quantitative experiments, possibly some species work and the microscope should be introduced.

In the university academic and especially in university sociologic courses the most intricate problems of interrelations of bacteria to each other as illustrating similar interrelations in human life might be conducted. Of course all this presupposes a bacteriological training of the teachers of the public and high schools.

For the present, the education of the mothers of the present might be attained, as suggested by Dr. Norman MacL. Harris, through lectures and simple "courses" given before mothers, in connection with settlement work or in the mothers' meetings sometimes held in connection with the graded schools: women's clubs might secure teachers ready to give short courses in elementary laboratory work. Perhaps "correspondence courses" in the great journals devoted to women might, under proper supervision, stimulate many mothers to do a little elementary bacteriology at home. However done, it is the writer's belief that until such teaching is done—and done by methods involving not merely lectures or demonstrations but personal experiments by the mothers (present and prospective) themselves, the methods of personal defense against infection will never so take their proper place as to be real factors in the suppression of disease. Only when the "cleanliness" of fresh collars and cuffs and nicely brushed hair, etc., has added to it the real cleanliness of hands free from the discharges of the toilet room will personal cleanliness mean anything in relation to infection.

H. W. Hill

Minnesota State Board of Health Laboratories

TEACHING BY THE LECTURE SYSTEM

At an open meeting held a short time ago by the Case School chapter of the society of Sigma Xi, for the discussion of subjects of special interest to the members of the instructing staff at the Case School of Applied Science the lecture system was discussed. The different ideas presented seemed to suggest that a paper on this subject might be of some interest and possible benefit. I shall not discuss the efficiency of the lecture system as compared with other systems of teaching a science, since there can be little doubt but that under existing conditions this method if properly carried out is by far the best one for most sciences; but I shall treat of the various means of carrying it out and try to indicate those which seem best suited to attain the highest efficiency.

It is not the purpose of this paper to give in detail a full treatment of the different points to be considered in presenting a science course by the lecture system, but rather to collect a few facts and ideas which may, in this way, come to some who possibly have not been placed in an environment which would demonstrate the importance of the matter, and who have therefore not put as much thought on this particular question as efficient teaching would demand. A science should be presented in such a manner as will make its particular group of natural phenomena understood with the least possible expenditure of mental exertion and time on the part of the student. The presenting of a science in this manner should be the aim of the science teacher. Further, the teacher should strive so to correlate facts and suggestion that the phenomena and their explanation should be the most easily remembered.

In most of our schools, existing conditions make the lecture system by far the best for presenting a science to a class of students. This fact is more especially true in a largely experimental science, such as in chemistry or in physics. As the teaching of chemistry has been the vocation of the writer, what follows will probably apply more to the teaching of chemistry than to the teaching of any other science. The question then resolves itself into: what is the best method for conducting a lecture course so that its qualities shall be clearness, comprehensiveness, individual completeness and individual broadness? It is not alone sufficient to give a man knowledge. The subject must be presented to him in such a manner as to interest him sufficiently to make

him exert himself to learn it. Care must also be taken to show him where he can find the more detailed information. It does not suffice to teach any subject from one point of view. The failure to present a subject broadly turns out narrow men. It is broad men the world demands and these are moulded by viewing a subject from as many different standpoints as possible. For the broadest diffusion of knowledge, men of different years should be given somewhat different standpoints and shown where to find their knowledge somewhat differently. A hard-worn path should not be followed. A lecturer who writes a set of notes which he intends to follow year after year, without revision, soon finds that his intention was unsound. A lecture on almost any portion of a fast-growing science like chemistry needs more or less revision every time it is given.

Since, therefore, the straight lecture course with no reference books, text-books or mimeograph notes gives the student but one point of view, that of the lecturer, such a course is to be censured in all cases where it is possible to give it otherwise. There may be two classes of teachers who might use this method where it is not necessary: those who have had a limited experience and who are fearful that they might, for the time being, forget some of the details which the students might wish to discuss; and those who are omniscient. The first class will soon realize the fact that no man can have everything at his tongue's end, but that a teacher must be familiar in considerable detail with the subject he is teaching if he is to be at all successful.

The lecture course with mimeograph notes by the professor may be permissible in three cases: where there is no suitable text-book or reference book, where such a book is so expensive that the teacher does not feel justified in requiring the students to buy it, or where certain directions for laboratory use are, for special reasons, to be taken from the larger reference books or from the more recent literature. The dictation of such directions is perhaps allowable in a very few cases, but not for any extended course. The dictation of a complete course of laboratory directions is little less than a waste of time both for the students and for the teacher.

When we consider carefully the lecture course accompanied by a suitable text-book or reference book, by frequent recitations or conferences, and by occasional written exercises, we shall probably find the most efficient method, at least for all experimental sciences. Let us here distinguish between text-books and reference books. A true text-book should be brief and to the point, as supposedly it is to be gone over page by page. At present, however, there are a number of so-called text-books which are so much padded and cover so much ground in detail that they are entirely unsuited for this purpose. There seems to be a tendency to use such large books as text-books, with the false idea that a better course can be given, whereas in reality the student is so confused that his course becomes a chaos of facts and directions. This of course applies more especially to beginners. What can be more absurd than the placing of books like Frezenius's "Qualitative Analysis" or "Quantitative Analysis" in the hands of beginners in these subjects? The most efficient text-books for these courses comprise few and very definite directions, with explanatory notes. In an advanced course, when the student has been fairly launched in the subject, a more complete book may be used, which is not to be considered as a text-book, but more as a reference book from which suitable exercises may be selected.

The lecture itself can not do all the teaching. It should, however, lead, interest and inspire the student. The subject matter should be covered as completely as the time will allow, but not so rapidly that the average student can not grasp it readily. In order that the student should get the most out of a lecture he should be required to read carefully the corresponding pages in the accompanying reference book before the lecture takes place. The references of the pages to be covered at each lecture should be given at the previous lecture. The student should by all means study these pages in conjunction with his notes the same day the lecture is given. and more diligently the parts which were empha-

sized in the lecture. To interest the student as well as to insure greater clearness, as many typical experiments as possible should be carried out on the lecture table if the course is a complete one. If the course is only a preliminary one these experiments may be wholly or partially omitted. The manner of presenting the experiments has a large influence in communicating inspiration to the students as well as does the personality of the lecturer. To have this inspiring effect in the highest degree the lecturer must above all use good English and so choose his words that the least possible effort on the part of the student is required to comprehend the subject. The experiments must go smoothly. No muddy, half-way experiments should have a place on the lecture table. The man who has the reputation of never having an experiment fail always tries his experiments carefully before the lecture. The giving of experiments with a three-minute preparation nearly always results in few experiments and many failures. This always gives the students less respect for and less confidence in the lecturer, and the qualities which the lecturer should endeavor to have in his lecture, those of interesting and inspiring the students, are lost.

The holding of frequent recitations is an important adjunct in order to get the best results from a lecture course. Recitations hold the student to study, emphasize the important parts of the subject, give opportunity for explaining points upon which the individual student may be hazy, and give the student practise in expressing himself. These recitations should not be the reciting of a strict page by page text-book assignment, but consultations on the subject matter outlined in the lecture, whether given in the lecture or studied in the assigned reference book, or found in other available reference books. The student should always be encouraged to look up points upon which he is not clear and the books where he is likely to find the information suggested to him.

Suppose a lecturer treats in his lectures exactly the same material as is given in the reference book, or more than is given in it. The question might be asked: what is the use of a reference book under these conditions? The reference book still has the greatest value. The student has his book and can refer to it any time he feels so inclined. He can not apply to the instructor at all times as he can to his book. The student also acquires a knowledge of the subject from two standpoints: the lecturer's and the author's. In the event of recitations he may get still another standpoint. This broadening of view is still better attained by changing the assigned reference or text-book from year to year. This can readily be done in many subjects, especially those of a general nature. This changing of reference books has admirable effects. In different years it turns out men with slightly different standpoints. In the main what they learn is the same, but they do not get it in exactly the same relation; and the men graduating from a school where this custom is practised are likely to be, as a body, broader than those from a school where it is not. Another most important effect of changing the reference book from year to year is the keeping of the teacher from a rut. A lecturer, to continue successful, must keep up to the times and must do it broadly. It would seem that the using of a different reference book from year to year, as before mentioned, is also commendable as being in keeping with a broadness of presentation by the lecturer. A set of lecture notes should necessarily be revised each year, the newer facts and discoveries inserted and the old replaced as necessary. It is imperative, and the mentioning of it here may perhaps seem absurd since it can scarcely be believed that any one in the teaching profession should lose sight of its importance. This keeping apace with the times is certainly worthy of as much thought and attention as the imparting of knowledge, if not more so.

Norman A. Dubois
Case School of Applied Science,
March, 1909

KAKICHI MITSUKURI

Advices from Japan report the death, on September 16, of Dr. Kakichi Mitsukuri, dean of the College of Science in the Imperial University of Tokyo. Dr. Mitsukuri was one