CHAPTER 15

BERGSON AND LOUIS DE BROGLIE

It is true that all previous considerations presuppose that microphysical indeterminacy has an objective status and therefore is not a mere result of temporary technological limitations of our present measurements. I discussed this particular problem at length in a chapter entitled 'The End of the Laplacean Illusion'[1] in my previous book in which I listed all the facts supporting the objective status of indeterminacy: not only the general bankruptcy of *all* the ideas constituting the classical deterministic model of the physical reality, but also the peculiar character of radioactive explosions, whose statistical character and indeterminacy cannot by their very nature depend on the intervention of the observer. I also pointed out that this character is not confined to radioactive processes only. The emissions of photons have essentially the same 'radioactive' character, and this is true of spontaneous disintegrations of all recently discovered "particles" as well. I also pointed out that resistance to the concept of the objective contingency of microphysical events is due mainly to the tenacity of certain classical beliefs, including the belief in the Laplacean-Spinozist concept of causality, which is still wrongly regarded as the *only* type of rational order.

In this context I shall confine myself to a brief discussion of the philosophical thought of Louis de Broglie, whose discovery of the undulatory nature of matter had as revolutionary a significance for the development of physics as did the early discovery by Planck and Einstein of the corpuscular character of light. I am choosing de Broglie not only because he shows for a physicist a rather uncommon knowledge of Bergson's work, but also because his successive hesitations between a subjectivist and objectivist interpretation of quantum indeterminacy exemplify in an abbreviated form the present controversy about it.

The philosophy or, more particularly, the philosophy of science of Louis de Broglie can be gathered from a number of essays contained in

five of his books: *La physique nouvelle et les quanta* (1937), *Matière et lumière* (1937), *Continu et discontinu en physique moderne* (1941), *Physique et microphysique* (1947) and *Nouvelles perspectives en microphysique* (1956). With the exception of the last book, he consistently maintained the indeterministic interpretation of microphysics, not hesitating also to use philosophical and epistemological arguments against the plausibility of any return to classical deterministic models. In the first four books mentioned above he consistently maintained that the principle of indeterminacy of Heisenberg is an inevitable consequence of the indivisibility of the atom of action *h*, and that the very existence of this constant makes it impossible to speak of the precise localization of physical entities in space and time.[2] This is what makes both the concepts of the classical particle as well as of the classical wave inapplicable on the microphysical level. Thus the extension of the classical principle of determinism to microphysical phenomena is nothing but an illicit extrapolation of macroscopic experience beyond its legitimate limits.

He also pointed out that his own interpretation, though incompatible with rigorous Laplacean causality, nevertheless remains compatible with a *widened* or generalized notion of causality which would still preserve some continuity or connection between successive events. In this type of connection the antecedent "cause" would be a *necessary, though not a sufficient, condition of the "effect"*. Such causal continuity is describable, *not* by the classical dictum "*causa aequat effectum*", but by its emended version, *sublata causa tollitur effectus*.[3]

His view, then, was fairly close to Reichenbach's view of "ambiguous causal nexuses" and to the prevailing tendency among physicists to regard each event as merely *probably* implied by its antecedents instead of being deducible from them in strict Laplacean fashion. This makes it understandable that in this period he regarded his original commitment to determinism as a result of mere habit rather than of conviction. He firmly rejected the hypothesis of "hidden variables" by means of which determinism could be restored on the sub-quantum level. He concluded that "the laws of mechanics, with their apparent rigour, are nothing but a macroscopic illusion due to the complexity of the objects on which our direct experience bears and not to a lack of precision of our measurements".[4]

These views of Louis de Broglie showed themselves in his attitude toward the three twentieth century French thinkers who were concerned