

**AN INTRODUCTION TO
THE CALCULUS, BASED
ON GRAPHICAL METHODS**

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An introduction to the calculus, based on graphical methods by George A. Gibson

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BASED ON GRAPHICAL METHODS

BY

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PREFACE.

IN the following pages an attempt has been made to present the elements of the Calculus in a way that will appeal to comparatively immature students. The reasoning is based essentially on the graphical representation of a function, and it is hoped that students who have obtained a firm grasp of the meaning of such representation will be able to gain, without serious difficulty, a right apprehension of the meaning of a differential coefficient. I have deliberately abstained from crowding the book with diagrams, because I assume that before the student begins the study of the Calculus he will be quite familiar with the methods of graphing the ordinary functions and will have reached the stage at which he can at once form a mental picture of such graphs. From the educational point of view the graph is not so much an end in itself as an aid to the comprehension of the variation of a function.

In all practical applications of the Calculus the consideration of a differential coefficient as the measure of a rate of variation is of the utmost importance, and this aspect of a differential coefficient can be very readily understood by any one who is familiar with graphical work. The only satisfactory way, however, by which the conception of a rate can be adapted to practical uses is, in my judgment, the method of limits; I have therefore used that method throughout the book.

The first eight chapters treat of algebraic functions alone, and they contain many of the simpler applications of the Calculus; the chapter on Graphical Integration may, if desired, be taken up as soon as these chapters have been mastered. The discussion of the circular and exponential functions will probably be found distinctly harder; but long experience has convinced me that the difficulties are due not to the nature of the Calculus but to the student's imperfect knowledge of trigonometry. It seems to me that a student who has not a firm grasp of the Addition Theorem should postpone his study of the differentiation and integration of circular functions till he has obtained that grasp; the Theorem is absolutely necessary for many of the most important applications of trigonometry and is, after all, very easy to understand and apply.

I have included a short discussion of the Fourier Series, because of the numerous applications it is now receiving in elementary work; in the sections that treat of the decomposition of an empirical function I have given a solution, due to Professor Runge, which seems to me to be thoroughly practical.

It may seem to many that I have tried to build on too slight a foundation of elementary mathematics. I am well aware that a thorough knowledge of the Calculus can only be obtained by those who have had a broader training in the elements of mathematics than I assume in my readers; but I have for several years given courses on the Calculus to large classes of evening students and I have found that it is quite possible to do much good work on the lines followed in this book. A student, however, who wishes to profit by the course laid down must work many of the examples in the various sets of Exercises; the principal results in differentiation and integration must be as familiar

as the multiplication table, and the best way of acquiring that familiarity is by working numerous examples. The time required for this purpose is by no means so great as many people suppose; in any case, that familiarity must be acquired if the Calculus is to be the instrument and not the master of the student.

In conclusion I desire to tender my cordial thanks to several friends who have encouraged me in the production of the book: to Mr. P. Bennett, Mr. W. A. Lindsay, Mr. P. Pinkerton and Mr. A. T. Simmons for very efficient help in proof-reading; to Mr. J. Dougall and Mr. J. Miller for the solutions of the examples; and to Professor R. A. Gregory for his most helpful advice at all stages of the progress of the book. I must also thank the printing staff of Messrs. MacLehose for the excellence of their share of the work.

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