

physics; 6, application of the calculus of variations to eigenvalue problems; 7, special functions defined by eigenvalue problems.

The original design of writing this work arose from the observation that while mathematics had in the past received inspiration from the close relation which exists between analysis and the intuitive conceptions of physics, the source of this inspiration was tending to run dry. Analysis was becoming more and more an end in itself and the physicist tended more and more to estrange himself from an understanding of the problems and methods of the analyst. No doubt there were faults on both sides; indeed, it is largely true that mathematics tends to outstrip its applications and it is probably too much to ask the physicist to interest himself in those parts of a subject for which he can see no immediate applications. Nevertheless, one cannot remain blind to the fact that this forging ahead on the part of mathematics has served the physicist well, for example, in the development in the present century of the theory of relativity and of quantum theory.

However that may be, Courant saw in this growing estrangement a danger signal to both sciences, and he set about writing a book which should effect a reconciliation by helping the student and preparing the ground for the research worker. This is from every point of view a worthy aim and one which has been ably fulfilled by the presentation in one place of a clear and scholarly account of mathematical methods which appeal to the physicist for their applicability and to the mathematician for their rigour. Moreover, the bringing together of a well-chosen selection from original papers and other published work makes smooth the path of the student to an extent which anyone can appreciate who has had to delve for himself. The usefulness of the work is further enhanced by the attempt to make each chapter substantially independent, thus affording the opportunity of selecting just that topic on which the reader requires orientation.

The second volume is largely independent of the first in that it aims at a systematic treatment of partial differential equations in their relation to mathematical physics. This volume contains seven chapters as follows: 1, preliminary notions; 2, general theory of partial differential equations of the first order; 3, linear differential equations of higher order; 4, differential equations of elliptic type and potential theory; 5, differentials equations of hyperbolic type in two independent variables; 6, differential equations of hyperbolic type in more than two independent variables; 7, solution of boundary and eigenvalue problems by the calculus of variations.

In the first volume many particular problems are considered in which linear partial differentials of higher order are concerned. In the second volume a systematization is attempted with the object of making the subject more approachable.

In mathematical physics it is seldom that the totality of all solutions of a differential equation is required; even the finding of a special class of solutions is not the object. Rather the aim is usually to pick out one particular solution which is to satisfy relations laid down by the problem itself, initial conditions or boundary conditions. In this respect it is important to observe that boundary value problems and partial differential equations of elliptic type belong naturally together, while initial value problems belong to equations of hyperbolic type such as arise in connexion with oscillations and radiation.

From the point of view of mathematics a physical problem is only properly stated when the solution (1) exists, (2) is unique, and (3) depends continuously on the data, the condition of physical determinateness. Throughout this volume the above general considerations are kept clearly before the reader, the emphasis throughout being on the broad connexion of ideas. The last chapter is very interesting, for here the direct method of the modern calculus of variations is applied to establish the existence and uniqueness of the solution of equations of elliptic type. The principle here is to replace the boundary problem by a variation problem in which a function is sought which has the necessary properties of differentiability, and which renders the appropriate variation expression a minimum. It is not assumed that such a minimum exists, but a lower bound d certainly does. There then exists a sequence of functions which are admissible in the variation problem and for which the variation expression tends to d . This sequence of functions, called a minimal sequence, does not necessarily converge, nor, if it does, is the existence of the derivatives of the limit function evident. But it can be shown that it is possible from the minimal sequence to extract a subsequence defining a function which has the required properties of differentiability and which satisfies the differential equation.

L. M. MILNE-THOMSON.

METALLURGY IN EVERYDAY TERMS

Metals in the Service of Man

By Arthur Street and William Alexander. (Pelican Books, A.125.) Pp. 192+20 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1944.) 9d. net.

THE purpose of this admirable little work is abundantly fulfilled—that of bringing home to the general reader the importance which metallurgy now occupies in our industrial life. While serving this useful purpose it will, nevertheless, be read with delight by those who already have a wider knowledge of the subject. Although not putting forward a text-book, the authors have succeeded in overcoming the difficulties which are inherent in summarizing so broad a field and this in a manner and with an accuracy of statement to which academical exponents of the subject could take very little exception.

The great merit of the authors of this book is the simplicity of language used in an exposition of matters relating, more particularly, to the character, structure and behaviour in use, of metals and alloys. It has the quality and value of the spoken word rather than the more formal phraseology of the text-book. For this very reason it should be of particular interest to those who are faced with the introduction of this subject to students, and it is to be hoped that the authors may find time and opportunity to demonstrate still further their gifts of exposition for the benefit of those who need some guidance in framing elementary courses of instruction in these important matters. The authors must have derived considerable enjoyment from the compilation of this short account of 'metallurgy without tears', and in making apt use of homely similes with which to press home fundamental principles. Their friendly artist must have shared this enjoyment in devising his quaint and original illustrations, which are diverting and yet convincing.

S. W. SMITH.