homology groups up to the definition of the extension functors as the derived functors of Hom, and the proof of the basic exact sequences for the extension functors. In the last two chapters this is applied to a discussion of the various homological dimensions and an introduction to duality theorems and quasi-Frobenius rings.

This book covers a remarkable amount of ground in 88 pages. Although, as a consequence, the style is occasionally a little compressed, it is not a difficult book to read. In the opinion of the reviewer, the book would form an excellent basis for a lecture course aiming at introducing research students to the tools of homological algebra, and the excellent sets of exercises at the end of each chapter enhance its value in this respect.

D. REES

HADWIGER, H., DEBRUNNER, H. AND KLEE, V., *Combinatorial geometry in the plane* (Holt, Rinehart & Winston, London, 1964), vii+113 pp., 30s.

This most interesting book is a translation by Klee, with additional material, of the monograph *Kombinatorische Geometrie in der Ebene* (Geneva, 1960) by the first two authors; this in turn was based on an article by Hadwiger in *L'Enseignement Mathématique*, (2) **1** (1955), 56-89, subsequently translated into French by J. Chatelet. So the exposition is not entirely new, but it is convenient to have this compact presentation of the material in English. In their Introduction the authors comment on the basically elementary nature of the methods of plane combinatorial geometry. It is perhaps surprising that the elementary properties of convexity are often not included in the undergraduate syllabus, though as far as (lack of) difficulty is concerned they are well within the scope of the course. Apart from the intrinsic interest of the subject, so apparent in this book, and its application to the now fashionable topics of game theory and linear programming, convexity is of importance later in functional analysis. It is also interesting to note that a recently published survey of " new school mathematics " (*Some Lessons in Mathematics*, C.U.P., 1964) includes a short chapter on convexity in which Helly's theorem (see below) is mentioned. Lest, however, it be thought that mathematical silk purses can be made too easily from sows' ears, it should be added that the simple nature of the tools has to be matched with considerable ingenuity in their use!

The first 40 pages of Part I of the book contain the statements of 98 propositions, set out as problems, with connecting explanatory material and references. Many of the problems derive from the fundamental theorem of E. Helly that if in a family of bounded closed convex sets in real n-dimensional space, every $(n+1)$ of the sets have a common point, then there is a point common to all the sets of the family. The proofs are given or sketched in Part II (pp. 57-98). Whether this mode of presentation, used so successfully in Polya and Szegö's famous collection of problems on analysis, is ideal here is open to some doubt. Certainly it gives a good bird's-eye view of the subject, but there will probably be few readers among the uninitiated who progress far without rather frequent glances at Part II! As an (admittedly extreme) example it may be mentioned that problem 76 is van der Waerden's celebrated theorem on arithmetic progressions, appearing here in a slightly unfamiliar geometrical guise. This is in Section 9, whose subject matter overlaps most closely with " combinatorics " as the word is understood today. It also includes F. P. Ramsey's combinatorial theorem and the " marriage problem " theorem of P. Hall (though the standard necessary and sufficient condition for that problem does not appear to be stated explicitly). The relevance of this section to the kind of problem treated elsewhere in the book becomes clearer on reading the corresponding part (pp. 52-54) of the translator's addendum. The latter, entitled " Further development of combinatorial geometry " occupies pp. 40-56 of Part I. It contains n-dimensional generalisations of some of the earlier results, and other material, including problems 99-109. These are not discussed in Part II but, as elsewhere in the book, adequate references are given. Finally, there is a bibliography of 202 items (of which the last 86, forming a separate alphabetical sequence, were added by the translator) and an index.

The book, which is one of the publishers' Athena Series, can be recommended for the impression it gives of the power of elementary geometrical reasoning.

D. MONK

BELLMAN, RICHARD, *Perturbation Techniques in Mathematics, Physics and Engineering* (Holt, Rinehart and Winston, London, 1964), 118 pp., 30s.

The text is divided into three sections whose titles " Classical Perturbation Techniques ", " Periodic Solutions of Nonlinear Differential Equations and Renormalisation Techniques ", and " The Liouville-WKB Approximation and Asymptotic Series ", give some indication of the range of topics discussed. The style is annoyingly " chatty " and oratorial, and one cannot help but feel that here is a series of lectures bound into a book. As is permissible in a course of lectures to a known audience, but is not permissible in a book, the sections are of uneven depth, some of the simpler work being over-explained at the expense of some of the more difficult! The text will certainly be of interest to the applied scientists for whom it was written, but I fear that many will find it a difficult text, even with the knowledge of " an intermediate course in calculus and the rudiments of the theory of ordinary differential equations " assumed by the author. The reader is invited to try a " plethora † of problems "; too many of these are of a pure mathematical nature. There are extensive references to the background material of the book. The typography is excellent.

J. W. SEARL

LINNIK, YURI V., *Decomposition of Probability Distributions* (Edinburgh and London, Oliver and Boyd, 1964), xii+242 pp., 84s.

It has been common knowledge over the past few years that a considerable amount of work had been done by the Russian school on what has been called the " arithmetic of probability distributions ": i.e. topics such as the factorisation of characteristic functions into the product of two (or more) non-trivial characteristic functions, or equivalently the representation of a distribution function as the convolution of two others. Nevertheless probably all but the already-committed specialist have been deterred by the combination of language difficulties and the somewhat inaccessible character of the relevant journals from investigating this, for only relatively short accounts have been given in English. Now, however, the present book by Linnik, who has himself been responsible for much of the work in the field, has made the task much easier.

The first six chapters (approximately half the book) begin by setting down the basic requirements from real and complex variable theory, giving in some detail the essentials of less familiar topics, then summarise many of the properties of characteristic functions, and finally give the almost classical theorems of Cramér and Raikov on the decomposition of the Normal and Poisson laws respectively. While its contents are available elsewhere, this part of the book is in fact very useful.

The remainder of the book describes recent developments, in the direction suggested

† Any unhealthy repletion or excess! S.O.E.D.