It is impossible in the space of a brief review to do justice to the tremendous wealth of mathematics which has been compressed within the 148 pages of this book. The first three chapters contain interesting examples which are examined in detail in subsequent chapters. The author claims that the reader could start at chapter IV and refer to the earlier chapters only when necessary. The treatment of the first three chapters, however, is clearly the study of complex manifolds from the viewpoint of a differential geometer, and this geometrical way of thinking is present throughout the whole book. The essential step in chapter IV is the introduction of a new pseudo-distance on every complex manifold in an intrinsic manner. A complex manifold is called hyperbolic if this pseudo-distance is a distance. This new pseudo-distance has two basic properties shared with the classical pseudo-distance of Carathéodory; first, they agree with the Poincaré distance on the unit disk, and second, every holomorphic mapping is distance decreasing. In some sense, the Carathéodory pseudo-distance is the smallest while the new pseudo-distance is the largest. Many results on complex manifolds are obtained by purely metric space/topological methods.

Chapter V deals with holomorphic mappings of a complex manifold into a hyperbolic manifold. In chapter VI Picard's theorem is generalized to higher dimensional manifolds. Chapter VII shows how results of chapters IV, V and VI could be extended to apply to complex spaces. Relationships between hyperbolic manifolds and minimal models are studied in chapter VIII. In chapter IX two kinds of intermediate dimensional measures on a complex manifold are introduced in an intrinsic manner. This chapter ends with a list of unsolved problems. From chapter IV onwards nearly all the material is to be found in recent research papers. Although the author displays his mastery of the subject matter, this is a tough book to understand. In order to read the book it is necessary to have some knowledge of modern differential geometry (for example, volumes 1 and 2 of *Foundations of Differential Geometry* by Nomizu and Kobayashi). Metric topology, Lie groups, fibre-bundles, homotopy theory, sheaf theory, Chern classes, measure theory and the theory of seminorms are all grist to the author's mill. The book concludes with an extensive bibliography of more than 130 items, most of which have appeared only during the past decade.

This is a really important book for the professional mathematician. It is well printed. The only misprint which I was able to spot was on the inner dust cover where it seems that the author was a Sloan fellow at the tender age of 12 years!

T. J. WILLMORE

Pyrimidines up to Date

The Pyrimidines: Supplement 1. By D. J. Brown. With chapters by R. F. Evans and T. J. Batterham. (The Chemistry of Heterocyclic Compounds: a Series of Monographs.) Pp. xxiv + 1127. (Wiley-Interscience: New York and London, November 1970.) 425s.

THE original volume of *The Pyrimidines* by D. J. Brown was published in 1962 and provided a comprehensive review (to 1957) of the practical aspects of this subject, as well as providing a summary of information on the properties and on the absorption spectra of pyrimidines and giving a short general introduction to pyrimidine chemistry. The first "Supplement" updates the review to the end of 1967. The need for such a supplement is obvious. In the original volume about half of the 2,200 references were dated 1950 or later, whereas the supplement cites 2,200 new references.

This supplement is not a new edition of *The Pyrimidines*, and is intended to be used in conjunction with the original volume (like any *Ergänzungswerk* volume of Beilstein—the author's expression). The format of the supplement is thus the same as that of the original volume and the chapter and section headings are followed by a reference to the corresponding part of the original volume. There are, however, a number of new sections having no counterpart in the original volume. The chapters on the introduction to pyrimidines, on synthetic methods and on the syntheses and reactions of substituted pyrimidines are followed by a chapter by R. F. Evans on the reduced pyrimidines (including a new section on mass spectra), and a chapter on the ionization and spectra of pyrimidines. This chapter includes a new section by T. J. Batterham on the nuclear magnetic resonance spectra of pyrimidines. Then follows the appendix table giving the melting points and literature references of simple pyrimidines, the numerical list of references and the detailed index to the supplement. Like the original volume the supplement does not detail fused-ring pyrimidines, nor does it consider the more biological aspects of pyrimidine chemistry or the nucleic acids.

By using the supplement with the original volume the methods of synthesis and the reactions of many types of substituted pyrimidines may be found and, by consulting the tables, the literature and melting point of any simple pyrimidine described up to mid 1967 can easily be obtained.

This supplement is an essential companion to the original volume and will be welcomed by all those who work in pyrimidine chemistry and related fields. They owe much to D. J. Brown for the invaluable and painstaking work that he and his colleagues have done to produce this monumental work. D. T. HURST

Abstract Linear Algebra

Les Matroïdes: Nouvel Outil Mathématique. By C. P. Bruter. (Initiation aux Nouveautés de la Science, Nr. 21.) Pp. xii + 192. (Dunod: Paris, 1970.) 38 francs.

THIS book is arranged in two parts—one of introduction and one of applications. The first two chapters are an excellent and concise introduction to set theory and modern algebra. The last two chapters concern linear programming and graph theory. Although of university standard, the book could be read with profit by any non-specialist, not necessarily a mathematician. The coverage is too brief, however, to serve as a course text.

A matroid is a finite set E together with a function from the set of subsets of E to the non-negative integers satisfying certain conditions. Matroids give the structure of the underlying sets of modules with a finite number of elements. Thus the study of matroids (due to Whitney in 1935) is that of abstract linear algebra. The structure of a graph can be given as a matroid by considering its circuits.

The first chapter begins with set theory, relations, equivalence relations and classes, and continues with correspondences and functions. By defining correspondences (generally omitted at this level) before particularizing to functions, the author is able to define a partial groupoid (a set closed under a binary operation which is not necessarily defined on every pair of elements). This leads to the definition of a left neutral partial groupoid in which multiplication on the left, when defined, leaves the element on the right unaltered. This operation is easily represented as a graph. Conversely, a graph without repeated edges has the structure of a left neutral partial groupoid. The author makes, however, perhaps too great a claim for the primacy of the latter among algebraic structures.

Then follows the natural progression of algebraic structures from partial groupoids to groups and thence to rings, integral domains and fields. This leads to the most important and, for this book, the most central structure, modules, and consequently to vector spaces and linear transformations. Structure preserving mappings are called morphisms throughout. Affine and projective spaces are mentioned as well as various types of lattices. The solution of linear equations by pivotal condensation is explained in detail and this method is used for the solution of several problems in linear programming.

Applications are given to several optimization problems, and the book is notable for the many examples given in the text.

J. W. P. HIRSCHFELD