dr. C. E. Guillaume, director of the International Bureau of Weights and Measures, relating to the progress of the metric system in the Far East. This was written on May 23, 1921, and we have had it translated for the information of the readers of SCIENCE. We have received from official Japanese sources additional information in regard to the Japanese metric law, passed on April 11, 1921, and the program for rendering it effective.

Practically all readers of SCIENCE will be glad to know that the Britten bill, now known as H. R. 10, is being endorsed by national organizations and has a fair chance of pass-