NEW FOUNDATIONS OF QUANTUM MECHANICS

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BY

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CONTENTS

CONTENTS

CONTENTS

PREFACE

This book is a much enlarged and consolidated version of the author's *Foundations of Quantum Theory, a Study in Continuity and Symmetry* (Yale University Press, 1955) and *From Dualism to Unity in Quantum Physics* (Cambridge University Press, 1960). Its aim is the solution of a problem known to an earlier generation as 'The Quantum Riddle', that is, the task of deriving the amazing laws of quantum mechanics from a non-quantal basis without *ad hoc* assumptions. Non-quantal is not to mean classical deterministic, however. In the contrary, our starting-point is probabilistic from the beginning. By applying the same general postulates of symmetry and invariance, which are known from deterministic mechanics, also to regulate the structure of a probabilistic theory, one arrives at the 'new' quantum mechanics which was established in 1926 after more than two decades of trial and error. The Quantum Riddle is thereby solved by the method of theoretical physics.

But scientists, bent on research and development of new territory, are seldom swayed by methodological considerations alone to revise their once accepted approach. The innovation of this book is to point out that there are serious faults in the purely *physical* arguments which have led to the current dualistic doctrine according to which diffraction and other wavelike phenomena of matter force us to accept two contradictory pictures, together with an elaborate subjectivist interpretation of atomic events, instead of one unitary reality. The faulty physics consists in ignoring an important element of the quantum mechanics of particles, namely the rule for the quantized exchange of linear momentum (Duane's third quantum rule, 1923) established in perfect analogy to the quantum rule for the energy (Planck) and for the angular momentum (Sommerfeld-Wilson). The third quantum rule yields indeed a complete explanation of all the wavelike

phenomena of matter, including diffraction and coherence, without using the fantastic hypothesis of particles occasionally transforming themselves into waves or, what is the same, 'manifesting' themselves as though they did. It is a grave error of omission when physicists in their extended discussions about the interpretation of quantum theory never mention the third rule of quantum mechanics, the Missing Link between wave-like appearances and particle reality, entailing an agonizing reappraisal of the antiquated yet ever repeated dogma of duality. The latter is a thorn in the sides of both physics and natural philosophy which we are trying to extract.

There are, then, two distinct keys struck in this study. First, a major one of deducing the quantum laws from general non-quantal postulates of symmetry and invariance imposed on the probability structure of mechanical events. It is a new key, as far as I know, and as far as the literature resounds with assurances that quantum mechanics can *not* be so deduced, that it rather rests on its own sovereign principles. Second, a minor key, struck by many others before, of criticizing the current tenet according to which the knowledge of observers, subjective pictures, refined language, and renunciation of objective reality are inherent in the theory.

If the amazing formalism of quantum mechanics can be understood as a necessity under simple non-quantal assumptions, this encourages a new approach to the *teaching* of the theory in a systematic organic fashion, as a *quantum design*, rather than as 'the strange story of the quantum' which follows the erratic ways and byways of history. Instead of assimilating the once useful tale of two pictures, the student may learn from the beginning that quantum mechanics is neither excessively abstract and symbolic, nor does it deal with the knowledge or absence of knowledge of observers; it rather connects data of instruments, as does every other branch of theoretical physics.

A. L.

NOTE

Superior figures in the text thus (1) refer the reader to References on pages 166–8.