

example, alkylnitrenes, aryl nitrenes, carbonyl, sulphonyl, amino-nitrenes. All of the foregoing classes are the subject of separate chapters, and the book also includes sections on the electronic structure and spectra of NH and nitrenes, deoxygenation of nitro and nitroso compounds, acylnitrene cyclizations, cyanonitrene, nitrenium cations ($R_2C=N^{\oplus}$) and, finally, other nitrenes, including NH itself and nitrenes of elements other than C, N, S or H.

Apart from cataloguing past work on the various species, this is very much an account of work still in progress. Thus differences of opinion are to be found on such topics as the extent to which nitrenes are involved as intermediates in the reduction of aryl nitro and nitroso compounds as a prelude to their self-cyclization. The various authors have been allowed to speak for themselves with, apparently, the minimum of editing; this makes for some lack of uniformity and a certain degree of overlap, which is partly compensated for by a liveliness and ease of flow that is to be welcomed.

There is no doubt that this is a definitive collection of articles by a number of the principal workers in the field; it is indispensable for anybody actually working in this area, but it is also extremely interesting for its own sake and is likely to prove most stimulating to anybody concerned generally with reactive intermediates and reaction mechanisms. The general layout and production are excellent.

PETER SYKES

RECURSIVE FUNCTIONS

Recursiveness

By Samuel Eilenberg and Calvin Elgot. Pp. vii + 89. (Academic: New York and London, August 1970.) 61s.

THE concept of recursiveness was formulated in Gödel's sensational work in 1931 on the limitations of mechanical languages: he proved that even the true statements of elementary arithmetic could not be recursively generated. Subsequently, Turing formulated his concept of an abstract computing machine; the functions computable by these machines are exactly the recursive functions. Turing also produced a very convincing analysis of mechanical computation, which indicates that any mechanically computable function could be computed on his machines. Assuming this to be correct, the Gödel theorems reveal absolute limitations, the philosophical connotations of which are obvious enough, even if their exact implications are a matter for controversy.

The initial excitement which greeted Gödel's and Turing's work has inevitably diminished, essentially because the results are negative and limitations are never very attractive. Research in the area has gradually concentrated around its more positive aspects, the most important being a number of unsuspected applications within the wider field of mathematical logic and set theory. Attention more recently has (ironically) turned towards increasingly formal axiomatizations of the theory, and this brief monograph is one of a number of recent contributions in this direction.

One departure from standard practice is that the framework of category-theory is used throughout the book, and the authors are to be congratulated on the elegant development which this makes possible. Also, some of the new closure conditions which they use to formulate recursiveness are especially interesting and powerful. I have only three criticisms to make. First, very little effort is made to relate the development here to other work in the area. Second, the formulation of recursiveness on sets of words over a finite alphabet, in which the authors follow much current practice, offers special advantages in the treatment of recursiveness on

syntax and hence of Gödel's theorems, and so it is to be regretted that no such treatment is included. Finally, the connexions with automata theory and mathematical linguistics, which are alluded to in the introductory remarks, are never discussed in detail. This is particularly unfortunate because the book seems to be aimed at research workers in these fields. Nevertheless, those who are familiar with the revolutionary effects of the Eilenberg–Steenrod axiomatization of algebraic topology twenty years ago may suspect that this monograph is not the final word.

C. E. M. YATES

MODULE ALGEBRA

Rings, Modules and Linear Algebra

By B. Hartley and T. O. Hawkes. (Chapman and Hall Mathematics Series.) Pp. xi + 210. (Chapman and Hall: London, September 1970.) 45s.

A VECTOR space is built up linearly by means of "scalar" multipliers from a number field. The more general concept of a module replaces the field by an arbitrary ring (with unity) related to an Abelian group so that a "product" is defined satisfying the usual distributive and associative laws. This highly abstract concept coordinates much linear theory.

The authors assume some knowledge of set theory, vector spaces, and matrices, work now generally dealt with in a good sixth form. The book itself is in three parts. In the first part, rings are defined and studied, to show in the main what properties of fields continue to hold for rings, and the module is defined. The natural austerity of the subject is mitigated by some informal comment, and there are useful exercises; a well-grounded student should find no serious difficulty in reading this section. The second part concerns structure theory; this is likely to be found stiffer going, and the authors have helped by giving two accounts, one using matrices, the other presenting a more compact version of the fundamental theorems on structure without using matrices. The reader may find the former version easier to grasp, but should not ignore the latter, more difficult perhaps but ultimately giving a better insight. The final section studies some applications. One concerns the classification of finitely generated Abelian groups. The other deals with canonical forms of matrices, leading eventually to the calculation of eigenvalues, a problem apt to turn up in many mathematical investigations.

The authors have provided a clear introduction to a theory of considerable elegance and power.

T. A. A. BROADBENT

FOREST DISEASES

Tree Pathology

A Short Introduction. By William H. Smith. Pp. xii + 309. (Academic: New York and London, August 1970.) 103s.

NEW books on forest pathology are rare, and one looks forward with interest to reading a new author's views on the subject. This book proves eminently readable, but as a short introductory textbook it does have a number of limitations.

The author claims to have compiled a compendium of "significant pathological stress factors", and not to have given a "comprehensive account of the diseases of forest trees". In the space of some three hundred pages one could not endeavour to cover this subject in depth, and the approach is essentially superficial. Selected