reviewer feels that the clarity might have been enhanced by the inclusion of more illustrations. Italics, we feel, are used to excess, sometimes for definitions and sometimes for emphasis, and the reader is not always certain for which purpose they are employed. We would have welcomed also introductory paragraphs outlining the purpose and chief results of each chapter, for, as is common in many works on algebra, the reader often finds it difficult to decide which results are of prime importance and which results are secondary. The printing is excellent.

D. E. RUTHERFORD

PICCARD, SOPHIE, *Sur les bases des groupes d'ordre fini* (Neuchatel, Secrétariat de l'Université, 1957), pp. xxiv+242.

Mlle. Professor Piccard is known not only as an enthusiast but also as the expert on the bases of finite permutation groups. It follows that those who are interested in this topic will give her book a warm welcome. To describe the subject matter to the uninitiated it is perhaps best to illustrate it with an example. The symmetric group $\mathscr{S}_4$ of all permutations on four letters which we may designate simply as 1, 2, 3, 4, is generated by the three transpositions (12), (23), (34). These three independent generators form a system of order 3. Quite apart from equivalent systems of generators obtained from the above merely by renumbering the letters, other systems of independent generators are possible and those of the smallest possible order are called bases. In $\mathscr{S}_4$ the bases are of order 2 and indeed this group can be generated by any one of the following pairs of permutations (123), (34); (1234), (12); (1234), (123); (1234), (132); (1234), (1324). Thus $\mathscr{S}_4$ has five different types of base. For any given base there are a set of characteristic relations which define the group. For instance if $S = (1234)$ and $T = (1324)$ the relations which define $\mathscr{S}_4$ are $S^4 = TS^2T^{-3}S^2 = TSTS^3T^{-1}S^3 = 1$. The book under review is a study of such bases and characteristic relations, especially those of the symmetric and alternating groups but also of many other permutation groups with special types of base. The value of the subject is that it throws some light on the difficult problem of classifying all finite groups of a given order according to their structure.

Parts of this volume are necessarily in the nature of a catalogue of bases of those groups which have been fully investigated. For instance there are 2308320 bases of the alternating group $\mathscr{A}_7$. As might be expected Hölder's theorem that $\mathscr{S}_6$ is the only symmetric group possessing outer automorphisms can be established by considering characteristic relations.

The book is carefully composed and excellently printed. A very useful feature of the work is a preliminary synopsis defining all those group concepts with which the reader is expected to be familiar, and including some results established in Mlle. Piccard's two previous works on the symmetric group. These features make the book self-contained. It is a pity that there is no index in addition to the Table of Contents.

D. E. RUTHERFORD

KHINCHIN, A. Y., *Three Pearls of Number Theory* (Graylock Press, Rochester, N.Y., 1956), $2.00, 64 pp., 16s.

This little book contains an account of three very beautiful results in Number Theory. They are typical of the subject in three respects : the deceptive simplicity of statement ; the complication of their proofs (which even Khinchin's lucid exposition cannot entirely hide) ; and the fact that each one was first proved by a young man on the threshold of his career, after defeating the efforts of learned mathematical scholars.

The book is thus not merely a lifeless exposition of abstractions, but a human document, full of challenge and stimulation. It is excellent reading for the