BOOK REVIEWS

ROCKAFELLAR, R. TYRELL, *Convex Analysis* (Princeton University Press, 1970), xviii+451 pp.

This book presents a branch of nonlinear several-real-variable analysis of growing importance in the study of optimisation problems in many areas of applied mathematics, in which differentiability assumptions are systematically replaced by convexity assumptions. It develops the theory of convex sets and functions from scratch with the sights aimed at convex programs and the relation between them and their duals. There are eight main sections: Basic Concepts; Topological Properties; Duality correspondences; Representations and Inequalities; Differential Theory; Constrained Extremum Problems; Saddle Functions and Minimax Theory; Convex Algebra.

The book is written at graduate level, but to quote the Preface " In view of the fact that economists, engineers and others besides pure mathematicians have become interested in convex analysis, an attempt has been made to keep the exposition on a relatively elementary technical level ", and in fact the only prerequisites are a sound knowledge of elementary real analysis and linear algebra, plus preferably some notion of the applications for which convex analysis is designed.

A central tool in the development is Fenchel's conjugacy operation for convex functions, while the later theory is unified by the neat and remarkably versatile notion of a (convex) *bifunction*, which is simply a convex function F on the product of two linear spaces, regarded as associating to each u in one space a convex function Fu on the other; heuristically Fu is the perturbation of an " original " objective function FO caused by changes in a set of initially zero parameters $u = (u_1, \ldots, u_m)$. Throughout, the author shows how hypotheses of theorems can be weakened in the presence of extra conditions, such as polyhedrality of a convex set or function. To help one through the resulting proliferation of detail there is an introductory section guiding one to the most significant results. (I still tended to get bogged down; a better page-layout and the judicious use of bold type would have helped.) The style is easily read and there are plenty of worked examples. There is an adequate index of some 500 entries, and a section on history and references, with a large bibliography.

The plethora of detail reflects the fact that this is a young subject, and that the book is a reference text oriented towards those who need the techniques of convex analysis in practical problems. The continual honing-down process of mathematics may furnish future introductions to the subject with a more streamlined approach, but this book should remain for some years the standard reference for anyone interested in convex analysis. I recommend it strongly.

J. D. PRYCE

ADAMS, J. F., *Algebraic Topology—A Student's Guide* (London Mathematical Society Lecture Note Series 4, Cambridge University Press, 1972), vi+300 pp.

This book is aimed specifically at research students in algebraic topology. The first part of the book, consisting of 31 pages, could be described as a statement of what every professional algebraic topologist should know together with the sources from which the material can be studied. Students should find the advice given in this section very useful, particularly the recommendations of which papers to read (and occasionally which papers not to read) for each particular topic.