

# SCIENCE

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## GRADUATE STUDY AND RESEARCH<sup>1</sup>

By Professor LUTHER P. EISENHART

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In order to understand the present status of graduate study and research in this country it is advisable to review the development during the years. Although in some of our institutions there were graduate study and research before 1870, in the main our students went abroad for this purpose previous to that time. The organization of the Johns Hopkins University is generally regarded as marking the beginning of a new epoch in higher education in America. The conception on which it was founded was that there should be provided in Baltimore a place where young scholars attracted from various parts of the country might carry on advanced studies, particularly with reference to the development of scholarship and research. At the beginning the group was small and the professors were chosen solely with reference to the part they might play in this plan. There was no provision for

<sup>1</sup> Founder's Day Address at Lehigh University, October 2, 1935.

advanced degrees. The subsequent institution of degrees has had fundamental bearing on the whole question under discussion.

Under the impulse to graduate study and research given by the Johns Hopkins University other institutions of the country began to make provision for them. In the main, these institutions had been concerned with collegiate education, and graduate schools as they developed became part of the same structure, like an upper story. In the past fifty years we have seen many such structures developed. Some institutions have distinguished between those who are teaching in the graduate school and those associated with the undergraduate school, but in many cases the same faculty members take part in the instruction of both groups of students. An advantage of the latter plan is that a larger group is concerned with advanced work, with the result that many of the younger members of the faculty are thus able to have their part in

it with resulting benefit to themselves and to the institution. The development of faculty personnel is an ever-present problem. If a young man is added to the staff because of his promise in scholarship as well as his ability as an undergraduate teacher, he must be given opportunity from time to time to develop his scholarship. Some of us older men find it hard to step aside in favor of younger men even on a scheme of rotation of courses.

A half century ago in the curriculum of the American college a continuing study of the classics and mathematics was considered fundamental. Following the introduction of the free elective system at Harvard and the changes in the curricula of the various colleges resulting therefrom, there grew up the conception that a college education consisted merely of a composite of credits received for courses taken, usually without any requirement that the knowledge of the content of these courses be carried beyond the semester in which a course was taken. Instead of the graduate school, by its presence on the same campus, exerting an influence in the direction of a university attitude toward undergraduate study, the college traditions were transmitted to the graduate school, with the result that graduate work in many places has been conducted along lines similar to that in the college where the question of credits rather than knowledge is paramount. We hear so often that a student has had for instance Eighteenth Century Literature or Medieval History but not that he has it now.

One frequently hears that there is no limit to the number of new courses introduced into the college curriculum, and that ordinarily courses are introduced not with reference to any well-thought-out plan of their relationship to the training of the student but because various members of the faculty desire to give particular courses. This observation frequently applies equally well to the graduate school. I question whether there is necessity for a great number of courses in any one subject provided they are organized relative to a plan and the courses are thought of as only part of the instructional system. Nor is it necessary that there be courses in every division of a subject but that whatever provision is made should be thought of in relation to what the graduate school intends its students to become. The student should acquire a certain mastery of his field, but this mastery should not be one of memory only. It is the development of his powers for further study and investigation with which the graduate school should be concerned. Whether in college or in university the idea seems to be that the institution is responsible for providing the student with a well-rounded and finished education rather than an orientation and beginning in his field for continuing study and development.

We are inclined to smile when a parent whose son has failed to qualify for the bachelor's degree says that his son has wasted four years, and yet is not that same attitude revealed with regard to graduate study, that is, should any one carry on graduate study unless he receives a degree for it? The parent feels that his son is entitled to a degree if he has spent four years in college, and one of the fundamental difficulties with graduate instruction is that the student feels that he is entitled to a degree if he has spent one or more years in advanced study. The degree of doctor of philosophy, as fundamentally conceived, should indicate that the bearer has acquired a mastery of his field of study and has shown that he has the capacity for independent research by producing a dissertation which enlarges or modifies what was previously known or presents a significant interpretation of his subject. This, however, is not the point of view frequently held. The degree is looked upon as representing the close of a certain process of advanced study rather than the sign that its bearer is prepared to start upon a scholarly career. Far too many candidates for this degree feel that it is the responsibility of those in charge of graduate instruction to see to it that they present an accumulation of material which in one way or another will be accepted as a dissertation. They feel the degree should be an award for earnestness and conscientiousness.

In my opinion the various accrediting agencies of the country, in determining whether a college should be put on the accredited list, have unconsciously had an unfortunate influence on graduate education. In determining whether a college has a suitable faculty, the conclusion is frequently given in terms of the number of Ph.D.'s and M.A.'s on the faculty. The effect of this process has been that college administrators insist that the members of their faculty have Ph.D.'s. If there is a professor of history, for example, who has been very successful as a teacher of undergraduates, but who does not have this degree, he is practically forced to get one. He proceeds to do it on the best terms possible. He attends a number of summer sessions to secure sufficient credits and then probably takes a year's leave of absence to write a dissertation on some subject ordinarily quite devoid of any relationship to his subsequent teaching. The professors in the graduate school to which he goes are expected to do all they can to have him accomplish his purpose. Thus, instead of devoting the year to a broadening and deepening of his knowledge, which would be of advantage to him in his teaching, he is merely trying to meet an artificial requirement. The presence in our graduate schools of many students who look upon the advanced degrees merely as a means of meeting such requirements, and not because they are

fundamentally interested in advanced scholarship, interferes seriously with the graduate school being an institution primarily for the development of men who are going to have an effective part in research.

A review of the careers of those who have received the degree of doctor of philosophy raises the question whether graduate study leading to this degree has as its fundamental purpose the development of men and women for a scholarly career. Recently there was an investigation by the Mathematical Association of America of those who received this degree in mathematics for a period of four or five years in the early twenties and as a result of this study the committee announced that it was a safe prediction that of those receiving this degree at present about 80 per cent. of them would never carry on any research of significance, although some may for a short time develop further the immediate subjects of their dissertations. No doubt all our journals would be overflowed if all our Ph.D.'s continued to produce articles. It has been suggested that this situation be corrected by two doctorates, one connoting knowledge and the other capacity for research. But here again we are trying to solve a problem by means of labels and not by judgment of men. It would be rash to conclude that all the 80 per cent. who have not published results of research had done their work in a perfunctory manner and did not profit by their years of advanced study. It may very well be that quite a number of them have continued to investigate, and more particularly have transmitted to their students an inquiring attitude of mind and thus are having a genuine part in the development of younger scholars.

The master's degree continues to be one of the big problems of the graduate school. There seems to be no general agreement as to what it should connote or what its purpose is. As a usual thing, it is granted for one year of study after the bachelor's degree, and the requirements for the degree generally consist merely of an accumulation of credits. There seems to be no intrinsic reason why a degree should be given for this study, but the degree has a certain commercial value, particularly with regard to those engaged in teaching in secondary schools. Some institutions look upon it as being a little doctor's degree and require a thesis. The writing of such theses may be all right, provided that they do not take too much time, but it is a question whether shorter papers in connection with seminars would not be more appropriate as a training for scholarship and research at this stage. When an institution has a large number of students presenting such theses the oversight and reading of them is likely to be very time-consuming for the faculty and not of very great value in themselves, and thus the time of the faculty is likely to be deflected from students more

worthy of their assistance and from research on their own part which would be of more value for scholarship in general. The demand for the master's degree, largely because of its commercial value, has induced many colleges of the country to introduce a year of graduate study for which the degree is given. If a student is merely interested in the degree, I have no question to raise about the wisdom of the plan, but if a student is planning to go to a university for further graduate study, I question very much whether it is advisable for him to continue for a year at his own college. He is not likely to be associated with a group of able students interested in the same field, and he may fall into bad habits of study, if his teachers are so fully occupied with undergraduate instruction as not to be able to give him the proper attention.

In pointing out the drawbacks to a fuller realization of the purposes of a graduate school, I would not desire to give the impression that a great deal has not been accomplished in this country during these fifty years. In many fields the scholars of America are on the par with those of any other country. Many of our publications, whether as articles or treatises, rate in the first class. I am delighted to feel that the time is past when we should be apologetic about our scholarship, and I regret any evidence of such an attitude. It may have been appropriate years ago for us to give special consideration and place to European professors visiting this country. But that time has passed, and such consideration as may be shown should be because of the merits of the individual and not because he is a European.

Opportunities for advanced study and research by those holding the Ph.D. degree provided either by universities or the foundations have played an important part in the advancement of American scholarship. In particular, when one reviews the research which has been conducted by the National Research Fellows in the sciences during their years as fellows and subsequently, and the positions many of these men hold to-day, there can be no question of the value of this program. The Social Science Research Council and the Council of Learned Societies have likewise disbursed their funds to advantage. Here we have well-chosen students of ability given opportunities to continue study and research for its own sake and not with reference to degrees. The Institute for Advanced Study at Princeton is the embodiment of the original conception of the Johns Hopkins but at a higher level.

I have spoken of the effect of the college upon the university, and from the new developments that are now taking place in the colleges I believe there will come a better attitude toward study in the graduate schools. Many colleges are giving up the idea that

it is their function merely to teach the students and are realizing that they have the greater responsibility of training them how to educate themselves. Too long the colleges have had the idea that its students were not capable of directed study but that everything had to be explained and given to them. We are beginning to realize that our college students have unexpected potentialities for work of high quality and independence and that what the colleges have to do is to give them a responsible part in their own education. The conception of a degree as an indication that the student has merely satisfied the requirements of a set of isolated courses is being modified. We are proceeding slowly to this new point of view and even now many a college curriculum contains a great variety of courses introduced without reference to any well-thought-out plan of their relationship to the training of the student. If to the function of teaching there is to be added that of guidance, the faculties of our colleges will need more and more teachers who have the scholarly attitude and an understanding of research. This means that a teacher will be judged not by his degrees but by what he has become in the process of qualifying for these degrees.

Undergraduates are capable of carrying on investigations of a subject and, in many cases where they are expected to do it, the students declare that it is the most interesting experience of their college career. The students must be under the guidance of men experienced in this technique. Even if the research which teachers are doing themselves is not fundamental or of great intrinsic merit, it may well be that its effect upon their attitude toward their students is of great value. Can a live teacher be keeping up in his subject without being faced with questions to be investigated and feel an irresistible urge to seek and to find?

A graduate school does not have to be big in order to be good, any more than it is good because it is small. It is not the question of a large variety of courses in any subject nor of the number of higher degrees granted. The fundamental question is what kind of scholars are produced. Education is not effected by legislation but by opportunity. Rules and restrictions limit the able and unduly encourage the mediocre. For in graduate work, as in many other human activities, "the letter killeth, but the spirit giveth life."

## HOW TO VIEW THE SCIENCE MUSEUM

By Dr. F. B. JEWETT

PRESIDENT OF THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY

THE function of the New York Museum of Science and Industry is well stated in the paragraph from the will of Mr. Henry R. Towne. Mr. Towne saw the necessity in our mechanistic world of some agency capable of imparting to those who are not scientists and engineers an insight at once into the power as well as the limitations of technology when applied to the peaceful arts. The dynamic museum featuring both the history and the present status of science and industry seems clearly indicated as that agency.

Such museums are newest in the family of institutions devoted to display. That they are late comers is not because men have only recently had the wit to create them. It is because until recently science, both fundamental and applied, has not provided us with a sufficient panorama to make such a display especially significant. So long as the things of science and particularly those which entered into our daily lives were few and largely unrelated, it would have been difficult, if not impossible, to use them as exhibits in a museum of technology should be used. There would have been too many gaps to make the road plain to any except the expert.

However, because of the tremendous acceleration of scientific research during the past fifty years and the

flood of new applications of science which has poured in on us in consequence, we have come recently to recognize that a great revolution is occurring. We find ourselves in a world where many of our most powerful tools are tools with which man has had little or no real experience. True, we know how to use them in a material sense, but as to their ultimate effect on our tribal affairs we are still quite in the dark. We have tried vainly to control them by consulting the experience bequeathed to us by the fathers and we have found that they would not be controlled by the wisdom of that experience alone. They were part and parcel of a new order which demanded a broader understanding on our part.

Fortunately for us, as new things have multiplied and new difficulties have arisen, it has become apparent that these revolutionary things of science in whatever field they may touch our lives are all branches of a common trunk and that if we would control the branches we must know something of the trunk. It is always easiest to reason accurately from the particular to the general. The mass of us must come to have some knowledge of certain fundamentals of science and the scientific relationships which control much of the world we live in, if as a group we are to