Mathematical Methods of Operations Research. By Thomas L. Saaty. 421 pp. McGraw-Hill Book Co., Inc., New York, 1959. $10.00.

Operations Research—Methods and Problems. By Maurice Sasieni, Arthur Yaspan, Lawrence Friedman. 316 pp. John Wiley and Sons, Inc., New York, 1959. $10.25. *Reviewed by Philip M. Morse, Massachusetts Institute of Technology.*

THE two volumes under review illustrate the progress of operations research in the past two years. Brochures defining the subject and arguing its value are no longer sufficient (if they ever were); these books are written to be texts suitable for the courses in operations research now being offered by numerous universities. They discuss the special theoretical and experimental techniques which have recently been developed to measure, simulate, and predict operational behavior. They also exhibit the beginning of a differentiation of the field into its "pure" and its "applied" aspects, Saaty's book tending more toward the philosophical and theoretical and the book by Sasieni et al. devoting most of its pages to a series of examples illustrating the use of the methods in practice.

Both volumes have chapters on probability and statistics, on linear programming, on game theory, and on queuing theory. That of Sasieni, Yaspan, and Lawrence Friedman discusses these in connection with specific operational situations, such as inventory management, allocation problems, and competitive situations. Saaty's book devotes space to a discussion of logic and the scientific method, and is perhaps more useful to one who likes his introductions logical and general; Sasieni et al. will be preferred by those who learn by concrete examples. Thus the two treatments complement each other; between them they give a fairly complete picture of the present state of development of operations research. They will, of course, be out of date in two or three years.

Applications of Finite Groups. By J. S. Lomont. 346 pp. Academic Press Inc., New York, 1959. $11.00. *Reviewed by J. Gillis, The Weizmann Institute of Science.*

THE unfaltering success of the process which reduced one field of physics after another to systems of differential equations might be said to have started with Newton, although earlier unsystematic attempts on these lines date back, in principle at least, as far as Archimedes. The rise of quantum theory at the beginning of this century seemed to threaten difficulties, but these were successfully dealt with by Schrödinger in 1926. Schrödinger's work opened up possibilities which Heitler and London and their successors were quick to exploit for the investigation of chemical bonding, molecular structure, etc., questions which for centuries had been treated on a phenomenological basis, with very little theory and less understanding.

Remarkably enough it was precisely this culminating success of the methods of infinitesimal calculus which brought scientists up against one of its serious limitations. For, as the author points out in the book under review, it is not a suitable instrument for expressing properties of symmetry. Differential equations describe local properties of functions while symmetry is a property in the large. Thus, except for such simple symmetries as could be taken care of by a fortunate choice of coordinate system, a new idea was necessary. And this was precisely what group theory, already a well-developed discipline, provided. It is no accident that the first good book on group representations and their applications (Wigner, 1931) appeared at the same time as the wave equation attack on molecular problems was getting into its stride. Of subsequent books one might mention two on the fundamental theory of group representations (Murnaghan, 1938; Littlewood, 1950) and one written from the point of view of application (Higman, 1955).

Dr. Lomont's book, however, is in a class of its own. The group theory used is at the very forefront of the subject, while the applications are worked out in a manner which demonstrates the full power of the method. This is not an easy book for whiling away idle moments. It will have to be read, or rather studied, with pencil and paper at hand; but those prepared to make this effort will find it amply rewarding.

The first chapter is a compendious résumé, without proof, of the relevant results of matrix algebra. The second chapter begins with an account of the basic theory of abstract groups, mainly without proofs, though some connections between theorems are occasionally sketched in. The second part of this chapter is devoted to three applications of abstract group theory; transformations of thermodynamic relations, the Dirac equation, and a group theoretic introduction to annihilation and creation operators for fermions.

However, it is in Chapter 3 that the real business of the book begins. We are first given a rapid development of representation theory, with outline proofs, leading up to the "key theorem". The proof of this last theorem is deferred to an appendix and is there given in full. Representation theory is then further developed into character theory and various techniques for the calculation of character tables are described. All of this is illustrated by reference to some of the classical groups.

Chapter 4 presents an impressive collection of applications. It begins with the further development of annihilation and creation operators and continues with an instructive account of the classical theory of molecular vibrations and of the theory of symmetric wave guide junctions. This is followed by a discussion of crystallographic point groups, a subject on which it would be very difficult by now to find anything very new to say. It is interesting, however, that the treatment in this book makes it possible to handle the subject quite exhaustively in some 17 pages, including such questions as the dielectric and elasticity tensors of crystals, etc. After this there is a digression into con-