THE **Knowable** AND THE **Unknowable**

Modern Science, Nonclassical Thought, and the "Two Cultures"

Arkady Plotnitsky

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Preface

This study offers an exploration of the relationships between modern mathematics and science—in particular quantum mechanics, arguably the most controversial scientific theory of the twentieth century—and what I here call nonclassical thinking and the theories, nonclassical theories, to which this thinking gives rise. This thinking and these theories radically redefine the nature of knowledge by making the unknowable an irreducible part of knowledge, insofar as the ultimate objects under investigation by nonclassical theories are seen as being beyond any knowledge or even conception, while, at the same time, affecting what is knowable. Thus, according to Niels Bohr's nonclassical understanding of quantum mechanics, as expressed in the statement to which I continue to return throughout this study, "we are not dealing with an arbitrary renunciation of a more detailed analysis of atomic phenomena, but with a recognition that such an analysis is *in principle* excluded" (Bohr's emphasis). It is this impossibility, *in principle,* of any analysis of the phenomena considered by nonclassical theories beyond certain limits (which nonclassical theories establish as well) that defines these theories. By the same token, this impossibility also defines "the unknowable" of my title as that which is placed by such theories beyond the limit of any analysis, knowledge, or conception, while, again, having shaping effects upon what can be known. Indeed, as will be seen, in these circumstances, the very concept of "phenomenon," as relating to these objects, or the concept of "object," requires a special reconsideration and redefinition, which Bohr was compelled to undertake in the case of quantum mechanics.

By contrast, classical theories, as understood here, consider their primary objects of investigation as, at least in principle (it may not be possible in practice), available to conceptualization and, often, to direct or, at least sufficiently approximate, representation by means of such theories—in short, as knowable. This is "the knowable" of my title. Classical thinking does not deny that there are things that are, in practice or even in principle, beyond theory or any knowledge. In contrast to nonclassical theories, however, classical theories are not concerned with the irreducibly unknowable or its effects upon the knowable. The irreducibly unknowable, if allowed, is placed strictly outside their limits, rather than is seen, as it would be in nonclassical theories, as a constitutive part of knowledge. Thus, most of classical physics, such as classical, Newtonian, mechanics, can be and customarily is seen as classical theory in this sense, in contrast to quantum mechanics in Bohr's or other nonclassical interpretations. It is a separate question whether quantum mechanics could be interpreted classically, or, conversely, classical mechanics nonclassically. As will be seen, the cases of classical and quantum physics are not symmetrical as concerns their respective resistance to classical interpretation. This resistance is much greater and is perhaps even impossible to overcome in the case of quantum mechanics. In any event, on the view adopted by the present study, the knowable and the classical are one and the same. By the same token, classical theories become a pathway to establishing the existence of and the link to the unknowable, and they have also contributed and often led to the emergence of nonclassical thinking historically. Indeed classical theories provide not only a pathway to the unknowable but, by definition, the only such pathway. For how could we otherwise *know* about the unknowable, or, more crucially, how could we rigorously establish or conjecture the existence of the unknowable in this radical sense, rather than only imagine it, did the unknowable not have manifest effects upon what we can know? These manifestations, however, or these effects of the unknowable, cannot be properly understood by classical means and instead require nonclassical theories. Accordingly, nonclassical theories theorize both the knowable *and* the unknowable, found in nonclassical situations, and their (nonclassical) relationships. This different (from that of classical theories) relationship between the knowable and the unknowable is just as crucial to understanding nonclassical theories and their place in intellectual history or culture as the radical nature of the nonclassical unknowable itself. Indeed both, this relationship and the nonclassical unknowable, define each other.

The nonclassical theories and ways of thinking specifically discussed in this study are those exemplified, in various ways and to various degrees, in the works of Niels Bohr, Werner Heisenberg, Jacques Lacan, and Jacques Derrida. This study devotes a chapter to each of them (a little less in the case of Heisenberg, whose work, however, is prominent throughout the book). Bohr's interpretation of quantum mechanics, known as complementarity, serves as the primary paradigm of nonclassical theory for this study. The ideas of a number of other figures—such as Karl Friedrich Gauss and Bernhard Riemann, on the side of mathematics and science, and Friedrich Nietzsche, Georges Bataille, Maurice Blanchot, Emmanuel Levinas, and

Gilles Deleuze, on the philosophical side—will be addressed as well. While extraordinary in their own right, these ideas indicate the broad historical and conceptual range of nonclassical thinking and of the interactions between nonclassical thinking and mathematics and science. The argument of this study is that these interactions proceed in both directions. Modern mathematics and science, from at least the early nineteenth century to quantum physics and beyond, contain elements of nonclassical thinking and sometimes borrow these elements from other areas of human inquiry. Reciprocally, nonclassical thought elsewhere often depends on modern mathematics and science and their philosophically nonclassical aspects.

Although some among the mathematical and scientific subjects to be considered here are complex, no disciplinary knowledge of mathematics and physics is required for understanding my argument. I have tried to introduce these subjects for nonscientific readers and to be as clear and accurate as possible in my exposition of them; and I have tried to do the same for the nonscientific subjects discussed here. While the book is not a primer on the nonscientific subjects anymore than it is on the mathematical and scientific subjects in question, my aim is to make the nonscientific material sufficiently available to the reader, including possible scientific readers, just as it is to make the mathematical and scientific parts of the book available to nonspecialists. However, the character of *our* "two cultures," as C. P. Snow famously called them, the humanities and the sciences (mathematics included), makes the situation to which this project belongs (and that it indeed addresses), and, accordingly, this task itself asymmetrical. This asymmetry persists, even though there may be more symmetry than is often thought and even though there are, and have always been, arguably, beginning at least with Plato, more than two cultures involved, or perhaps both more than two and less than one. Partly real and partly imaginary, the "Snow divide" persistently and perhaps unavoidably reenters this multiplicity and this less than unity. The Greeks might have introduced this split when they invented mathematics, arguably the first science in the full sense of Snow's argument, since mathematics appears to have managed to place itself apart from philosophy, poetry and the arts, politics, and to some degree even language, although it could not be born or exist without them. But then, neither this type of invention nor this type of divide could have a single origin, a point or even a culture of unique emergence, or have occurred one single time, even leaving aside large-scale cultural entities (that is, cultural multiplicities), for example, Babylonian, or, later, Arab mathematics and astronomy, or the always partly evolutionary nature of such events. All of these—emergences of new sciences, the many (more than two and less than one) cultures that give them birth, the two cultures and divides to which they give rise, and so forth—occur all the time, sometimes without involving mathematics and science. The complexity, the irreducible nonsimplicity, of these dynamics makes it difficult and ultimately impossible to establish once and for all (in many cases, even provisionally) what defines each culture and what divides them. In the case of Snow's two cultures, however, the divide persists. It is equally difficult to say whether the Snow divide will ever allow a "dream of great interconnections," of which Bohr speaks and which requires greater cultural multiplicity, to become much more than a dream. One of the persistent effects of the Snow divide is the asymmetry, just invoked, of the ways in which we discuss the two cultures. The nature of this asymmetry, or of the Snow divide itself, is outside the scope of this study, although, thematically and in practice, it could not be avoided either. In any event, in view of this asymmetry, while nonclassical theories in other fields of inquiry in turn require as rigorous and careful treatment as possible, the presentation of mathematical and scientific ideas places greater demands on a project like the one undertaken here and, accordingly, at certain points on the book's readers.

I stand by my argument and claims concerning mathematics and physics. As far as quantum mechanics qua physics is concerned, most of my claims will be supported by arguments offered in Bohr's works (with some of Heisenberg's ideas added on), obviously, in turn given a particular interpretation, and, hence, also entailing a particular interpretation of Bohr's interpretation of quantum mechanics. This role of interpretation or reading is unavoidable, even by classical, let alone nonclassical, standards of interpretation, however careful and rigorous one tries to be. Most of my arguments, moreover, would apply whether or not one agrees with Bohr's interpretation of quantum physics, although I argue this interpretation to be at the very least viable and effective, even if not inevitable, however troubling or even epistemologically unacceptable it may be for some. The latter was actually the view of Albert Einstein, who ultimately found quantum mechanics itself consistent and effective but epistemologically unpalatable in view of its nonclassical implications (his view of Bohr's complementarity is more complex and ambivalent).

While, in accordance with the outline just given, conceived more broadly, the argument of this book is also a response to both long-standing and more recent debates concerning the two cultures. The most recent stage of these debates also involves what has become known as the "Science Wars," following the appearance of Paul R. Gross and Norman Levitt's book, *Higher Superstition: The Academic Left and Its Quarrels with Science* (1994) and

Alan Sokal's hoax article published in the journal *Social Text* (1996). A more recent book, *Impostures intellectueles* (1997), coauthored by Sokal and another theoretical physicist, Jean Bricmont, first published in France and later in England and the United States under the title *Fashionable Nonsense: Postmodern Intellectuals' Abuse of Science* (1998), and hosts of related publications have expanded these debates still further, both intellectually and politically, and indeed geographically, in particular to the French intellectual scene. One of the aims of this study is to contribute to more productive approaches to understanding the relationships among the various disciplines involved in these debates and to a better understanding of the debates themselves. A more sustained understanding of the nature and significance of nonclassical thought in mathematics and science, on the one hand, and in the humanities and social sciences, on the other, is, I would argue, crucial to this task.