PLANE GEOMETRY DEVELOPED BY THE SYLLABUS METHOD

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BY

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W. P. I

PREFACE

THE belief that the proofs of Geometry should be, as far as possible, worked out by the pupils, either in class discussions or individually, is becoming more widespread every year. The day of memorizing proofs will soon be past, and the most efficient method for mental training along logical lines will be the one generally adopted. This syllabus is written with the hope of encouraging teachers to undertake Geometry by the "no text" method. The author believes very decidedly that this method gives a maximum of mental training with a minimum waste of energy.

The list of theorems is based on the latest reports of the Mathematical Associations, and, while much shorter than that in many of the text-books, it will be found sufficient to prepare the pupils for any of the colleges. It contains all the theorems of the "New England List" with a few additions that simplify proofs.

The order is the development of ten years' class use, and will be found different from that of any text. Whenever a theorem has seemed to be simplified, either in content or in proof, by making a change in its place in the order of theorems, that change has been tried in class, and has been made permanent if it proved of advantage. Any teacher using this book should feel equally free to make changes in the order if he is convinced that there is a decided advantage in the change.

The chapter on Logic has been found of great assistance in helping the pupils to think accurately, and it is certain to save more time for a class than its discussion requires.

The definitions and axioms are given in quite complete form, not for assignment to the class, as this part of the work should be developed *before* the text is given to a class for study; but as a guide for the teacher, both in order and in subject-matter, and as a reference book for the pupil. Good results can be secured by withholding the book from the pupils until part, at least, of the preliminary matter has been discussed.

The subjects of "existence" and "betweenness" have not been considered to any great extent, as they do not seem worth the time and effort required, except to a student of the more advanced pure mathematics. "Location" and "intersection," on the other hand, are of such vital importance in considering the correctness of proofs that they have received some attention. The aim throughout has been to arrange a system of Geometry that should be natural, reasonably complete, and suitable to afford as much mental training as the maturity of the pupils would allow. The author has not hesitated to assume any axiom that would help more than its presence would complicate; on the other hand, he has left out things that seemed to require more than they gave.

Geometry itself has no concern with measurement by means of a unit. The applications of Geometry to such measurement are, however, very frequent and very important, and while this book presupposes geometrical proofs to as great a degree as seems possible without unnecessarily complicating the subject, there has been no attempt to draw a hard and fast line of demarcation

between Geometry and its applications. If a teacher believes in distinguishing sharply between the different branches of mathematics, the study of the lengths of line sects and the calculation of areas can be put under the head of MENSURATION.

The exercises are in two divisions, those under the theorems and those in general lists. The exercises under the theorems have been chosen to illustrate the uses of the various theorems, and they should therefore be of great help to the teacher. The general lists give the pupils practice in finding for themselves what principles underlie the proofs. Probably no class could finish all the exercises in the book in one year, but the teacher can easily choose those best suited to his purposes. There are several pages of college examination questions. Some of these are duplicates of exercises scattered through the book, but the differences in wording, as well as the desire to let students know what type of questions examiners ask, has prompted leaving them in the book.

This book has been written with little reference to the order and methods of other texts, for it is a compilation that has grown naturally from class work. The author is, of course, indebted for many of the ideas used to numerous works on mathematics and its pedagogy, but in many cases it is now impossible to tell from what source the suggestion first arose. He wishes, however, to acknowledge his special indebtedness to Dr. William H. Metzler of Syracuse University, for assistance and encouragement in the writing of this book.

EUGENE R. SMITH.

SUGGESTIONS TO TEACHERS

Preliminary Definitions and Axioms. Do not assign these to the class to read until after they have been thoroughly discussed in class. As far as possible, let the pupils frame the definitions for themselves, and lead up naturally to the simple deductions from them (starred in the text), so that the pupils can begin to discover those truths from the very beginning.

Every word of this part need not be digested before going on to the theorems; but before any new work is undertaken the teacher should make sure that the pupils have a perfect grasp of the particular facts to be used in developing the new matter. Certain parts can be touched upon lightly on the first reading, and cleared up thoroughly just before being used. *Make haste slowly.*

Theorems. Develop the very difficult ones in class by the question and answer method of analysis; assign those less difficult for outside preparation or to be worked out in class, either at the board or at the pupils' seats. Clear up the work frequently by review recitations covering the theorems recently done. Use a great deal of oral work, asking for every viewpoint on both new and old work. *Never tell the pupils what to do; ask questions so framed that the pupils are made to think.* Summarize frequently, and by the use of exercises cultivate the pupils' power to choose the correct method.

Notebooks. The author advises that the pupils be required to keep notebooks in which they write out all the theorems, unless the conditions under which the teacher is working make it impossible. All necessary corrections can be noted by the teacher and made by the pupil, after which the theorems can be filed, and so become at the end of the course a complete reference book compiled by the pupil. A loose-leaf system will be found convenient.

Time Required. *Do not hurry the early work.* Whatever time is used in obtaining a thorough understanding of the foundations and of the methods will be more than repaid by increased speed later on.

The first quarter of the year's course should be spent on the work up to the section on Locus in Book I, and if this assignment is not quite finished, no great harm will be done.

The second quarter should almost, if not quite, finish the second book.

The third quarter should take about to the constructions of the fourth book.

The last quarter should finish the syllabus and leave at least a month for general review and additional exercise work.

This is an estimate of a fair average rather than of an excellent record, and many classes can do much better; it supposes that a good deal of original work on exercises, and almost daily oral work on uses of theorems, methods of attack, and other important topics have been taken.

Logic. Make frequent use of the section on Logic. Ask the pupils to state the converse and the contraposite of very many of the theorems, and to discover whether these