respectively as " The lower and middle school " and " The higher school ". The first covers algebra and geometry, and the second calculus and analytical geometry. The translation reads well and the treatment is clear and concise, and, especially in the second part, is illustrated by quotations from original sources. The translator has added a humber of footnotes of his own and has adapted the author's bibliography for English-speaking readers.

Although it shows no marked originality of material or treatment, this moderately priced book should prove entirely suitable for its avowed purpose.

R. SCHLAPP

HIGGINS, P. J., *A First Course in Abstract Algebra* (Van Nostrand, 1975), vi+158 pp., £2·25 (paper back), £4·50 (cloth).

In this book the author has " tried to combine a careful treatment of the rudiments of abstract algebra with a study of various topics in which the use of abstract algebra, though not essential, is natural and illuminating ". Elementary properties of groups, rings and fields are discussed and are then used to investigate integers and polynomials. There are eleven chapters with the headings: What is Abstract Algebra?; Set Theory; The Integers; Groups; Factorisation in $\boldsymbol{Z}$; New Groups from Old; Linear Congruences in $\boldsymbol{Z}$; Rings and Fields; The Ring $\boldsymbol{Z}_n$ and the Field $\boldsymbol{Q}$; Rings of Polynomials; Polynomials over $\boldsymbol{C}$, $\boldsymbol{R}$, $\boldsymbol{Q}$ and $\boldsymbol{Z}$.

Group theory is developed up to the First Isomorphism Theorem, direct products and subgroups of cyclic groups. The chapter " Rings and Fields " covers elementary concepts up to the First Isomorphism Theorem and the field of fractions of an integral domain. The applications reach such results as unique factorisation theorems in integers and polynomials, Euler's theorem, and the theory of partial fractions for both integers and polynomials.

Most students meeting abstract algebra for the first time should find the wealth of applications of elementary results presented in this book both exciting and illuminating. I have some reservations, however, concerning the presentation of the theoretical aspects of groups and rings. In some places the language is not as precise as could be wished, for example " Given a partition $X = \bigcup_{i \in I} X_i$ of the set X . . .". Proofs are surprisingly terse considering the level of the book and consequently a student may fail to grasp the full significance of the ideas. I quote two examples. Part (vii) of the first theorem concerning groups states " if $x_1, x_2, \ldots, x_n \in G$ then the product $x_1x_2, \ldots, x_n$ is independent of the position of brackets ". The expression $x_1x_2, \ldots, x_n$ is not defined and there is no discussion of how to insert brackets to make it meaningful. The generalised associative law surely involves a subtlety that merits a careful treatment at its first introduction. The second point involves a subgroup of a group which is defined as a subset containing the identity of the group and being closed under products and inverses. The author then claims that it is easy to see that a subset of a group which is itself a group under the restricted multiplication is a subgroup. There is no discussion of the point that the subset which is itself a group might have an identity other than that of the whole group. The strength of the book however lies in its examples, applications and numerous exercises, all of which are pitched at the right level.

I have noticed one incorrect exercise (on page 38 the reader is asked to prove by induction that $n^2 \leqq 2^n$ for all positive integers n) and twelve printing errors, only one of which could conceivably cause misunderstanding. The quality of printing is adequate although since it is not justified on the right the pages have a ragged appearance. The book is reasonably priced and its enthusiasm and practical approach make it an interesting introduction to abstract algebra.

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