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# La Thermodynamique de la Particule isolée (ou Thermodynamique cachée des Particules)

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# BOOK REVIEWS

**La Thermodynamique de la Particule isolée (ou Thermodynamique cachée des Particules).** By Louis de Broglie. 125 pp. Gauthier-Villars, Paris, 1964. $7.50.
*Reviewed by R. B. Lindsay, Brown University.*

It is no news that Louis de Broglie continues to be dissatisfied with the current probabilistic interpretation of quantum mechanics, according to which indeterminism is fundamentally built into the behavior of matter on the microphysical level. In this book he sets forth again with commendable clarity a review of his attempts to provide what he feels is a more rational approach, with special emphasis on a thermodynamic interpretation. The volume takes the form of the lectures de Broglie delivered in his final course at the Institut Henri-Poincaré prior to his retirement in 1962.

The first five chapters of the book constitute a summary of the background on which de Broglie's ideas are based, including a brief review of Hamiltonian mechanics, relativity dynamics, statistical thermodynamics, relativistic thermodynamics, together with the Helmholtz and Boltzmann analogies between mechanical and thermodynamic quantities. These topics are presented with the elegance for which the author has long been justly famous. The real meat of the volume is found in the last four chapters. Here the author reviews his interpretation of quantum mechanics involved in the theory of the double solution, in accordance with which the ordinary $\Psi$ function, which is the solution of the Schrödinger equation, cannot be the whole story of the behavior of the particle being described. Rather, according to de Broglie, there must be another wave equation whose solution is the physical wave that represents the particle in the sense that in a certain region at a given instant of time the amplitude of the wave is very large, thus corresponding to the physical presence of the particle, while on all sides of this region the amplitude becomes very small. De Broglie realized that to insure this result the wave equation would have to be nonlinear and imply the existence of a special "quantum force."

**Louis de Broglie**

The author abandoned the double-solution theory in the late twenties but resurrected it a dozen years ago, when he recognized that the introduction by Bohm and Vigier of a subquantic medium with "hidden" variables would enable him to put his theory on a statistical basis, provide for the existence of the physical wave for the particle, and justify the assumption that $|\Psi|^2 d\tau$ gives the probability of finding the particle at a given point of space in the volume element $d\tau$. The picture that emerges is that of a particle conceived as a highly localized nonhomogeneity in a wave whose propagation equation contains the proper mass of the particle. In the absence of perturbing forces the particle moves along one of the streamlines or rays associated with the wave. However, the particle is assumed to be in contact with a subquantic medium which exerts a perturbing influence on it by exchanging energy with it. This medium thus acts as a kind of hidden thermostatic reservoir. Because of the perturbations the proper mass of the particle is subject to fluctuations and the particle itself is subject to a kind of Brownian motion, which provides a rational background for the probability picture of the conventional interpretation of quantum mechanics.

But de Broglie goes further and, by introducing the entropy of the hidden reservoir as a function of the proper mass of the particle, is able to show that along the actual path of the particle the entropy is a maximum. In this way he establishes for quantum mechanics a connection between Hamilton's principle and the second law of thermodynamics, which is analogous to that which Helmholtz strove to introduce into classical statistical mechanics in the last century.

Opinions will obviously differ as to the value of these ideas of de Broglie. He himself confesses that some of the notions are artificial and that the whole subject needs more detailed exploration, which he hopes will be continued by his students. The important point is not that these ideas may change the current interpretation of quantum mechanics, but rather that they demonstrate the value of the free use of the imagination of theoretical physicists in the construction of theories which may provide suggestive insight into the new experience which the experimentalists are steadily creating. It would be highly unwise to ignore such points of view.

**Two-Dimensional Problems in Hydrodynamics and Aerodynamics.** By L. I. Sedov. Transl. from Russian and edited by C. K. Chu, H. Cohen, and B. Seckler. 427 pp. Interscience, New York, 1965. $16.50.
*Reviewed by J. Gillis, Weizmann Institute of Science, Rehovoth, Israel.*

This new translation from the Russian is a series of articles on various topics in hydrodynamics. The unifying feature is the approach through the theory of functions of a simple complex variable. Indeed the main purpose of the book is to present and illustrate this approach, and the problems have been chosen largely with this end in view.

Some of the work presented is quite classical, e.g., the Blasius-Jonkowski