APPLIED ANALYSIS IN THE U.S.S.R.

Approximate Methods of Higher Analysis
By L. V. Kantorovich and V. I. Krylov. Translated from the Russian by Curtis D. Benster. Pp. xv + 681. (Groningen : P. Noordhoff, Ltd., 1958.) n.p.

THE first edition of this book appeared in 1936, as "Methods for the Approximate Solution of Partial Differential Equations"; it dealt with boundary value problems for linear equations. The title was changed to the present one for the second edition (1941), on the inclusion of an extended treatment of conformal mapping, and an account of the numerical solution of integral equations. The present translation is from the 1952 edition,, which does not differ greatly from the earlier editions : the authors promise a complete revision which shall take account of the substantial progress made since 1941, when no doubt the use of linear operators and function spaces, for example, will find a place. In the interim, a translation is most welcome, since the book as it stands is probably alone in its class, yet for linguistic reasons many of us have been debarred from immediate knowledge of its richness of content. In spite of an increasing flow of translated books and periodicals, it is not easy to acquire a full insight into the rapid growth of Soviet mathematics, though F. J. Weyl, writing from the U.S. Office of Naval Research, measures the will to do so by his remark : "It is a unique distinction of the mathematical community to have never been taken in by the myth, now generally shattered, that Russian science merely followed the lead of the West—at a respectful distance".

The book in each of its main sections exhibits the intention of pressing the processes of pure mathematics beyond the domain of form and theory to the region of numerical calculation, to numerical approximations accompanied by estimation of error. Methods are illustrated by examples from various fields of applied mathematics, carried out to detailed numerical conclusions with evaluations of bounds to errors. The first section deals with solutions of Laplace's equation by infinite series, including Fourier series, with paragraphs on methods of accelerating the convergence. The second section discusses numerical methods for solving integral equations of Fredholm's type, with some emphasis on the 1930 method of N. M. Krylov and N. N. Bogoliubov, illustrated by solving the Dirichlet problem for an elliptic boundary. In the third section, the method of nets, which replaces a partial differential equation by a set of finite difference equations, is expounded with attention to the convergence of the process and the estimation of error. Rather more advanced theory begins in the fourth section, which studies variational methods : the Rayleigh-Ritz method, first fully elucidated by N. M. Krylov, and the related but somewhat simpler and more general method of Galerkin, are fully explained and exemplified. The fifth and sixth sections form a compact treatise of 250 pages on the theory and applications of conformal mapping ; the reader is supposed to know the elementary ideas as far as Riemann's theorem on the existence of a conformal mapping between two simply connected domains. The boundary-value problems of Dirichlet and Neumann, and for the biharmonic function, receive thorough treatment. There are numerous examples, though, for the biharmonic problem, the reader is naturally referred to the many and varied applications of the method made by Muskhelishvili in his excellent book on elasticity. It may be noted that Muskhelishvili refers to Kantorovich and Krylov as a classic work on the application of complex variable methods, and the two books resemble one another closely in spirit and in technique. The final section gives Schwarz's method of solving Dirichlet's problem for a complicated domain by combining solutions for simpler domains : the method is illustrated by the complete solution for an L-shaped domain.

As a compendium of methods available in 1940, and as an instance of what can be done by skilfully combining general theory with numerical analysis, this is a noteworthy volume. It should be interesting to see how future revisions are modified by the increasing dominance of the automatic computer. The translation, by C. R. Benster, is fluent : the bibliography unfortunately makes no serious attempt to include non-Russian material. **T. A. A. BROADBENT**

THE THEORY OF PRACTICE

Planning of Experiments
By Dr. D. R. Cox. (Wiley Publication in Applied Statistics.) Pp. vii + 308. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1958.) 60s. net.

DR. D. R. COX succeeds well in his aim of writing an introduction to modern thought on the design of experiments free from the statistical and mathematical technicalities that often discourage the experimental scientist from study of a subject so inportant to his own work. He says much about the nature of computations required in the analysis of experimental results without presenting one analysis of variance table. He displays a wide range of standard experimental designs, and discusses their uses, while saying little about how to construct them or about mathematical theorems relating to their existence.

Although an increasing number of scientists has sufficient knowledge of statistical practice to learn about experimental design more intensively than this approach permits, undoubtedly many others will profit from it. The book could be an admirable introduction to statistical ideas for a biological or industrial scientist ; from it he would learn little about the standard procedures of statistical analysis, such as are to be found in most elementary text-books, but he would acquire something of greater practical value, an appreciation of the manner in which the design of an experiment affects the precision of the results and the efficiency with which the experimenter's time and resources are used.

Dr. Cox's book is far more than an introductory text. With the exception of Davies, probably no writer on design has given comparable attention to questions of general planning, such as the choice of treatments and levels for testing, of experimental units, and of measurements. Anyone concerned with experimental statistics can benefit from studying, for instance, the sections on types of factors and interactions and the choice of factors for inclusion in an experiment. An excellent and varied collection of examples will make the book also of value to the teacher.

The only serious blemish is the conversion of 6.25 dollars into a British price of 60 shillings. **D. J. FINNEY**