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MARK HOPKINS AND THE MODERN LOG

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President Garfield once said that his idea of a college was Mark Hopkins on one end of a log and a student on the other. I do not know all that President Garfield had in mind when he made this often quoted statement but the complement presents the picture of a superior teacher, a person of scholarship, able to inform, direct, and inspire his pupil. The personality of such a teacher is characterized by charm, by enthusiasm for learning, by intuitive and intelligent skill in dealing with human beings. His special ability is to use knowledge to create interest, to make the hard task seem easy, and to use his understanding of people to bring about advantageous changes in character. The personifications of this ideal have built schools, departments of learning, and whole professions. The testimonials of their efficiency lie among traceable groups of professional men and in valued memories of untraceable individuals. There are not many who have represented this ideal, but wherever they have lived their influence has acted as a permanent leaven in the lives they have t o u c h e d, strengthened ambitions, and raised standards of achievement. The sphere of their influence has been over the nation and into new generations of students, but the center of that influence has been in the laboratory and classroom.

According to a recent bulletin from Mt. Holyoke College, Mark Hopkins had a brother who was a chemist, and he needed more than a log; he needed a laboratory. With the great teachers of the sciences, these workshops were places where the teacher himself progressed in the pursuit of knowledge, and the students knew, by precept and example, the momentum of the search for new truth and enthusiasm in its discovery. Fortunately for many of us there have been teachers—of less fame than Mark Hopkins, Agassii, Jordon, and Bessey—who have exerted these same influences in colleges and secondary schools. We can look back and say of some important directive force in our lives that it was the work of such a teacher; and our gratitude has been as fervent as it was often late in recognition.

Is it not for these qualities of leadership in the world of thought that the professional training of teachers is aiming, especially in the fields of the sciences where the goal is to influence habits of thinking and where the laboratory provides the "log" for informal and direct leadership, the ideal that emphasizes an independent but personal relationship? The creative result of that relationship must be the accepted ideal of those interested professionally in improving science teaching. Much has been written about what science teachers do not know, what combinations of courses they are teaching, what the organization of the courses they teach should be, what their objectives should be, what adults read (or have a chance to read) in the daily papers, what the "practical aspects" of science are that may improve man's physical condition and

give the tax-payer value received for the money spent for the teaching of the sciences. In the literature of science teaching there is apparent approval of the unification of subject matter as the correct principle of organization through the entire school system. In all of these objective and subjective philosophies there is almost nothing that emphasizes the particular requisites of science as a distinctive method of learning with a distinctive educational value resulting from that method.

Not stopping to discuss personal qualities, or the manual and visual skills needed in handling materials for classroom studies, what are the tools of the teachers of the sciences? The questions said to be asked in order of their incidence as the mind develops are: what is it, how does it work, and why does it do it? What, how, why—these are the grist to the mill of teaching; and in exactly that order the teachers of the sciences need certain bodies of knowledge from the various divisions of each of the fundamental sciences.

To answer the question, "What is it?" in the biological sciences, the teacher must know the main groups of plants and of animals, the names of individual kinds, and the characteristics by which they are identified at a glance. He finds it advantageous to know how the names came to be given and something of interest about the specimen, and particularly how to find out these facts if he does not know them. To achieve the ability to answer this one kind of question, about plants alone, he must have studied the taxonomy and gross morphology of the main groups, he must have practiced the use of keys and field identification until by patience and effort he has gained some degree of speed and sureness, and also has some idea of the value and usability of this type of information. To comprehend the time-cost of such ability it must be remembered that ferns, flowers, woody plants, birds, insects, fish and other aquatic life, each have separate techniques and vocabularies.

The fact that no one knows all this range of information does not invalidate the necessity of a fund of learning to answer just this one kind of question. It is this kind of knowledge that enables a teacher to make a walk through a well-known field a revealing experience to his students. Is it because the recognition of plants, animals, and rocks by name, is a dull or "impractical" kind of knowledge that such teaching has been left to Scout organizations, National Park naturalists talking to tourists, and other vacation activities?

The answers to the questions "how" and "why" are more commonly thought of in connection with science training. To answer questions concerning stages of events and their causes in studies in the biological sciences, the teacher must know the activities of plants and animals in specific relation to the structures concerned, and the processes in relation to the anatomy taking part in each process. Any disjunction of process and place of occurence prevents the formation of clear mental concepts that are the basis of usable knowledge. "Why" questions are often answered correctly by "I do not know," which may be the only intelligent and honest answer, but too often the lack of an answer is disguised by just words that seem to be an answer to the thoughtless, as in saying that plants grow toward the light because they need light. To provide real answers for this type of question requires experimental experiences in the laboratory and in the field. Causes and results of natural phenomena can only be explained to students by discipline in

both the fundamental and applied sciences for all natural phenomena involve a series of physical, chemical, and physiological changes.

Among the thoughtful leaders of professional teaching there is no tendency to minimize the necessity for a large amount of factual knowledge for the teacher, but there are those who favor (without objective evidence as to value) the generalized type of course to such a degree that the result is to reduce the amount of factual learning below a desirable minimum. This tendency has been partly a result of just criticism of the old "type" course in which the facts learned often had no connection with the daily phenomena of living. One of my friends told me that students in one of our universities were half through a semester course in botany before they realized they were studying plants.

The tendency toward generalized courses has also resulted from the discernment of the interdependence of one branch of science on knowledge from another. But whatever the cause of this move toward generalized courses involving more than one field of science, it has resulted in a philosophy of man's-interest-the-center-of-v a l u e in education; and as it has over-reached legitimate aims it has in turn divorced science and science teaching and placed real obstacles, I believe, in the way of achieving superior teaching in the sciences.

Mark Hopkins could get along with a log and his brother needed a laboratory, but the modern Hopkins needs much more than these things connote to the average mind.

Of first importance is the training of the individual teacher. This not only includes his training in a science and the related sciences but his training in how to organize and present the material to his classes. We have criticised the teachers colleges and colleges of education very severely on their over-emphasis on method of presenting material to classes, and they in turn have criticized the college and university science teachers for their laxity in trying to improve their methods of teaching. It is unfortunate that the professors of education have had so much to say without enough factual information and it is equally unfortunate that the teachers of the sciences have for the most part continued as they were taught and have not consistently tried to improve their teaching. There is an increasing number of science teachers who are attempting to conduct research in their teaching rather than to continue to wishfully think they are doing a good job of teaching. If you wish to see how bad some of the science courses are, just ask for the final examinations to see how little some teachers expect the students to know at the end of a semester's or quarter's work. Research in teaching is equally important with research in isotopes and human physiology, provided the person conducting the research is well trained in the fundamental sciences.

We have criticized the survey or generalized courses that cover more than one field of science, and I believe justly so. The state high school visitors office has said that the poorest planned and poorest taught courses in the curriculum of our high schools are the so-called general science and biology as they are most commonly planned and taught. It is worthy of note that the University of Chicago and the Ohio State University both found that their students (in general botany at Ohio State and in the first year of biological science at the University of Chicago) who did the best work did not have biology in high school, and those who had biology in high school did less well. My colleague and I

found that the students who had courses in botany and zoology in high school were most likely to do well in college botany and college zoology, and that many of those who had the high school biology were low in achievement.

Another "sliver" that needs to be examined on the Hopkins log is the time honored plan of college courses that have lectures given by one teacher, the laboratory conducted by other teachers or graduate students who are more interested in an advanced degree than anything else, and a so-called quiz section often conducted by a third person. Students have long criticised science courses conducted in this lecture-laboratory-quiz plan, but the staffs of our colleges have for an equally long time ignored these criticisms. This is one of the places where, I believe, the professors of education have been justified in criticising the beginning science courses. There is accumulating evidence that the laboratory-discussion method of teaching a science is superior to any method yet devised. A number of colleges and universities are now working with this plan of presenting a science with much success. The laboratory-discussion method of teaching science begins with the laboratory as the source of information for the student, and has some aspects of real research for these beginning students. The textbook becomes a reference book and not the source of information. One teacher conducts the class throughout the term so that the students feel that the work is organized and presented in a definite sequence that is conducive to learning. This is commonly lacking in the lecture-laboratory-quiz method if the statements of several generations of students are to be believed.

Another sliver that almost amounts to a plank on the Hopkins log is the teaching load and overload of the high school teachers who are sending their students to us in the colleges. A study made by E. F. Potthoff of the University of Illinois has shown that in this state "3,490 teachers were teaching a total of 716 different teaching combinations of subjects. The average number of teachers per combination therefore was slightly less than 5, . . . and 96 per cent were taught by not more than twenty teachers. . . . More than three-fourths of the total number of combinations consisted of three or more subjects. The general picture presented by these results is that conditions with respect to subject combinations are chaotic." This is not peculiar to Illinois.

This situation can be corrected, and the responsibility in Illinois rests with the Office of the State Superintendent of Public Instruction and the College of Education and the office of the High School Inspector of the University of Illinois. The State Teachers Colleges have to date been followers and not leaders in maintaining the accrediting standards for our high schools. The bulletin of the University of Illnois entitled "The Recognition and Accrediting of Illinois Secondary Schools" was compiled by the University and the Office of the State Superintendent of Public Instruction in 1940. This was a real improvement over the previous standards but it has not been rewritten since that time.

There are criteria given for the minimum, medium, and superior preparation of teachers in all subjects. The minimum preparation for teaching botany or zoology is 8 semester hours. But if biology is taught the teacher only needs 5 hours of botany and 5 hours of zoology and 6 semester hours in some other courses in the biological sciences. In other words the high

school teacher needs less preparation in subject matter to teach a course of study that includes all of the biological sciences than to teach any division of the sciences in that group.

The physical sciences are evidently more difficult than the biological sciences, for according to the 1940 bulletin to teach chemistry or physics the teacher must have 10 semester hours in each and should have a minor in mathematics. If astronomy is taught in the high school that is not so difficult for only 5 hours of college preparation is required if the teacher has 16 semester hours credit in the physical sciences.

General science is expected to include physics, chemistry, botany, zoology, physiology, physiography or geology and astronomy and lately meteorology but the teacher can teach general science if he has to his credit 6 to 10 semester hours in the biological sciences and 6 to 10 semester hours in the physical sciences. It apparently makes little difference as to what courses are included.

But to teach speech in Illinois high schools the teacher must have 16 hours of college credit in courses in speech, exclusive of the required courses in oral and written English that are a part of the first year's work in college.

Since our high schools have 716 different teaching combinations and since the minimum accrediting standards for science teacher preparation in this state are so low, is it any wonder that many of our college and university graduates try to qualify for certificates in as many teaching combinations as possible? As a result they are often well prepared in only one subject and sometimes not well prepared to do superior teaching in that subject.

One remedy for the poor teaching that exists in our public schools is to simplify teaching combinations, to increase accrediting standards for teacher preparation, and to give the teachers time for preparation of laboratory materials so necessary for good science teaching.

The Illinois State Academy of Science through the committee on the Teaching of the Sciences has recommended to the Office of the State Superintendent of Public Instruction and to the Office of the High School Visitor of the University of Illinois that the following criteria be made a part of the accrediting standards for the teachers in the schools of Illinois.

1. We have recommended that no teacher of any subject be permitted to teach without a minimum of 16 semester hours in that subject, and that if combination subjects be permitted the teacher must have 16 semester hours in each subject of the combination. For example if physical science is taught the teacher must have 16 semester hours work in chemistry and the same in physics; if biology is taught as a combination course the teacher must have 16 semester hours of botany and 16 semester hours of zoology. It is of course expected that the hours of credit must be in courses of study that can furnish the material for high school classes.

2. If general science continues to be permitted it is recommended that the teacher must have a year's work in at least three of the subjects included in general science as it is now taught and a minor (16 semester hours) in one of the three. Personally, I believe general science should be dropped from high school curricula.

It is obvious that the log of Mark Hopkins is no longer adequate for the equipment necessary for the work of either college or high school, at least in the sciences. The teacher and his preparation is of first im-

portance, the plan or method of teaching and the laboratory equipment are probably equally important if our students are to have a square deal.

If the colleges and universities can obtain objective evidence and use that as well as the best subjective evidence for the training of science teachers, the work in our high schools will improve and as a result we will have better trained students than we now have in our first year college classes. To arrive at this improvement we as college teachers must obtain satisfactory objective evidence that our college courses are well planned and well administered.

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