PREFACE

It is probable that almost every teacher of advanced calculus feels the need of a text suited to present conditions and adaptable to his use. To write such a book is extremely difficult, for the attainments of students who enter a second course in calculus are different, their needs are not uniform, and the viewpoint of their teachers is no less varied. Yet in view of the cost of time and money involved in producing an Advanced Calculus, in proportion to the small number of students who will use it, it seems that few teachers can afford the luxury of having their own text; and that it consequently devolves upon an author to take as unselfish and unprejudiced a view of the subject as possible, and, so far as in him lies, to produce a book which shall have the maximum flexibility and adaptability. It was the recognition of this duty that has kept the present work in a perpetual state of growth and modification during five or six years of composition. Every attempt has been made to write in such a manner that the individual teacher may feel the minimum embarrassment in picking and choosing what seems to him best to meet the needs of any particular class.

As the aim of the book is to be a working text or laboratory manual for classroom use rather than an artistic treatise on analysis, especial attention has been given to the preparation of numerous exercises which should range all the way from those which require nothing but substitution in certain formulas to those which embody important results withheld from the text for the purpose of leaving the student some vital bits of mathematics to develop. It has been fully recognized that for the student of mathematics the work on advanced calculus falls in a period of transition, — of adolescence, — in which he must grow from close reliance upon his book to a large reliance upon himself. Moreover, as a course in advanced calculus is the *ultima Thule* of the mathematical voyages of most students of physics and engineering, it is appropriate that the text placed in the hands of those who seek that goal should by its method cultivate in them the attitude of courageous

explorers, and in its extent supply not only their immediate needs, but much that may be useful for later reference and independent study.

With the large necessities of the physicist and the growing requirements of the engineer, it is inevitable that the great majority of our students of calculus should need to use their mathematics readily and vigorously rather than with hesitation and rigor. Hence, although due attention has been paid to modern questions of rigor, the chief desire has been to confirm and to extend the student's working knowledge of those great algorisms of mathematics which are naturally associated with the calculus. That the compositor should have set "vigor" where "rigor" was written, might appear more amusing were it not for the suggested antithesis that there may be many who set rigor where vigor should be.

As I have had practically no assistance with either the manuscript or the proofs, I cannot expect that so large a work shall be free from errors; I can only have faith that such errors as occur may not prove seriously troublesome. To spend upon this book so much time and energy which could have been reserved with keener pleasure for various fields of research would have been too great a sacrifice, had it not been for the hope that I might accomplish something which should be of material assistance in solving one of the most difficult problems of mathematical instruction, — that of advanced calculus.

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