The Grassmann and Heyde method calls for the titration of *alpha*-aminocarboxylic substances with alcoholic KOH to an endpoint with thymolphthalein comparable in depth of color to that of a dilute, ammoniacal $CuCl_2$ solution. If to the color standard there is added a small amount of freshly precipitated $BaSO_4$, a turbidity is produced similar to that resulting from the precipitation of enzyme in the titration mixture. With this procedure, and a white box illuminated by a "daylight" bulb, data suitable for the calculation of reaction constants for trypsin were acquired.[5]

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DISCUSSION

BIOLOGY IN THE PREMEDICAL CURRICULUM

MANY colleges and universities are in the process of reevaluating their aims and teaching methods and of revising their curricula. The preprofessional curricula are necessarily affected by these changes. As far as the premedical curriculum is concerned, it is fortunate that medical schools and colleges seem to be in agreement on the basic principles on which this program should be based. Spokesmen of the American Association of Medical Colleges[1,2] as well as individual administrators and teachers of medical schools have repeatedly stressed the necessity of a broad cultural background rather than a narrow and specialized training in sciences, as the basis for the medical school and medical profession. For the medical student, an appreciation of arts and literature and an insight into social institutions and their history is deemed just as necessary as a thorough grounding in the natural sciences. The foundation for these qualifications must be laid in the college, which means that in a premedical curriculum the humanities, social sciences and natural sciences should be well balanced. Since the liberal colleges stand for the same general principle, there should be no difficulty in fitting the premedical program into the framework of an A.B. curriculum, by making allowance for the special needs of premedical students and by giving flexibility to the program of those who do not intend to take the A.B. degree. The difficulties become apparent when details are considered. Many difficulties arise from the fact that the entrance requirements of different medical schools differ widely. A more serious dilemma faces the sciences. If the principle outlined above is to be adopted sincerely, then premedical students should not be encouraged to specialize in natural sciences except in the case of those students who are especially gifted for them. On the other hand, those aspects of physics, chemistry and biology which are of importance for medicine grow steadily; so much so that, for instance, soon the need for a second year of physics may become urgent. The situation is aggravated by the prospect that in the future many, if not the majority of all premedical students will not stay for more than three years in college. This means that the natural sciences are forced to accomplish more in a shorter time. It is urgently necessary that we scrutinize carefully and rigorously the contents of the courses which we offer to premedical students, and that we improve the efficiency of our teaching methods.

Last summer a small group of biologists and two members of medical schools met at the Marine Biological Laboratory in Woods Hole for an informal discussion of some of these problems as far as they concern the role of biology in the premedical curriculum. Those present were Ph. Armstrong, Syracuse University Medical School; E. Ball, Harvard University Medical School; L. V. Heilbrunn, Department of Zoology, University of Pennsylvania; R. Kempton, Department of Zoology, Vassar College; D. Marsland, Department of Biology, New York University; A. K. Parpart, Department of Biology, Princeton University; A. W. Pollister, Department of Zoology, Columbia University; W. R. Taylor, Department of Botany, University of Michigan, and the writer. It was felt by the group that some of the conclusions reached in this conference might be of a more general interest and might serve as a basis for further discussion. It should be stated that the participants expressed their personal opinions and not those of any organizations or institutions. Furthermore, this report is based on the spontaneous discussion which developed during the conference and makes no claim to cover the ground adequately. The following ten points present the edited and somewhat enlarged protocol of the meeting.

(1) The entrance requirements of the different medical schools differ widely from each other (see the tabulation of Swett[3]). The premedical curricula of colleges are even more diversified, due to local conditions and traditions, and because the colleges have the responsibility of preparing premedical students for more than one medical school. We recognized fully that a certain degree of diversity is desirable and also inevitable, but it was felt that at present there exists too much variation. As a result the stu-

[1] W. C. Rappleye, *Jour. Assoc. Am. Med. Coll.*, 15: 221–227, 1940.

[2] F. C. Zapffe, *ibid.*, 15: 228–234, 1940.

[3] F. H. Swett, *ibid.*, 15: 385–386, 1940.

dents entering medical schools differ widely in the degree of preparation, which may be a handicap for instructors in medical schools. Representatives of the medical schools should get together with representatives of the biological societies to work out a more uniform framework of prerequisites which could still leave room for sufficient diversity. As long as the present conditions exist the Association of American Medical Colleges would render a real service to biologists and college administrators if it would publish in its journal, at frequent intervals, a tabulation of the entrance requirements of all medical schools, similar to the tabulation of Swett.[3]

Concerning the Elementary Courses in Biology

(2) There was general agreement that elementary courses for premedical students should under all circumstances include laboratory work.

(3) Since a number of colleges have adopted, or will adopt, a terminal introductory course in biology in which the laboratory work will be reduced and, in part, replaced by demonstrations, films, etc., the question arises whether a separate parallel course, including laboratory work, should be offered to premedical students. We agreed that there can be no universal answer to this question; in many institutions the staff may be too small to make such a split feasible. However, the question deserves serious consideration. It may be argued on the one hand that a general introductory college course should present the basic concepts of biology in such a manner that the course would be as profitable for preprofessional students as for non-science students. On the other hand premedical students are a selected group, many of whom have a special interest in natural sciences and are better prepared for them. It should be possible to give those students a more comprehensive course at a more rapid pace. Many of us have had satisfactory experiences along that line with the selected groups of Army and Navy students. Since the majority of the premedical students will probably have to be prepared in three years, a rigorous training from the start would be advisable.

(4) The role of botany in a general biology course has been much debated. To what extent should botany be included? Should botany and zoology be taught in separate courses or as an integrated unit? We agreed that either arrangement may yield satisfactory results and that the local situation in the different institutions should decide which procedure is to be followed.

(5) It was agreed that it would be advantageous if a course in chemistry would precede the introductory biology course. Those who have had experience with this arrangement reported very satisfactory results.

Concerning Anatomy and Embryology

(6) The question was raised whether embryology should be required of all premedical students. The answer was in the affirmative. A knowledge of the elements of embryology is necessary for the medical students. Those who have had no embryology either in college or in the medical school are at a disadvantage. Some medical schools are aware of this need and offer embryology courses, but such courses are likely to emphasize human or mammalian embryology only. College courses in which the general principles are stressed would be more desirable.

(7) It was felt that the elements of vertebrate anatomy are likewise an essential part of the premedical curriculum. They may be offered in a special course or be included in a comprehensive elementary course. We all agreed that a course in cat anatomy is not essential or advisable. It defeats one of the main purposes of the anatomy course: to give the student a broad comparative and historical point of view of vertebrate organization, before he begins to limit his study to one single form, the human.

Concerning Advanced Courses

(8) The group was of the opinion that a course in general physiology would be very helpful, since the average student entering medical school is unaccustomed to the ways of physiological thinking. However, such a course should not be a dilute mammalian physiology course but give an understanding of basic phenomena, such as cell respiration, nutrition, irritability. The study of the physiology of vertebrate organs is coming more and more to be dependent on cell physiology. For properly taught courses in general physiology, the student is urged to apply his knowledge of chemistry and physics to physiological techniques and physiological interpretation. This is highly advantageous, and the premedical student, accordingly, should defer his course in general physiology until he has completed his courses in physics and chemistry.

(9) Just as mammalian physiology would be an unnecessary and undesirable duplication of a medical school course so would be other courses of medical content, such as histology, bacteriology or medical parasitology.

(10) Genetics should be more strongly emphasized in the premedical curriculum. The ignorance of most medical students in matters of genetics is pitiful. Yet the importance of genetics for many problems in medicine and public health becomes so obvious that a few medical schools have already organized courses in medical genetics. Again, college courses stressing the fundamentals rather than the application to medicine would be preferable. The traditional Drosophila laboratory-course may be too specialized in the other

direction. A new type of genetics course might be developed in which elementary principles, physiological genetics and the application of genetics to the human being would be emphasized.

Another important point was briefly mentioned but not discussed at the Woods Hole meeting: The frequent complaint of medical school instructors that the college fails most seriously in the formal education of the students. Their faculty of logical reasoning and of independent thinking are not sufficiently developed. They are not able to draw simple conclusions from premises. They have not acquired the ability to express themselves concisely in words or in writing. I believe that these criticisms are by and large justified. The fault lies in part with our teaching methods. We are apt to apply without discrimination the methods of elementary courses to the junior and senior level, where they do not belong. A number of colleges and universities have gone a long way towards improving this situation, but much remains to be done. It is suggested that a new seminar or discussion type of an advanced course be designed in which the formal lectures are reduced to a minimum. Instead, the students would be guided to discuss and evaluate phenomena observed in the laboratory or demonstrated by slides; to formulate conclusions and explanations; to suggest further experiments, and to present short reports. In this way, an atmosphere can be built up in which the emphasis is not on memorized facts, lecture notes, examinations and grades, but on the satisfaction derived from independent thinking and the insight into the scientific method. The subject matter of such a course would be of secondary importance. We have had excellent results along these lines in a summer course organized in conjunction with Washington University Medical School, in which problems of growth, experimental embryology and developmental genetics served as the basis for the discussions.

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SUPPRESSION OF VITAL DATA

THE publication of the results of research is intended to inform the world, and above all the scientists engaged in parallel investigations, of the progress made; that prestige attaches to priority in publication is relatively a trivial consideration. A claim for priority should be explicit enough to show belated rivals whether their work is still sufficiently different in method from that of the first-comers to be worth completing. The scientist is not bound to broadcast his hopes for the future of the research, nor to commit himself in print to beliefs not fully secured by experiment; on the other hand, he is, surely, not entitled to suppress uncontroversial facts that are essential to understanding and appraisal of his paper. Thus Hutchings and others[1] must have known, but did not mention, the source from which they isolated a new *Lactobacillus casei* factor; and though synthesis is not always an unequivocal proof of chemical constitution, SubbaRow and others[2] must have known, but did not mention, at least the starting point and procedures selected for their synthesis of a compound apparently identical with the *L. casei* factor from liver. It is not to be supposed that it was considerations of national security that dictated this omission of vital information. The columns of SCIENCE should not be open to communications of this kind.

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THE YALE CYCADEOIDS

ONE hundred years ago the famous Buckland finely illustrated the Dinosaurs and other ancient reptiles of South England. Also well illustrated, were low and bulky accompanying petrified plants correctly inferred to have some relation to "sago palms." These, however, were not well understood and remained relatively unstudied, as had isolated types from the Carpathians and elsewhere in Europe.

The final and inescapable incentive to acute structural study of the sago-palm relatives or "fossil cycads" was yet to come from the vast assemblage of specimens which came into view in the Mesozoic Rim of the Black Hills of South Dakota and Wyoming from 1893 on. It was presently found that counting the more isolated finds the Hills were girdled by occurrences of the fossil cycads, with some vertical distribution in the latest Jurassic and lowermost Cretaceous. The Dinosaurians were also found present in vast array.

Such an array could not escape that acutely aggressive assembler of paleontologic evidence, O. C. Marsh, of Yale. He at once made extensive purchases from local fossil hunters about the Hills. And then, when the dinosaur *Barosaurus* was collected at Piedmont by Wieland as Marsh's student, the "cycads" took on an immense meaning. The acute study was begun. The collections were signally added to, so that now the Yale collection of fossil cycads perhaps equals all other such collections put together. Their study, as extended to the more severely scientific viewpoints, has led to the publication of splendidly illustrated quarto volumes as brought out with the aid of the Carnegie Institution of Washington. Also, collateral

[1] B. L. Hutchings and others, SCIENCE, 99: 371, 1944.
[2] Y. SubbaRow and others, SCIENCE, 102: 227, 1945.