

his education is still incomplete, but he brings with him an ordered mind which makes easier his own path and that of his superiors, for he is quick to grasp essentials and to reach results. He outstrips his less favored brother who lacks the training and discipline of the college or university; and the fact that occasionally there are to be met splendid examples of practical intelligence and energy whose training has been obtained in the world's hard school of experience and not within academic walls does not in the least lessen the force of the contention in favor of the college-trained man's availability.

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CONCERNING BOTANICAL INVESTIGATION IN COLLEGES

DURING the last two or three years several articles have appeared in *SCIENCE* which have had to do wholly or in part with scientific investigation in colleges. As a college teacher the writer has read these with interest. He is just entering upon his twentieth year as a college teacher and has, during two decades of experience with college students, reached certain conclusions concerning this subject, especially in so far as it relates to his own subject—botany. It is not believed that botanical science differs greatly from other sciences with respect to investigation, but it has seemed best to the writer to confine his statements to the science which he is teaching.

Every teacher of botany should be an investigator. The spirit of investigation, which appears in the normal person in early childhood, should never be stifled in one who is to teach botany or who is teaching that science. When the teacher of botany ceases to be an investigator he should retire. His investigation should extend at least to the plant life about him and to the literature directly or indirectly relating to his teaching. Some botanists fear that this spirit of investigation will, if carried further, interfere with teaching in college. The writer pleads guilty of seeing 100,000 titles in a single year in search of matter that might aid in his teaching and in the advancement of botanical science, recording some titles for future use, and examining others minutely. At the same time he was carrying forward some laboratory in-

vestigation; and he was conscious every time he came back to the classroom from his private laboratory or from the library that he was better fitted for his work and had a keener relish for it. For some teachers investigation is as much a tonic as is a pleasure trip or the round of social enjoyment for others.

Whether the teacher's investigation should extend far beyond the field of his teaching is a question for each one to consider for himself. Certainly the college teacher of botany may well include in his investigation many things which will probably never be used in the classroom, but which round out his knowledge of his subject, make him a better teacher, and may be drawn upon if needed. But his investigation should be secondary to his teaching and should be closely enough connected with it, at least in its initial stages, so that some of the facts ascertained may bear directly on the teaching. But if he be an investigator in the best sense, he will eventually push his investigation to the limits of human knowledge in some direction. His investigation now becomes real research. The question now is whether he shall continue or stop. He certainly should do the latter if he does not regard his research of considerable human interest and if his enthusiasm for such isolated investigation does not make it a pleasure rather than a burden for part of his spare hours. If he has this faith in the value of his work and his enthusiasm inspires him to continue, the institution for which he works can afford to lighten his burden somewhat, if possible, for the benefit that such example will have on other teachers and on students in encouraging them to scholarly attainment. Some kinds of research can be carried forward on two or three hours' work each day; and the teacher can easily learn to drop his research and go to his students refreshed and the more ready to work with them because of the keen mental gymnastics connected with his own laborious study, the teaching by its different and disconnected nature seeming like a diversion. The man of strong body and active mind can carry the in-

vestigation forward and still keep abreast his profession as a teacher.

The teaching being of prime importance, the college teacher's botanical investigation should never be required to be done at a given time, and he should be free to drop it for a day, a week or a month whenever his teaching requires all of his time. Teaching is an aid to research, and research is an aid to teaching; and there are lines of research that touch college teaching as well as university teaching. The university teacher may make research his main work; the college teacher should never. No college teacher should be chosen or retained mainly on account of his ability as an investigator, but encouraging a college teacher in a limited amount of research is a different matter. No science stimulates to investigation and research more than botany, and the college teacher of this science who is not an investigator is scarcely worthy of the profession.

But what of botanical investigation by the college student? No college student should be thrown on his own resources in investigation to the exclusion of regular instruction after two or three years of botanical study. The student is too narrow at this time and will remain so if he begins to give much of his time to investigation. But the writer believes that some young people should begin specialization in the late teens and that in rare instances a part of this specialization may well be investigation, even for the undergraduate student. And why not? We often start the child at music as early as five or six years, but we too commonly attempt to thwart the desire of the youth for investigation until the last bit of enthusiasm and initiative is crushed. Some would smother it in the brightest and best prepared undergraduate and expect it to burst into a living flame soon after the student reaches the university. The rare undergraduate who has the desire, ability and time for investigation of some definite botanical problem and who has a teacher who can not or will not encourage and direct him is unfortunate. It is a misfortune that some college teachers of botany are not investiga-

tors and can not direct such students. On the other hand, it is fortunate for the college teacher that very few of the students in our classes are ready to attempt special problems.

Even after many years of experience, the writer does not think that he should attempt to direct more than two or three of his students in special investigation at one time. These he tries to select early in the courses in botany and to suggest something to them which may be carried along for a time with their regular work and take more of their time as they advance, the investigation sometimes being finished under his direction after they have graduated. Every advanced student of botany might well be expected to do seminar work, but few teachers can find time to direct all advanced students properly even in this. The writer has a senior college student who has been working on a special problem for two years and who spent the whole of last summer in laboratory investigation and library work, in matter related to this problem and others similar to it, without credit on his course. This student has gone through about 40,000 titles in search of literature pertaining to this work and is aiding his teacher in perfecting his lectures on the subject, and in putting them together in systematic fashion. The student is by no means narrow in his botanical training, nor is he regarded narrow as a college student.

Independence and originality should be encouraged, and why should we discourage the exceptional student when he reaches the point where he wants to attempt some independent work? The effort may or may not result in something worth publishing, and if published, it should not be tabooed because done by an undergraduate student. Some of the best research is done by those who have had no college or university work. So far as they go, the results obtained by undergraduates are sometimes equal to those of graduate students who undertake more difficult problems. Like the teacher's research, the student's investigation should center about some problem related to his undergraduate courses and his proposed life work. There are many

problems of this kind. Some of them are work on some portion of a local or a state flora, investigation of some plant disease, the study of the woodlots of a small area adjacent to the college, the working out of keys for the identification of certain fungi or other plants of the region, the investigation of botanical instruction in high schools or colleges, studies in laboratory administration, etc. These and many other problems may well be attempted by the exceptional undergraduate, provided his teacher has sufficient insight and enthusiasm to aid him when he needs help.

Lest the drift of the argument above may have obscured the writer's views somewhat, it needs to be repeated in closing that the investigation of the undergraduate should never exclude thorough and broad botanical training, nor should it replace a knowledge of the elements of many subjects in the college curriculum. Hence it must be confined to the rare student, who is especially fitted and has time for this work and the more important general work which will give him a broad mental training.

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*THE "KAISER-WILHELM INSTITUT FÜR
PHYSIKALISCHE CHEMIE UND
ELEKTROCHEMIE"*

ON October 1 Professor F. Haber will begin his work as director of the new Kaiser-Wilhelm Institut für physikalische Chemie und Elektrochemie at Dahlem near Berlin. The buildings of the Institut, work upon which was begun during the present summer, are being erected by the Prussian government working in conjunction with the "Koppel-Stiftung" for the purpose of improving the intellectual relations of Germany with other lands."

The "Koppel-Stiftung" which was founded in Berlin some years ago by Geheimer Kommerzienrat Leopold Koppel, and which until now has maintained the German School of Medicine in Shanghai and the American Institute in Berlin, will provide the funds for