A DRILL-BOOK IN TRIGONOMETRY

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A Drill-Book in Trigonometry by George William Jones

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GEORGE WILLIAM JONES

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Trieste

A

DRILL-BOOK

IN

TRIGONOMETRY

BY

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FIFTH EDITION.

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GEORGE W. JONES.
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PREFACE.

In 1881 a TREATISE ON TRIGONOMETRY was published under the joint authority of PROFESSORS OLIVER, WAIT, and JONES. In 1889 this book was rewritten and reissued under the same title and by the same authority. In all five editions have been printed.

Professor Oliver died last March, and now that a new edition of the book is called for and many changes are proposed, it seems better, perhaps fairer towards him, to issue it under my single name. It may be regarded, then, both as a new edition of the older book, and as itself a new book.

Among the more important changes are these:

1. The introduction, at the beginning, of a chapter on THE RIGHT TRIANGLE, treating it as the pupil has been accustomed to think of it in plane geometry, and without the complex notions of directed lines and angles.

In this chapter he learns, also, how to use tables of trigonometric ratios and logarithms, and he gets some notion of the simpler applications of trigonometry to problems in surveying.

2. The second chapter, on the GENERAL PROPERTIES OF PLANE ANGLES, follows more closely the general lines of the old treatise, but it differs widely in details: in particular, it makes a much freer use of projections.

3. The third chapter, on PLANE TRIANGLES, shows a more radical departure. The habit of writers on trigonometry seems to have been to give broad and general definitions of trigonometric ratios, and to prove generally the propositions that relate to plane angles, and then, when they come to discuss the properties of plane triangles, to forget all they had said before, and to fall back on the ratios of positive acute angles.

In the edition of 1889 I tried to make the definitions and the proofs general; but the method then followed never satis

fied me, and I sought in vain for light in the many American and foreign text-books that I consulted.

But now, through a happy suggestion of one of my assistants, Mr. Fowler, I think I have overcome the difficulty. That suggestion was to use THE EXTERIOR ANGLES; and by such use I have been able to make the proofs general and the formulæ symmetric. So, in space trigonometry, I have been able to apply this suggestion to the discussion of the properties of triedral angles and spherical triangles with the best results.

4. Greater prominence has been given to the GENERAL TRIANGLES.

5. The proof of De Moivre's formula by aid of imaginaries has been left out: I propose to write a book, shortly, on HIGHER ALGEBRA, and it has seemed to me that there would be the best place to discuss the applications of imaginaries to trigonometry.

6. Most of the FIGURES have been redrawn.

On the other hand, many parts of the older book have been included without change, notably the discussion of derivatives and series, of directed areas, of astronomy, and of navigation; and for the most part the examples have been taken bodily.

As to the title of the book, it has seemed to me that the word TREATISE was too large for me; and as I have meant my book primarily for class use, I have called it a DRILL-BOOK.

In writing this book, I have been very fortunate in my assistants. To Mr. Charles S. Fowler and Dr. Virgil Snyder, instructors in mathematics in Cornell University, I am deeply indebted, both for their valuable suggestions, and for their unwearied labors in beating out the text and in preparing the questions and examples; and, for its dress, I am no less indebted to my draughtsmen, Mr. John S. Reid and Mr. Hiram S. Gutsell, instructors in drawing, to my engravers, the American Bank Note Company, and to my printers, Messrs. J. J. Little & Co.

GEORGE W. JONES.

ITHACA, N. Y., *January* 1, 1896.

SUGGESTIONS TO TEACHERS.

THERE are many things in this book not meant for beginners. Below is a rough list of the chapters and parts of chapters that may be taken up at a first reading: the parts omitted are for advanced classes. And as to those parts which are included in the list, great caution must be taken lest too many examples, or too hard ones, be set; for there are many of them, printed in a small space. No one can be expected to work them all, and the hardest of them should be reserved for the strongest pupils. But the profit comes to the pupil by hard thinking; and the best part of the thinking is in answering the questions.

Very often more than one figure is used to illustrate a principle: for the most part, the first figure is the simplest, and that one should be well understood before the others are looked at. Later the other figures may be taken up, and the generality of the principle will be felt only when they have all been studied.

When the reasons are obvious, both theorems and corollaries are left without formal demonstration; but students are expected to state the proofs.

In most cases theorems are given only in formula: it is best that these formulæ be translated into words.

In most cases answers to the examples are not given, and the student is left to test his own results: the testing is counted as not less important than the solution, and the habit of independent thought and self-reliance so cultivated as most valuable of all.

Only the main lines of the subject are developed in the text: collateral matters are outlined in the examples and left for the student to work out for himself.

FOR A FIRST READING.

I,	all,	pp. 1–21.
II,	§§ 1–9, 12,	pp. 22–53, 58–60.
III,	§§ 1–4,	pp. 62–75.
IV,	none.	
V,	§§ 1–7, 9–15,	pp. 104–130, 134–161.

NEW SIGNS AND WORDS.

SOME of the less familiar signs used in this book are these:

$\geqslant$, *larger than*; $\ngeqslant$, *not larger than*;

$\leqslant$, *smaller than*; $\nleqslant$, *not smaller than*;

$\gtrless$, *not greater than*; $\lessgtr$, *not less than*;

$\neq$, *not equal to*; $\cdots$, *and so on*, meaning the continuance of a series of terms in the way it has begun;

$\doteq$, *approaches*, meaning that the value of one expression comes very close to that of another, without absolute equality;

$\equiv$, *stands for*, or *is identical with*.

The common point of two or more lines or planes is their *co-point*; the common line of two or more points or planes is their *co-line*; and the common plane of two or more points or lines is their *co-plane*. The corresponding adjectives are *co-pointar*, *co-linear*, and *co-planar*.

The distinction between *larger-smaller inequalities* and *greater-less inequalities* is this: the first refers to absolute magnitude alone, without regard to signs of quality; the other, in common usage, regards both sign and magnitude.

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