THE PITTSBURGH SYMPOSIUM ON GROUP THEORY AND QUANTUM MECHANICS

In connection with the Annual Meeting of the Society at Pittsburgh, it was arranged to hold a symposium on *Group theory and quantum mechanics* under the joint auspices of the American Mathematical Society and the American Physical Society. The program was planned in co-operation with Professors H. P. Robertson and J. H. Van Vleck.

The symposium was held on Saturday afternoon, December 29, in the Union Room of the Carnegie Institute of Technology, and was followed by an interesting discussion; Professor Robertson presided. There was a large attendance of mathematicians and physicists. Abstracts* of the several addresses appear below.

I. *Representations and ray-representations in quantum mechanics*, by Professor John von Neumann.

It is known that any symmetry property of an intuitively described physical system finds its mathematical expression in the existence of a certain group under the operations of which the mechanical determining equations of the system are invariant. This group-theoretical principle of symmetry has been particularly suitable for group-theoretical methods. The mathematical theory, the application of which has in this connection led to many results in various fields of quantum physics, is the so-called *theory of representations*. As the states of the quantum mechanical system are really described, not by a uniquely defined wave-function, but by one which is only known—and has a physical meaning only—to within a constant factor of absolute value 1, the discussion must be based not on the theory of representations proper, but on that of representations to within a constant factor of absolute value 1. These have been called ray-representations. If the group of symmetry operations is a continuous (Lie) group, the representations may be discussed by considering the so-called infinitesimal representations of the group. These are characterized by certain commutation properties which, in the case of a ray-representation, will only be valid to within an additive constant multiple of unity. In some cases, these extra terms can be eliminated (transformed away). In some other cases they vanish automatically. There exist groups, however, for which neither is the case and the extra terms play an essential role. These possibilities are discussed for various main types of symmetry-groups.

* Because of illness, Professor von Neumann was unable to read the paper which he had prepared. It is nevertheless desirable to include the abstract of his work in this report for it furnishes a natural introduction to the other papers and the notions contained therein were referred to by the other speakers.