University Algebra, by Richard E. Johnson. Prentice-Hall, 1966. xii + 271 pages. $7.95.

This book has thirteen chapters, covering such standard concepts as groups, fields, rings, vector spaces, and determinants, with additional material on algebraic extensions, factorization in integral domains, lattices, etc. The reviewer has read carefully (and taught from) only the first five and one-half chapters and cannot comment on the remainder of the book.

The material on set theory and number theory is very skimpy (there are no exercises on the former and only a few on the latter). The author apparently assumes that the students will have been introduced to these topics elsewhere and will have acquired some competence in them (many exercises in later chapters require a real familiarity with elementary number theory). He also states certain basic facts (such as the completeness property of the real numbers) without making it clear whether the student should regard them as axioms or theorems.

The author is sometimes too intent on generality, and sometimes not intent enough. His definitions of the greatest common divisor and least common multiple of two integers beg the question of existence and do not yield unique integers, but they are the right definitions in more general integral domains. He proves Euclid's theorem that $p|ab$ implies $p|a$ or $p|b$, then postpones for six chapters a proof of the fundamental theorem of arithmetic, so that the latter becomes a special case of a theorem on unique factorization domains. On the other hand, he devotes separate chapters to Abelian groups and commutative rings before discussing general groups and rings, thus causing a certain amount of confusion, wasted effort and unnecessary restrictions in the statements of theorems (for example, the general associative law and some of the laws of exponents hold in any group, and it is slightly confusing to embed their proofs in a chapter on Abelian groups).

Although there are probably enough hard problems, there are not nearly enough of a routine or computational nature to enable the student to get well-acquainted with the concepts. The book has an egregious number of misprints and small errors, and the booklet of selected answers to problems (published separately) is untrustworthy. For a long list of errata and various additional comments (covering the first third of the book), interested readers may write the reviewer.

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Abstract Algebra, by C.-H. Sah. Academic Press, New York and London, 1967. xiii + 352 pages. $9.75.

This is a text for an advanced course for upper undergraduate or

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graduate students. After two introductory chapters on sets and functions, and integers and the rational numbers, the author develops elementary group theory; elementary ring theory; theory of modules, tensor products and algebras (including the decomposition of finitely generated modules over principal ideal domains); theory of vector spaces and canonical forms of matrices; theory of algebraic and transcendental extensions of fields; and Galois theory with classical applications. Thus the material is more or less classical (except for the chapter on modules it is roughly the same as the first volume of the English edition of van der Waerden), but the language is modern.

The book has a number of good features. In particular, I found the author's digressions on crucial points helpful. There are numerous good examples and exercises (with plentiful hints), and often the proofs of minor points are relegated to exercises. There are "Excursions" which deal with topics off the main path, and each chapter ends with a list of further references.

In spite of these features, I would not choose this book for a text. I believe that in general a student would find it unnecessarily hard work to read. Where notation and definitions should be used to clarify and simplify the subject, too often the notation obscures the essentially simple, and definitions are too numerous. A textbook should be written for the student's benefit, and there seems little excuse for a mass of symbols where a few extra words would clarify a statement and made the reading smoother. Categorical language has justified itself and the notion of a universal element seems to be especially valuable, but a student should be warned that (at this level at any rate) it <u>is</u> only a tool. Perhaps the irreverence of Serge Lang in referring to "generalized nonsense theory" is appropriate. This book contains some of the exciting and deep theorems in algebra; it is a pity if the student is left negotiating the shallows.

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<u>The variational theory of geodesics</u> by M.M. Postnikov. Translated from the Russian by Scripta Technica Inc. edited by Bernard R. Gelbaum. W.B. Saunders Company, Philadelphia and London, 1967. viii + 200 pages.

The general trend of this book, whose first Russian edition appeared in 1965, is modern throughout. Its primary concern is an important area of contact between the calculus of variations and differential geometry, namely the theory in the large of geodesics on Riemannian spaces.

The book as a whole is self-contained. It begins with a somewhat unusual introduction to the theory of differentiable manifolds, multilinear algebra and exterior differential forms. The next two chapters are respectively concerned with affine connections and Riemannian geometry.