An Introduction to the Theory of Groups of Finite Order

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A conspicuous place in recent pure mathematical literature is occupied by the Theory of Groups, but few opportunities have been given to the mathematician who does not wish to specialize in this direction to get a general idea of the scope of the theory. The type of investigation in which the method is used may be gathered from very simple examples. Suppose three men, X, Y, and Z, are standing in a row ; their relative positions may be altered by two operations: *(a)* moving the first man to the second place, the second to the third, and the third to the first, so that X, Y, Z, become Z, X, Y ; and *(b)* keeping the first man fixed, and interchanging the other two, so that X, Y, Z, become X, Z, Y. These two operations may be repeated in any order. The repeated operation *a*, *a*, changes X, Y, Z, to Y, Z, X whilst *b*, *a*, changes X, Y, Z, to Z, Y, X. The men are restored to their original positions by repeating the process a three times. This is expressed by saying that $a^2 <= 1$. In the same way $b^2 = 1$. Again, the successive performance of the operations *a*, *b*, *a*, *b*, also brings the men back to their original stations. This is expressed shortly by saying that *b*, *a*, *b*, $a=(b)^2=1$. Now consider a triangular prism, and 'P' that a fly can walk along its edges. The letter a signifies “walk along the side of a triangular end, in the clockwise direction.” The letter b signifies “walk along the edge common to the rectangles.” It will be noticed that a, a, a, means “walk round a triangle and come back to the same point,” so that $a^2 = 1$; *b*, *b*, means “walk to the other end of the prism and back,” so that *b* = 1; whilst *b*, *a*, *b*, *a*, means “go round a rectangle,” so that $(ba)^2 = 1$. In our two examples the laws of combination of the *a*'s and *b*'s are the same, and in the abstract theory of groups the two examples are considered identical. In each case there is a group of the sixth order, since there are six arrangements of the men and six corners of the prism. The processes *a* and *b* are called the generators of the group. Mr. Hilton's book contains many examples of the construction of groups; in fact he devotes about two-thirds of his space to the possible elements of groups, *i.e.*, permutations, algebraic substitutions, and geometrical movements. In the later chapters he confines his attention to abstract theory, and never interprets it in terms of the concrete examples which would give greater interest to the subject. This is especially unfortunate because the work was undertaken apparently with the express intention of showing that even the most recent developments of pure mathematics are not necessarily beyond the reach of the ordinary mathematical reader. On the other hand, the student who is making a serious study of this branch of pure mathematics will find the textbook of great assistance.

We must add a note about the printing. The book must have been very difficult to set up in type, owing to the frequent occurrence of mathematical formulae; but it is remarkably free from printers’ errors.

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