V. NOTES ON THE TEACHING OF LIBERAL ARTS MATHEMATICS

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Some seventeen years ago I began teaching college mathematics. At this time I began asking myself what it was all about. This question has led me to read some excellent books on the subject. The object of this paper is to give an accoumt of the results of my efforts to find an answer to my question.

The college mathematics teacher should by all means not be a person who has "completed his mathematical education." He should be motivated in his work by some rather clearly defined objective or set of objectives. He should have an underlying method of his teaching and study activities, and should possess a workable set of criteria for measuring progress toward his goal.

There should pervade all his activities the general aim of the liberal arts colleges: "to give to the adolescent an intellectual grasp on human experience."[1] To do this, the mathematics teacher should familiarize himself with the history and the fundamental principles of mathematics, physics, chemistry, astronomy, geology,, engineering, and finance, and should have some concept of the part they have played in the evolution of our twentieth-century civilization. The need for such a background becomes apparent when he considers that, after all, he is teaching human beings rather than teaching mathematics.

The more immediate objectives should be to help the student form and perfect in his mind certain fundamental mathematical concepts, to unify and to relate these concepts under general principles, and to help the

[1]Meiklejohn, The Liberal Arts College.

student acquire a degree of skill in applying these principles to the understanding of nature.

In order to attain these ends, it is required that the teacher proceed with a definite method. In the first place, he should take advantage of the adolescent's joy of exploration, but should test each new deduction by experimentation, so as to give to the student the utmost feeling of confidence in the mathematical structure.[2] Then the student ought to be led to understand that the concepts of mathematics are human inventions made in the attempt to describe nature, and that our concepts ought to be synonomous with the corresponding set of operations.[3]

To test the student's progress toward the attainment of his objectives, the teacher has at his command all the multitudious host of examinations, quizzes and tests; but they will serve him little benefit unless he understands clearly that an examination should seek to measure something, and that something is the progress the student has made toward the perfection of his concepts.

A set of criteria for the measurement of the perfection of knowledge has been proposed by Leibnitz.[4] He states: "Knowledge is either obscure or clear; either confused or distinct; either adequate or inadequate; and lastly, either symbolical or intuitive. Perfect knowledge must be clear, distinct, adequate and intuitive; if it fails in any of these respects it is more or less imperfect." He then defines the terms used somewhat as follows: We have a clear notion of an object when we can recognize it with certainty and without hesitation. We have a distinct notion of an object when, in addition to having a clear notion, we can describe the qualities by which we know it. Our idea of a thing is adequate when everything that enters into a distinct notion is known distinctly enough to satisfy the demands of the problem at hand. Any knowledge which we have directly through the senses or by immediate communication to the mind is called intuitive.

The modern objective examination can be easily adapted to fit into the scheme proposed by Leibnitz. The true-false statement and the multiple response type of test can be made to measure the clearness of a set of ideas. The completion test and the "definition" test can be made to measure the distinctness of ideas. The adequateness of ideas can be measured by the ability to solve problems or by the ability to interpret new reading material. The student's intuitions can be tested by his ability to express mathematical statements by means of diagrams and graphs, and by geometrical methods of solving problems.

In one of his public addresses a few years ago, Professor Judd stated that the material progress of no people has ever advanced beyond the mathematics of that people. Professor G. W. Stewart of the State University of Iowa says that the discovery of the Roentgen Ray is the last great accidental discovery in the field of the physical sciences; the mathematician is the file-leader in practically every physical discovery. Does it not seen that the one who guides the college student along the way of mathematical thinking has a part to play in the building of civilization important enough to justify the improvement of his art?

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[2]Carson, Mathematical Education.
[3]Bridgemen, The Logic of Modern Physics.
[4]Jevons-Hill, Logic, Chapter 1, Section V.