Apart from this mental stock-taking there is a value in constant relation of the new to the old. It is a fact, as Professor William James has pointed out, that the absolutely new makes no appeal.

In the teaching of theoretical subjects it is now regarded as highly desirable to introduce physical notions whenever and wherever possible. Professors Franklin, MacNutt and Charles, in their paper on "Practical Mathematics," repeatedly express this as their belief. Thus:

"In the teaching of mathematics every effort should be made to appeal to sense material and to the quantitative notions which permeate everyday life; and mathematical principles and relations should be visualized wherever it is possible."

". . . . . the only way to marshall the mind-stuff of a young man for the manufacture of ideas is to introduce the drag net of physical suggestion into every discussion. There is no other way to bring intuitive and sense material into the field of consciousness where it may be organized into a structure of ideas."

Of especial importance in maintaining the interest of engineering students is the correlation of theoretical subjects with practical engineering problems. Professor A. B. McDaniel, of the University of Illinois, has effectively pointed this out in his paper on Coördination in Engineering Instruction." Speaking of the teaching of trigonometry, he says:

"Generally, the speaker has found the student equipped with a vague idea of the trigonometric functions. Beyond the fact that they are certain abstract fractional forms, they mean very little to him. He does not readily see their significance in the solution of problems on paper, and in the field. Especially is he deficient in the ability to visualize these fundamental trigonometric concepts and quickly grasp their applicability. The reason for this is clear. *The subject is taught in an abstract way and not in correlation with the dependent branches of engineering.* Some schools, notably the college of engineering of the University of Minnesota, have endeavored to solve the problem by employing teachers with engineering training for the courses in mathematics. This method has proved to be quite satisfactory and efficient. Unquestionably such teachers vivify the subject, and present it in a concrete manner, having always in mind the future applications of the principles which they are drilling into the minds of the students."

(*b*) The indelible fixing of fundamentals in the student mind requires that the teaching shall largely be confined to fundamentals. Sufficient detail to enable the student to relate the problem to his own experience or to identify it later in practical affairs is salutary. More than this beclouds the central principle. The reduction of the principles taught to the fewest possible adds to clearness. Encyclopedic teaching is no longer in favor. When President Wilson began his teaching career he strove to compress into his lectures the greatest possible amount of information, but he soon discovered that the true ideal of teaching was not the communication of facts but the development of understanding in his students.

Symbolism in mathematics is responsible for the lack of clear understanding of many principles that for convenience are given statement in mathematical formulæ. Thus, Professors Franklin, MacNutt and Charles find that in their experience when a student is asked to state Joule's Law he will say "*aitch equals arr aye square tee*"! and that it is difficult to get him to say that "the amount of heat generated in a particular piece of wire during a given time is proportional to the square of the current in the wire and to the time that the current continues to flow." The aid to be derived in fixing principles in the mind of the student by their expression in words rather than in symbols is indicated by Professor Dugald C. Jackson, of the Massachusetts Institute of Technology, in the following:

"I am strongly in favor of emphasizing the instruction in mathematics, but particularly in calculus, on the side of the interpretation of the meaning of equations into simple terms of English, as the terms of English are those in which one ordinarily thinks, and it is necessary to make such interpretation in order that the logical processes of mathematics may be incorporated with our ordinary processes of thought and analysis."

On the principle that no operation is clearly understood until one performs it one's self, the subject should be drawn out of the student rather than put into him. He should solve his own problems, make his own discoveries and answer his own questions, merely receiving the guidance and suggestion needed to keep him on the trail. It is this method that Dr. E. J. Berg follows at Union College, Schenectady. While ideal, it has the disadvantage of requiring the expenditure of much time on the part of the instructor as well as a large teaching staff.

(*c*) Recognizing that the student must rely wholly upon himself when his college days are over, the judicious teacher will seek to provide him with adequate means of self-help. Primarily, the student must know how to study, but, as Professor George L. Sullivan has shown in his paper "Teaching Engineers How to Study," he usually does not. Increased attention must be given to this matter and an effective method of securing it would be to encourage students, by special recognition, to devise improved methods of study of the various subjects of the curriculum. An experiment of this kind is now being tried at Brown University.

So large a part does judgment play in the work of the engineer that a special effort should be made to develop it in college. Opportunities for choice and decision must be created and wherever possible responsibilities must be placed on the student. Let him fix important features of the problem in hand, although he may have to do it over several times as a result of erroneous assumptions. Require him to seek out his own data from the books, tables and typical plans available. Through the blunders, rather than by the fortunate steps he makes, he will understand the value of judgment and the meaning of responsibility.

Success in dealing with practical situations requires that the engineer shall be able to formulate the scientific problem from a layman's statement of conditions. One of the greatest difficulties of the young graduate is in making a book problem out of the information supplied him or to apply the theoretical principles learned in college to the securing of useful results from a mass of data gathered, perhaps, by himself. To remedy this, practice in formulating theoretical problems from practical statements of conditions and requirements should be given in engineering courses.

The Teacher.—Without able and inspiring teachers no institution can influence the student deeply or for long. Above all other qualifications demanded of one who would guide youth is character. No connivance at sharp practice, "tricks of the trade" or the operations of the disaster-inviting "bluffer" can be permitted. Varied ability, too, is essential. The teacher must possess mental calibre, an unusual facility of expression and tact in dealing with man, especially unruly and, at times, erratic students. Extreme cleverness in an instructor is, however, a handicap. The student's difficulties are not his