Introduction

The Sustainability of Erwin Schrödinger's Thought

HANS ULRICH GUMBRECHT

Erwin Schrödinger's eminent place in the history of the natural sciences is undisputed. As Robert Laughlin remarks in this volume, the theory of wave mechanics for which Schrödinger was awarded the Nobel Prize for Physics in 1933 constitutes the one "mathematical description of matter [that] we use today for everything from chemistry to subnuclear particles," not least because it transforms quantum mechanics "from a nightmare of confusing mathematics to something genuinely elegant." But from the current perspective, even the description of wave mechanics is not Schrödinger's most meaningful achievement. Michael Hendrickson demonstrates in his detailed analysis that a collection of speculations, concepts, and metaphors from a 1943 series of lectures by Schrödinger (published one year later under the title *What Is Life?*) was in fact a decisive, if not *the* decisive, impetus for the emergence of biogenetics (for example, the concept of the 'genetic code'), although Schrödinger himself never advanced very far in his knowledge of chemistry. Both facts—quantum mechanics and biogenetics—have long become common knowledge, though the theses, arguments, and equa-

tions to which they refer remain comprehensible only to those trained in the sciences.

However, facts like the ones this volume seeks to clarify and confirm are surely not all that constitutes Erwin Schrödinger's timeliness, which concerns us here. For facts alone do not account for the extent to which reading certain of his texts, above all 1944's *What Is Life?* and 1956's *Mind and Matter*, could generate such intellectual potential for our time, far exceeding Schrödinger's historical impact and lasting significance in at least two fields of natural science. Still, the basis of Schrödinger's intellectual timeliness does lie primarily in his objective achievements—those bits of knowledge that are the fruits of his labor—especially when we take into account how astonishingly resilient these achievements have proven in comparison to the merciless slide into obsolescence that is the usual fate of scientific knowledge. For example, it has become possible, thanks to new technologies of measurement, to conclude that in the historic debate among quantum physicists, Schrödinger has proven correct against Niels Bohr and Werner Heisenberg, although to the present day it is evidently considered a faux pas to point this out among scientists. Meanwhile, in the field of biogenetics, though Schrödinger's "account of the centralized agency of the all-powerful gene" has certainly been significantly revised, at the same time, almost paradoxically, other concepts, metaphors, and views, which he—speculatively—introduced into the debates of his time (such as the idea of a 'network' or that of the 'self-organizing system'), have catalyzed a dynamic development that has left behind the early phases of the pertinent research.

Indeed, these exceptional instances of enduring achievements within the natural sciences can at most awaken a remote admiration among those interlopers, the philosophically minded intellectuals; such staying power cannot explain the complex

fascination and *Auseinandersetzung* at work when we encounter Schrödinger's texts. Singular historical achievements do not, for example, answer why three months of reading Schrödinger's essays followed by an associated symposium remains one of the most productive experiences of Stanford University's Philosophical Reading Group, a workshop open to students and faculty from all disciplines, which has been meeting for nineteen years. This volume hearkens back to the discussions of Schrödinger by the Philosophical Reading Group, despite the fact that the texts it contains do not stem from those earlier debates; nor in fact are they even thematically predetermined by them. How is it that a circle composed primarily of humanists, approaching as dilettantes the text of a scientist, indeed one of the great natural scientists, was able to reap intellectual profits as significant as those it would gain in reading Hannah Arendt's *The Human Condition*, or even Kant's *Critique of the Power of Judgment*—texts which bookended the Schrödinger readings in the program of the reading group?

The obvious answer that persists in the minds of the Philosophical Reading Group's participants is that Erwin Schrödinger's life and work (and here I use the somewhat well-worn formula "life and work" advisedly) invited us, by means of an outstanding example of the scientific capacity for innovative approaches to general questions, to ask after the conditions which make such innovations possible. Naturally, this is a problem whose historical significance is outbid by its relevance for the scientific community and policy of the present and future. The surprising, almost bizarre dominance of biographical answers that one initially comes across (question 1, below) points to the ultimately rather philosophical—in any case, no longer primarily scientific-historical or biographical—problem of the sustainability of Schrödinger's thought. However, from a philosophical

perspective we want nothing less than to ask, Did Schrödinger's way of thinking make it possible to examine the many facets of a problem that had up to that point remained obscure, and so give expression to that which, once identified, would redefine the outlook of each subsequent generation of researchers and thinkers?

This second problem, which is the focus of our introduction, considers the intrinsic conditions for the sustainability of Schrödinger's thought, the core of the persistence of his work; it inquires into the source of his essential timeliness—and no longer merely the external circumstances of it. This also suggests why Schrödinger is profitable reading for more than just scientists. The search for this core once more splits the problem into two: the first part concerns the style of Schrödinger's thought (question 2); insofar as we manage to grasp this way of thinking, it becomes possible to uncover the essence of its content (question 3).

Question 1. The apparent institutional and biographical conditions for the specificity of Schrödinger's thought are, in their convergence, enough to generate a certain amount of skepticism concerning the efficiency of large-scale (and necessarily cost-intensive) underwriting of research. Similar issues arise when one examines the external conditions for the achievements of Albert Einstein, who was Schrödinger's friend as well as his colleague.

The same text that was so instrumental in the emergence of biogenetics makes visible Schrödinger's most earnest—if not his most expert—philosophical endeavors. There were long phases in Schrödinger's life, especially the years after the end of the Great War, in which he spent most of his working hours reading philosophical texts, above all the works of Schopenhauer and collections of Indian proverbs. But he was also interested in contemporary philosophical positions, for instance, the work of his

teacher Ernst Mach and the phenomenology of Edmund Husserl. Schrödinger drew on these readings with a certain amount of freedom, since he was under no pressure to consider himself a specialist. Both as a theoretician and in his rare experimental research he was solitary. It is certainly true that in his lectures, he captivated his listeners through stirring rhetorical brilliance, conceptual clarity, and descriptive precision, but it was nonetheless clear to him that he could hardly be productive as a member of a research group. Neither could he see himself as a successful tutor for advanced students. Erwin Schrödinger enjoyed civil and collegial relationships with all of the other capacities of that great age of physics, without restricting himself out of a sense of group solidarity to this or that cadre of collaborators or allowing himself to be constrained to circulate his discoveries only within the confines of a particular group.

The most natural scientific lifestyle for his type of work, and for himself, was the role of Fellow, the long-term, far-reaching position of independent guest at a university or research institution, a position that was offered to him multiple times between 1933 and 1956 in England and Ireland. Schrödinger was not interested in wealth but in securing his economic independence. He kept his distance from political ideologies or the political parties of his time just as much as from academic groups and schools, although he tended toward decisive opinions in science throughout his life. Without being demanding, Schrödinger expected that his needs would be met and his fancies realized—as might be expected (to take up for a moment the psychological perspective) from someone who grew up (like Theodor W. Adorno) as an only child doted on by an unmarried aunt. All these external conditions of his life and work coalesced to give Schrödinger an astonishing degree of independence from institutions and the social environment, whose contact and stimula-

tion he nevertheless needed. Such a convergence of professional prudence and individual talent in a single researcher could neither then nor today be acquired but rather must always already be in existence—and then, in individual cases, be individually employed.

Question 2. It is hardly possible to determine whether it was a consequence of biographical circumstances, but in any case Erwin Schrödinger remained the kind of scientist who is active in many fields and areas of concern rather than developing his skills along a permanent line of research:

> In my scientific work (just as elsewhere in my life) I have never tarried very long in pursuing a single program or axis of thought that defined me. Although I do not collaborate well with colleagues, nor unfortunately with students, my work has not progressed independent of them, for interest in a question comes to me only after others already have a like interest. Only rarely do I have the first word; much more often I take my inspiration from a desire to contradict or correct someone and am most concerned with the important discoveries that follow on an initial thought.

When, in 1921, he was appointed to the University of Zürich, "the multifaceted nature of Schrödinger's work in the areas of mechanics, optics, magnetism, radioactivity, the theory of gravity, and acoustics [stood] in the foreground" for his future Swiss colleagues. Additionally, he was able "to hold the biometrics lectures the biology students clamored for." And after his rather late breakthrough—in comparison to the other greats of natural science—in 1926 with the work on wave mechanics, the motif of 'multifacetedness' dominated his profile when he was named as the second choice for a successor to Max Planck in Berlin, a position Schrödinger would accept a year later:

> He has been well-known for several years for the multifaceted nature of his work, and likewise for his powerful and profound style in the identification and development of new issues in physics from unexpected perspectives, and he has mastered the whole spectrum of physical and mathematical methods. Schrödinger is an excellent orator and interlocutor, which he demonstrates through a straightforwardness and clarity, which his charming South-German temperament only underscores.[1]

The combination of scientific 'multifacetedness' and 'depth' emphasized here is at once more abstract and perhaps more exact than the pronounced convergence, which one observes again and again in Schrödinger's texts, between the identification of singular phenomena and the, in principle, inconclusive and open-ended series of *interpretations* of these phenomena, which invariably refer back to the respective phenomena again. Such a convergence was shaped through the divergent influences of his early teachers, the experimental researcher Ludwig Boltzmann and the epistemologist of science Ernst Mach. This, in any case, allows us to conceive as an intriguing intellectual gesture how Schrödinger's work, as Robert Harrison demonstrates, was driven by two fundamentally different passions: the desire to explain something and the desire to reveal something. The passion to explain leads to scientific knowledge, which thus usually marks the culmination and endpoint of every investigation, whereas Schrödinger's research began with knowledge and ended in awe.

This capacity, indeed this passion for inexhaustible wonder, distinguished Schrödinger's intellectual style. His wonder grew manifestly each time he reverted from the interpretation of a phenomenon or from a corresponding speculation to the phenomenon itself. It was then that he was able to bracket his pres-

ence as observer, to step back to give the phenomenon the space needed to show itself, to be able to reveal its nature. Conventional scientific knowledge, by contrast, absorbs the phenomenon in mathematical formulas and freezes it.

Schrödinger's wonder in the presence of the phenomenon led him to return over and again to the development of new interpretations and hypotheses; he did not, to all appearances, attempt to predict the outcome of this process—he merely sought it. And because of this, he not only developed a particular receptiveness to those questions that led to no answer, no 'scientific knowledge'; he also increasingly concentrated on examining such questions as 'mysteries' instead of avoiding them or, worse, distorting them to fit some familiar pattern of explanation. Harrison calls this attitude intellectual honesty. It is certain that Schrödinger's honesty and the intellectual dynamic stemming from it constitute an essential source of the fascination generated in reading his texts and of that which is so often and so justly praised as his "intellectual elegance."

Question 3. This intellectual style alone, with its characteristic complexity and energy, was enough to distinguish Schrödinger as one of the great scientific authors. But this style, independent of any particular constellation of issues, does not explain the persistent relevance of certain of his texts. For there are certainly formidable, elegant, and flexible thinkers who have never earned Schrödinger's prestige and status. We must ask then whether Erwin Schrödinger's style of thought has led once again to inconclusive or at least yet-to-be-concluded problems. Again, I align myself here with Harrison's view that to these layers of phenomena belong those very "antinomies" that Schrödinger tackled in *Mind and Matter.* From his reflection on the relation between scientific observation and phenomena he arrived at the question of the "place where mind encounters matter." This was

one of those moments where Schrödinger was "honest" enough not to force himself to produce an unequivocal answer that he didn't have. Notwithstanding, the problem did not loosen its hold on him but provoked the risky, philosophical, and particularly interesting conjecture that such a space of encounter between mind and matter might not exist at all.

Yet another problem without a solution was already evident in Schrödinger's earlier texts and would likewise preoccupy him to the end of his life. It concerns the possibility—so critical for him—that the soaring heights of interpretation and speculation would return, time and again, to a given phenomenon as his point of departure. He questioned how it was possible that the seemingly infinite variety of representations and interpretations could so often be subsumed in the vanishing point of the phenomenon. Of course, this is the classic epistemological problem of perspectivism. In his youth, Schrödinger apparently believed that Schopenhauer's philosophy offered a solution, which was derived from Indian thought: the teaching that all individual consciousnesses are merely fragments of a single transcendental consciousness. Whether in later years Schrödinger no longer found this answer wholly satisfying is difficult to guess. But he faced the question many times, without forcing himself to close off the exploration by positing a definitive solution.

From the standpoint of epistemological history, these two central questions—or rather, since both remain hitherto unanswered, these two "mysteries"—lead one back to the moment in the early nineteenth century that marked the emergence of the second-order observer.[2] Schrödinger's own intellectual preoccupations drew him further into them, but the questions were already there before him, independently ("objectively," so to speak) given. From the moment that for the 'subject' of early Western modernity—the world-observing Cartesian 'cogito'—

the practice of observing oneself in the act of observation became inevitable, it has likewise become exceedingly, and persistently, clear that we do not know how to reconcile world appropriation through the senses (perception) and world appropriation through concepts (experience). Schrödinger's search for the place where mind meets matter is a variant of this problem. Second, it has become apparent that for each phenomenon there can be as many representations as there are observer perspectives, which begs the question of whether we, in light of a potential infinity of representations, can any longer believe in the existence of individual reference phenomena. This is the problem that the young Schrödinger—through recourse to Schopenhauer and Indian philosophy—believed himself to have solved.

Since the early nineteenth century, scientists and philosophers were persuaded, time and again, to find definite solutions and thus to eliminate at least one of these problems. Philosophy of history from the Hegelian perspective, and evolutionism from the Darwinian perspective, were for the better part of a century considered solutions with regard to perspectivism; a similar status attached to the theory of relativity with regard to the question of the compatibility between conceptual and sensible world appropriation. Erwin Schrödinger made crucial discoveries and sustained productive institutions, but not by simply bracketing out these inconclusive questions. In other words, the things we know, thanks to Schrödinger, make us ever more conscious of what we yet do not know. For in spite of the wealth of solutions that present themselves, the world remains irreducibly complex; thus, in Schrödinger's works we see each new solution giving rise to a more acute awareness of the unresolved. And so we arrive at the reason that Schrödinger's speculations could never come to an end. Should we, however, find an answer to every question left unsolved by Schrödinger and by those who suc-

ceeded him, that would represent the end, indeed the nullification, of the distinctive sustainability of Schrödinger's thought. But this loss would be the condition for the most substantial and most sought-after scientific advancement imaginable.

Translated by Lisa Ann Villareal