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THE COLLEGE TEACHER AND RESEARCH[1]

IT is a part of the function of every progressive institution of learning, not only to impart knowledge to students, but to do its share in accumulating knowledge for the benefit of mankind. To this end, scientific research in some form is indispensable to the best attainment of a college.

It is far from my thought to place the importance of research on as high a plane as that of training character, but it is hoped that there may appear some elements in common to the two, and no lack of consistency between them.

It can hardly be doubted that there is such a thing as a research instinct. A small boy exhibits it when he picks to pieces a dead fly, or tries to make ink out of mud, or puts a firecracker in a glass bottle to see what will happen. Curiosity is an inseparable ingredient of the human make-up, and research is curiosity directed by a noble purpose and put to a noble service. There is something about the acquiring of first-hand knowledge that stimulates individuality and gives a sense of personal achievement. And with a person whose life and activities are chiefly intellectual, the exercise of this instinct is as essential to his progress as eating is to his physical welfare.

One of the sad privations in the life of a foreign missionary is said to lie in the fact that he is constantly giving out to those about him, without having the spiritual refreshment that would be afforded by association with kindred minds. He is constantly teaching religion to ignorant, undeveloped people, and longs for someone who will understand and sympathize with his point of view. Too often, the teacher of science in the small

[1] Address given before the physics luncheon at the Iowa Academy of Science, April 23, 1920.

college is an isolated missionary among barbarians who know not even his language, and who can give little inspiration to his particular work. And as the foreign missionary must refresh himself first-hand at the source of all spirituality, so ought the college scientist to get his needed inspiration by digging into Nature's secrets and striking for himself the fountains of scientific truth.

Too much can hardly be said by way of caution to college professors against growing "stale." Shut out from the intellectual communion which they crave by their virtual isolation from their own particular species (except at long intervals on such happy occasions as this); oppressed by a monotonous routine of hearing recitations, conducting quizzes, correcting papers and notebooks and attending faculty meetings; and oft-times discouraged by a lack of all evidence of appreciation, at least as expressed by any adequate compensation or equipment: what wonder is it that these men are prone to fall into the commonplace, to vegetate, as it were, and fail even to keep pace with the progress in their own fields? There is only one remedy. It is *action*. And research is action that extends to the very roots of the scientist's being (if, indeed, he be a true scientist at all), and regenerates his whole professional attitude.

There are, furthermore, certain very practical advantages to be gained from a reasonable activity in research. One can not engage in such work without becoming tolerably familiar with the field in which it lies, and with the subjects associated with it. It furnishes an incentive to more thorough study on the part of the teacher himself, and gives a mastery and a self-confidence in teaching, along these particular lines at least, that could hardly be gained otherwise. The professor of physics, for example, who has worked out some little line of inquiry connected with radio-activity, even though it be with the aid of a home-made electroscope housed in a tin can, and utilize no more expensive radio-active preparation than a cast-off Wellsbach mantle, has had first-hand experience with the obstinacy of electroscopes and the practical difficulties of radioactive experiments generally that will give him the feeling of knowing what he is talking about when it comes to teaching that part of his subject. The same circumstance gives the teacher the more complete confidence of his students and colleagues, who justly feel that a man who is making original contributions to his science is one who can be trusted to teach it with some authority. Nor is this feeling confined to the individual: it reflects credit upon the college and gives it character among scholastic institutions in such proportion as its researches are published and become known to the intellectual public.

There is also a still more direct benefit to the college whose professors are engaged in productive research in the laboratories of their own departments. Students like to see things. However reassuring may be the knowledge that their teachers have formerly studied and done research in some university or other, there is nothing so stimulating to their immediate interest as the opportunity to see research actually going on, to see new truth actually coming to light. The botanist who can beckon to his students to the microscope and say that here is a form of life never before described, or the geologist who can take his class to a rock exposure that disproves some prevalent theory of local geology, excites at once the interest and confidence of his pupils. No text-book statement is half so convincing. And the college student takes a measure of pride, and experiences a sort of awe, in the presence of what seems to him to be genius.

Can any one deny that the students in our hundreds of small colleges have as good a right to such advantages as the students of the few large universities of the land?

Now there seems to be an unfortunate impression among scientific people that research is practicable only with the elaborate equipment and in the surcharged atmosphere of the great university graduate school. It must be admitted that there are many research problems of which this is in a measure true. But research, like music, has its rôles, of which the minor ones have their own

peculiar importance and offer their own peculiar opportunities. If every musician aspired to play the pipe organ or to conduct a fifty-piece orchestra, it would indeed be an expensive and ambitious undertaking to become a musician. But some of the finest music is produced on the simplest instruments, or by the unaided voice; and it should be remembered likewise that successful research depends more upon the industry and personality of the man who engages in it than upon the apparatus which he may have at his disposal.

If college men are not recognized as research workers, it is because they do not produce; and if they do not produce, it is because they do not have it in them to do so, or else it is because they do not try.

The institution represented by the writer is not wealthy, but it is illustrative that, out of a dozen or more pieces of research in physics undertaken within as many years, only two have called upon any assistance whatever in the way of equipment from outside sources. Right-minded college authorities (and there are such) are not averse to making some reasonable provision for research work. I have observed that presidents and trustees gauge their appropriations largely by the confidence which they have in the man asking for equipment, in the wisdom and economy of his selections, in the uses to which he is likely to put the material purchased, and in the care which he is likely to take of it; and if they know that he will take every precaution to save the institution unwarranted expense, that fact will go a long way toward liberalizing their policy. Problems can be selected that depend upon diligence, care and skill, rather than upon elaborate apparatus.

A most encouraging circumstance also is the fact that there are great research agencies which have expressed themselves as only too glad to lend a hand in any worth-while problem that the college man may wish to enter upon. This is true of the great universities themselves; it is true of the National Research Council. To test this point, let any competent college scientist who genuinely wishes to do research work, but who lacks certain essential items of equipment, confer with the head of the appropriate department in this or any other graduate university, or make known his needs to the National Research Council at Washington, and discover how readily these institutions will give him, not only their material cooperation, but the best of their wisdom as well, in the problem to which he is addressing himself. The Research Council has even gone so far as to initiate a sort of bureau of exchange of research apparatus for the assistance of workers in just such cases. And the writer finds it difficult to express his appreciation of the ready liberality, and evidence of confidence, with which his own *alma mater* has supplied the somewhat heavy demands that some of his more recent work has made upon her resources.

A common plea among non-productive scientists is that they do not have time. That excuse is threadbare and in tatters. Men have time for what ever is worth while in the exercise of their powers. The amount of work a man can accomplish depends upon his determination and upon how well he has learned to systematize his day or his week. I am convinced that no college man, or university man either, can make real progress in research without setting apart a definite portion of his program for that exclusive purpose, and then sticking to it even to the extent of locking his doors, if necessary, against interruption while he is so engaged.

It often happens, however, that the worst intruder is one's own temptation to depart from his schedule. The research period arrives. There is a pile of test papers on his desk to be corrected, or a pile of ashes in his cellar to be carried out. Why not let the research go this week? After all, the research is only a side-issue. To minimize this, the writer has several times adopted the expedient of getting one or two college students to register for "advanced laboratory work" along the line of his own research, the laboratory period coming at regular scheduled

hours, and making it obligatory for the teacher to be on hand and to decline other engagements, which might otherwise be given precedence.

Such an arrangement adds zest to the work, in that it creates the atmosphere of mutual understanding and interest so much prized in the graduate school, and clarifies the teacher's own thinking as he explains the details to the students. It may afford, moreover, some little positive assistance, for there may well be parts of the routine experimental work or calculations that students can become skilful enough to perform with entire satisfaction. Several years ago, for example, I had on hand a piece of work in which an important part of the procedure was the repeated performance of very accurate weighings. I trained four students, at various times, in the theory of the balance and the practise of precise weighing, and while I prepared specimens, the students weighed them with as much skill and care as I myself could have done it. By no means the least benefit of this plan is its effect upon the student. No better training in perseverance and accuracy, no greater incentive to advanced study, no clearer insight into the real spirit of research, could be afforded the young learner than by this means. The realization that he is actually contributing to the sum of human knowledge is, to his developing nature, exhiliarating in the extreme. And best of all, no greater opportunity could be offered the teacher for that personal touch and influence which is the sacred privilege of the teacher's profession.

The research worker should make his work known. It is a most helpful thing to crystallize one's ideas from time to time in the form of connected statement, or better still, to keep a continuous written account of his procedure, his difficulties, and his results. To this end, he will find it of advantage to identify himself, by correspondence at least, with some not too distant university seminar, and contribute to its programs at suitable intervals in the form of research reports; to participate actively in the work of scientific organizations such as the Academy of Science, the American Physical Society, etc.; and to prepare his communications in suitable form for printing, at least in abstract. Another helpful feature is found in having a local scientific club, similar to the Baconian Club of this university or the Kelvin Society of Coe College, where people of somewhat kindred interest may get together and exchange experiences and catch something of one another's vision. In these ways the research worker gains the benefit of friendly encouragement and equally friendly criticism, and often has cause to appreciate the maxim that "two heads are better than one."

Above all, let us realize that we are never too old to learn, and that the most dangerous thing a teacher or a scientific man can do is to cease studying. Let the college scientist read books on new phases of his subject as they come out, even if he does not follow every technical detail, and even if he is obliged to borrow them from some university library for the purpose. Let him keep a classified card index of all the periodical literature available on his subject, noting especially articles that may suggest lines of investigation of particular interest to himself. Let him think beyond the daily topics of the classroom, let him mingle with practical men and get the bearing of his science on the affairs of the world. And what is most important, let him keep in touch with others of his calling, through visits and correspondence, so that in every possible way he may be open to the inspiration which comes with the pursuit of truth. For it is in these ways that the man who contributes to the welfare of mankind through scientific research lays his heavy foundations.

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WAXY MAIZE FROM UPPER BURMA

A variety of maize introduced from Shanghai, China, in 1908, was found to have seeds with a new type of endosperm. In the seeds of this variety the texture of the starchy tissue is unlike that of any variety previously known. This new type of endosperm has been called waxy. Although distinct from other types, waxy endosperm is by no means