

**ELEMENTARY CALCULUS:
A TEXT-BOOK FOR
THE USE OF STUDENTS
IN GENERAL SCIENCE**

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Elementary Calculus: A Text-book for the Use of Students in General Science by Percey F. Smith

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ELEMENTARY CALCULUS

A TEXT-BOOK FOR THE USE OF
STUDENTS IN GENERAL SCIENCE

BY

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PREFACE

THIS volume has been written in response to the unmistakable and growing demand for a text-book on the Calculus which shall present in a course of from thirty-five to forty exercises the fundamental notions of this branch of mathematics. In American technical schools students pursuing courses distinct from engineering branches usually terminate their mathematical studies with Plane Analytic Geometry. But in view of the recent remarkable development of certain of the general sciences along mathematical lines, such a course can no longer be regarded as adequate. Moreover, there can be no difference of opinion as to the relative advantage to the student of a knowledge of more than the mere elements of Analytic Geometry and an introductory acquaintance with the Calculus. It is, I think, the experience of every teacher that the average student first realizes the power and use of mathematics when taught to solve problems in maxima and minima by means of the methods of the Differential Calculus. Certainly no stronger argument can be adduced in favor of an adjustment of the curriculum which shall include this branch of mathematics. Such a change has been effected in the Sheffield Scientific School, and results abundantly justify the step.

For the general student in our colleges who elects a year's work in mathematics beyond the usually required

Trigonometry, the most satisfactory course would seem to be one in which the time is equally divided between Plane Analytic Geometry and Calculus.

In writing this book I have everywhere emphasized the possibility of applications. The examples have been carefully selected with this end in view. The first chapter may seem long, but the notion of limit certainly demands adequate treatment. While an elementary text-book offers no excuse for employment of the refinements of modern rigor, I have endeavored to avoid positive inaccuracies and have carefully distinguished between demonstration and illustration.

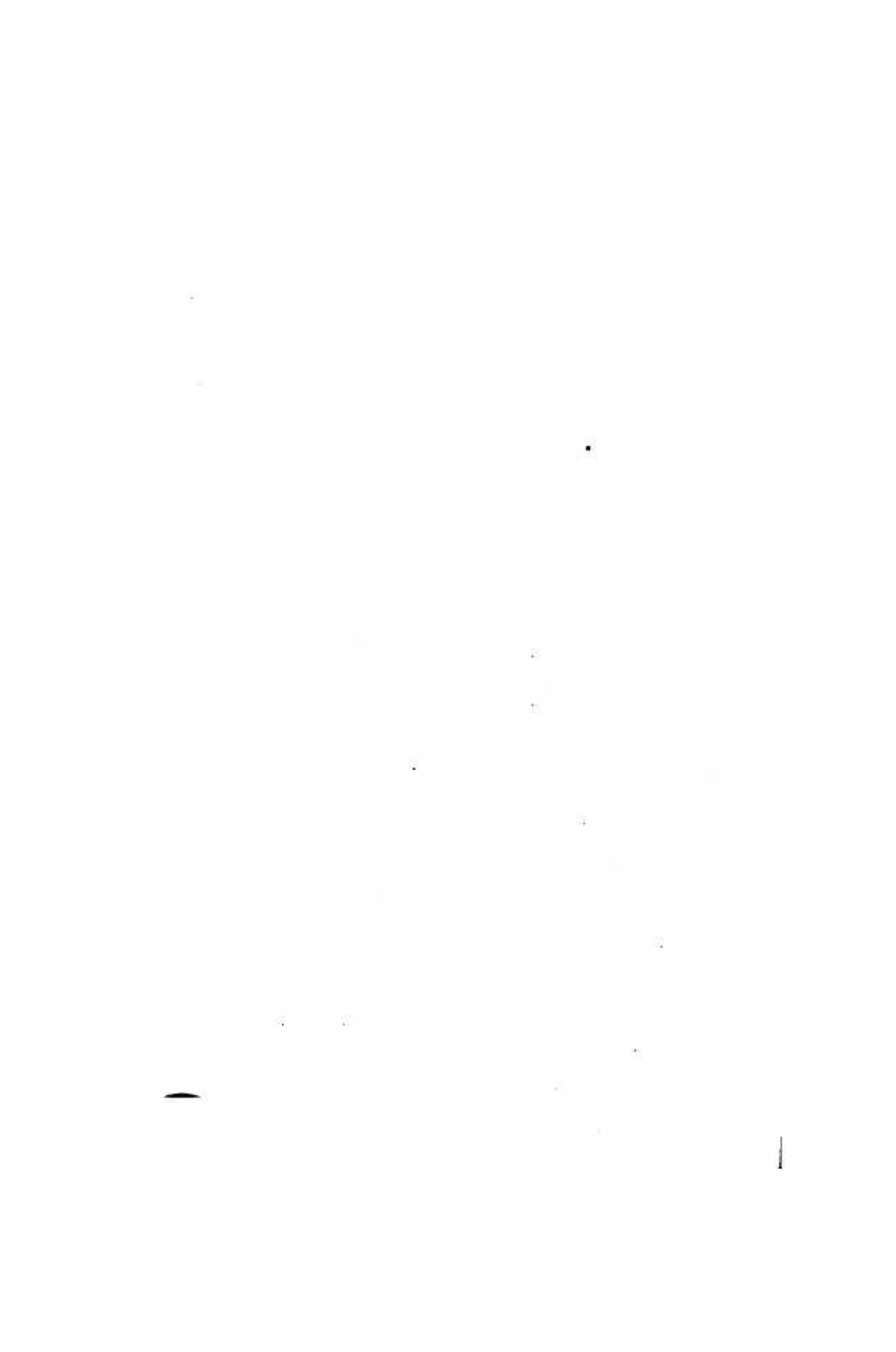
I am indebted to my colleague, Dr. W. A. Granville, for many helpful suggestions.

PERCEY F. SMITH.

SHEFFIELD SCIENTIFIC SCHOOL.

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ELEMENTARY CALCULUS

CHAPTER I

FUNCTIONS AND LIMITS

1. Continuous Variation. In this book we are concerned with *real numbers* only. Geometrically, such numbers may be conveniently represented by points of a scale (Fig. 1).



FIG. 1

Then to every real number corresponds one point of the scale, and only one; conversely, every point of the scale represents a real number. Any segment of the scale, however small, represents indefinitely many numbers. We speak indifferently of the number a and the point a of the scale.

A variable x is said to *vary continuously* between the numbers a and b when it assumes values corresponding to *every* point of the segment ab .

2. Functions. The problems arising in Elementary Calculus involve in general two variables in such a way that the value of one variable can be calculated as soon as a value is assumed for the other. Thus, in Geometry, the student has an illustration in the area and radius of a circle, two variables such that the area A can be calculated when we know the radius r from the formula $A = \pi r^2$.