SHORTER NOTICES

Introduction to the Mathematical Theory of the Conduction of Heat in Solids. By H. S. Carslaw. Second edition, completely revised. London, Macmillan and Co., 1921. xii + 268 pp.

The first edition of Professor Carslaw's work appeared in 1906 under the title *Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat.* This book, which was reviewed in volume 15 of this BULLETIN, was divided into two parts corresponding to the two principal topics in the above title. It had been out of print for some time, and the author wisely decided to rewrite the entire book in such fashion as to take account of the progress that has been made in the theories involved since the appearance of the first edition. The very considerable expansion of size inevitably involved in such a rewriting has led naturally to the replacing of the two parts of the first edition by the two volumes of the second edition.

The first volume, which was entitled *Introduction to the Theory of Fourier's Series and Integrals*, was reviewed in volume 28 of this BULLETIN. As pointed out in that review, it showed extensive rewriting and considerable expansion as compared with the first part of the original edition. The present volume likewise exhibits considerable alteration from the second part of the first edition. Chapters I–VI, which contain substantially the same material as the corresponding chapters of the first edition, have been extensively revised; chapters VII–X contain much new material; chapters XI and XII are entirely new.

The first edition of the book was particularly noteworthy from the fact that it was the first work in English in which a large group of the standard problems that arise in the theory of the conduction of heat were dealt with systematically in a rigorous fashion. In addition to this group, however, certain other problems were introduced where the possibility of a rigorous treatment was merely indicated instead of being carried out. This was probably due partly to considerations of space, and partly to a desire to keep the book sufficiently elementary to be palatable to the student of applied mathematics, the omitted proofs being in many cases long and difficult. In some cases the omission was perhaps due to the fact that no completely rigorous discussion was available in the literature. In the present edition such of the missing proofs as are not unusually lengthy are supplied, as for example in sections 17 and 31; in most other instances, where the complete discussion is not given, suitable references are furnished which will enable the reader, if so disposed, to find a rigorous discussion in the literature. One rather noteworthy exception to this rule may be found in section 51, where the possibility of the expansion of an arbitrary function of three variables in a triple Fourier's series is assumed. The omission of any reference in this case is quite understandable, as in spite of the very extensive literature on the ordinary Fourier's series, the reviewer is unaware of any discussion of the triple Fourier's series in existing literature which would supply the missing proof in the section mentioned.

Such a discussion will be shortly available, however, in a paper * by Miss Bess Eversull, which is to appear in the ANNALS OF MATHEMATICS.

Quite a little of the new material to be found in the present edition of Professor Carslaw's book is based on his own contributions to the subject since the appearance of the first edition. Thus for example the discussion in section 90 of the flow of heat in a wedge is based on a paper by the author in the PROCEEDINGS OF THE LONDON SOCIETY ((2), vol. 8 (1909–10)). Also chapter XI, dealing with the use of contour integrals in the solution of the equation of conduction, is based on papers by the author in the PHILOSOPHICAL MAGAZINE ((6), vol. 39 (1920)) and the PROCEEDINGS OF THE CAMBRIDGE PHILOSOPHICAL SOCIETY (vol. 20 (1921)).

Chapter XII, which deals with the use of integral equations in the solution of the equation of conduction, is only a very brief sketch of this subject. It was doubtless introduced mainly for the purpose of acquainting the student of applied mathematics with the possibilities in this direction and in this manner stimulating him to a study of the works that deal with the subject in a more extensive manner. A list of such works is given in a footnote at the beginning of the chapter.

The bibliography of works on the conduction of heat, found in Appendix II, has been brought up to date by the addition of titles of articles that have appeared since the publication of the first edition. The added titles for this period of fifteen years occupy three pages and form approximately one-fourth of the entire list, which corresponds to a period of a century. Thus we have a rough index of the mathematical activity in this particular field during recent years.

CHARLES N. MOORE

Praxis der Gleichungen. By C. Runge. Zweite, verbesserte Auflage. Berlin and Leipzig, Vereinigung wissenschaftlicher Verleger, 1921. 2 + 172 pp.

This book, printed in 1900 as number XIV of the SAMMLUNG SCHUBERT, now appears in larger format and better type as one of the new GÖSCHENS LEHRBÜCHEREI,—the second of the first group (*Reine Mathematik*). Changes have been few and unimportant. The reviewer noticed a paragraph at the foot of page 98 and a figure between pages 106 and 107, neither of which appears in the first edition, and an index has been added. Two errata have been carried over from the first edition: in line 2 from the bottom of page 38, for a_{14}, read a_{14}/a_{11}; in line 3 from the bottom of page 87, for 3217.18, read 5217.18. A new misprint is the omission of the i in the exponent of e in line 11 of page 165. But, considering the nature of the contents, there are on the whole remarkably few typographical errors.

This volume has become such a classic that it is scarcely necessary to describe it more fully than to say it gives in considerable detail, illustrated by numerous examples, the actual processes to be followed in solving numerical equations where the roots are to be found to a high degree of accuracy. Some theory is given, culminating in Sturm's Theorem, but the emphasis is laid on actual computations. It is to be hoped that

* This paper was presented to this Society at its meeting in Chicago, April 14, 1922. See this BULLETIN, vol. 28 (1922), p. 289.