Comparative Education Studies, Vol. 1 (1)
December 2024, pp. 50-65
DOI: 10.5281/zenodo.14584585

Research Article

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Revisiting Schrödinger's *Science and Humanism* and the place of Humanities in a Science Curriculum: Lessons for our Times

Abstract

This paper embarks on a contextual reading of a work by the renowned physicist and Nobel Laureate Erwin Schrödinger entitled *Science and Humanism*. It is argued that while specialisation does contribute to the advancement of knowledge, in itself that specialist knowledge means little and has a dehumanising effect on society. In order to become meaningful and in order to develop the faculties of critique and appreciation, a synthetic vision is required that can only come when the sciences are seen on the same playing field as the humanities. The reading revisits several arguments that Schrödinger draws upon which have implications for contemporary science education. The paper concludes that texts such as *Science and Humanism* are exemplars for cultivating and illustrating that critical and synthetic vision which is required in a hyper-specialised context of education.

Keywords*:* Science education, history and philosophy of science, humanities, humanism, synthetic vision

Introduction

It is a truism by now that the history and philosophy of sciences have an important contribution to make within the sphere of the pedagogy of science teaching. Nevertheless, much of this discussion dates back to the middle of the last century and even today, does not appear to have lost its significance (Matthews, 2014). However, with the passage of time the discussion has perhaps become a trifle repetitive, and its arguments and justification possibly diluted. This may be contested, even though it is a generalisation drawn from the vocation of most domains of research and investigation. On the other hand, particularly in India, the argument has received little attention as far as the domain of higher education is concerned—particularly with regard to science

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education. Courses on the history of science are cursory in nature and the relationship with science hardly illuminated (Raina, Pattnayak, & Valte, 2017).

In part the problem also arises from the fact that the history and philosophy of science—as a unitary field rather than two distinct ones—is an interdisciplinary formation whose internal modes of discussion and discursivity spans the sciences, humanities, and the social sciences. Departments and institutes of science which recognise its importance are more receptive to the logic and philosophy of science than to the exclusion of the historical contextualisation of science and the emergence of concepts. When the history of science is taught it is approached quite differently in departments of the humanities and social sciences on one hand, and for students of science and technology on the other. This paper reconstructs an argument from Schrödinger's reflections upon the need to bring the insights of humanism and the humanities to acquire an integrated and synthetic conception of knowledge.

However, more than what history and philosophy can contribute to science education instruction at the collegiate and university levels, the other concern that requires urgent attention—against the backdrop of the reconfiguration of the constellations of knowledge—is the transformation of the university as a site for the production of knowledge and the declining space for the humanities and social sciences within a university (Raina, 2023). The latter is indeed a pressing problem. There is a growing realisation of the place of humanities and social sciences in the development of the sciences (Bod, 2013). However, just recognition is not good enough. There is also an increasing realisation that research students across the sciences on one hand and the humanities and social sciences on the other need to be socialised into appreciating the scope and strength of the other and the limitations of their domains of investigation (Elkana, 2006). To hardwire this kind of thinking into students is a difficult problem and requires more extensive deliberation, as colleges and universities under the pressure of the neoliberal economy embark upon programmes of accelerated learning.

The aim of this paper is to raise a discussion on the relation between the sciences on one hand and the humanities and social sciences on the other. Much has been written on the relation between the sciences and humanities and social sciences by Ernest Nagel, Harold Kincaid, and others (Nagel, 1961; Kincaid, 2010). However, the focus of this article is to discuss how science education in particular can be reformed. The discussion is organised around a reading of a series of lectures delivered by the renowned theoretical physicist, Erwin Schrödinger published under the title *Science*

and Humanism (hereafter S&H).[1] Schrödinger was a theoretical physicist who in the annus mirabilis of 1926 published four papers on wave mechanics which—alongside the work of Werner Heisenberg and others—ushered in the revolutionary era of quantum physics. He was awarded the Nobel Prize for his work in 1933.

I shall principally focus upon that part of the book discussing S&H but shall also occasionally refer to the first half of *Nature and the Greeks* (Schrödinger, 2014) although even these lectures slightly get a little technical about quantum mechanics. There is nothing in this discussion that a sophomore with some knowledge of science would be unable to follow. An attempt will also be made to contextualise the arguments against the backdrop of the many post-World War II imaginaries of science. On this count it is important to point out that it appears that he did not share the positivist dream of eliminating metaphysics from science, although as pointed out later, he was critical of any kind of metaphysical realism. The elimination of metaphysics from empirical science would produce its own set of problems. In a collection of his essays *My View of the World* he wrote:

> In fact, if we cut out all metaphysics it will be found to be vastly more difficult, indeed probably quite impossible, to give any intelligible account of even the most circumscribed area of specialisation within any specialised science you please. Metaphysics includes, amongst other things—to take just one quite crude example—the unquestioning acceptance of a more-than physical— that is, transcendental—significance in a large number of thin sheets of wood-pulp covered with black marks such as are now before you (Schrödinger, 1964)

While he argued that theoretical metaphysics has been eliminated since the time of Kant, a total elimination of metaphysics would, in his view, remove the soul of art and science. In a long passage he alerts us to the dangers of eliminating metaphysics, but equally of the danger of being seduced by it which would end up being counterproductive:

[1] Schrödinger delivered two series of lectures entitled *Nature and the Greeks* and *Science and Humanism*. These distinct series of lectures were published in one volume, *Nature and the Greeks and Science and Humanism* in 2014. It is this latter publication that I shall be referring to.

> It is the apparent contradiction in this which is our problem as we go forward on the road of knowledge we have got to let ourselves be guided by the invisible hand of metaphysics reaching out to us from the mist, but that we must always be on our guard lest its soft seductive pull should draw us from the road into an abyss. Or, to look at it another way: among the advancing hosts of the forces of knowledge, metaphysics is the vanguard, establishing the forward outposts in an unknown hostile territory; we cannot do without such outposts (Schrodinger, 1964)

In other words, he sees metaphysics as part of the scaffolding, but for him, metaphysics does not form part of the house of knowledge— it is the scaffolding, without which further construction is impossible. It may appear that there is a definite ambivalence concerning the role of metaphysical presuppositions in the sciences. But this ambivalence could well be what Michel Bitbol (1999) calls "prudence." We shall come back to this idea of prudence ahead in the discussion on his philosophical predisposition.

A terminological clarification is in order since Schrödinger's lectures were titled *Science and Humanism* but the discussion in this article is about science and humanities. The question that one is then compelled to ask is what—if anything—distinguishes the two? While both terms have Latin roots, the term *studia humanitatis* embraced those intellectual pursuits designed for `a "gentlemanly education" while the term *humanistische Wissenschaften* in 19th-century German connoted historical and philological disciplines, and gradually came to cover all disciplines devoted to the study of human nature and culture, i.e., the social sciences and cultural anthropology. The term "humanism" —also possibly a 19th-century German invention—referred to the renewal of interest in the classic Greek and Latin authors in the late 18th and 19th centuries (von Wright, 1980). Accordingly, 'humanism', or 'neo-humanism' also became a name for a second return to the ancients in the search of standards of beauty and style which took place in late 18th and early 19th century Germany. In this context, I shall be using the term 'humanities' to refer to the study of the classic Greek philosophers that Schrödinger embarks upon as a pursuit in the humanities. Inasmuch as this is an effort to search for standards and ways of thinking, it is also an attempt to resurrect humanism.

Science and Humanities: A Common Quest

Shortly after the Nazis annexed Austria, Schrödinger was dismissed from his position at the University of Vienna.[2] Moore's biography of his life carries the correspondence of how he was offered a position at the Institute of Advanced Studies, Dublin. Eamon de Valera—an Irish statesman and Head of the Government and State in the 1930s—wrote from the Office of the Taoiseach (Prime Minister) in Dublin to E. T. Whittaker in Edinburgh: `

> In an evening paper a couple of days ago I saw it noted that Professor Schrödinger had been dismissed from his post. I suppose that it has not been possible for you to get in touch with him? I am very anxious that we should secure his services in connection with the project we discussed when you were here. [Establishment of an Institute for Advanced Studies.] If you are able to communicate with him, will you please convey to him an invitation from me to come to Dublin. Whilst we are waiting to have the scheme worked out, some special financial arrangement can be made for him. The important thing is that we should not lose his services (2015)

The years he spent in Dublin and England are important because he wrote a number of philosophical works which included *What is Life?* published in 1944, *Science and Humanism* in 1951, *Nature and the Greeks* in 1953, and *Mind and Matter* in 1956. He returned to Vienna in 1957 and wrote *What is Real?* This book contained the article on Advaita Vedanta that he had published in 1925 (Bitbol, 1996). His biographer Walter Moore points out that while it was hardly unusual at the time for German and Austrian physicists to have an interest in philosophy, in the case of Schrödinger, this interest was so deep and intense that he even contemplated sacrificing scientific research to pursue a life of philosophical study (Bitbol, 1996).

[2] A brief chronology of this period is taken from Moore's biography (2015):
19 November, 1933: Nobel prize in Physics
1 October, 1936: Professor at University of Graz
1 September, 1938: Dismissal from Graz, escape to Oxford 1938–
1939: Guest professor, University of Gent
7 October, 1939: Arrival in Dublin
1940–1956: Senior Professor, School of Theoretical Physics, Dublin Institute for Advanced Studies
28 March, 1956: Return to Vienna as Professor of Theoretical Physics (personal chair)
30 September, 1958: Emeritus Professor, Vienna
4 January, 1961: Death in Vienna

Thus, in the lectures Schrödinger delivered at the Institute of Advanced Studies in Dublin, he begins by framing this activity called 'science' not as distinct from the many aspirations of the humanities but as "forming part of Man's endeavour to grasp the human situation" (Schrödinger, 2014). Reckoning that much progress in the sciences has been an outcome of the process of specialisation that he considered to be an enterprise dedicated "to learn all that is known in a certain narrow domain and then to try to increase this knowledge by one's works" (Schrödinger, 2014), the central question he then poses is to ask is if specialisation in any field of knowledge has any value in itself.

The response of the educated majority to this query, as anticipated, would be to appeal to the practical benefits of these achievements through developments in technology which have gone a long way towards making the lives of millions much easier (p. 106). Schrödinger is not satisfied with this facile response of the educated majority and is of the impression that his scientific colleagues, presumably also theoretical physicists, would be unsatisfied as well. One gathers that most of the colleagues with whom he interacted on a daily basis would be theoretical physicists themselves. He proposes, instead, three other reasons in opposition to that of the educated majority, i.e., denouncing the specialisation of knowledge.

The first response runs against the grain of the two cultures debate.[3] Around this time, the sciences—in the aftermath of the developments that had occurred over the previous hundred years—began to move towards the centre of the academy, nudging the humanities and social sciences away from the place they had occupied for centuries. The academy was now fractured into the faculty of sciences and those of the humanities and social sciences. As a native German speaker—though we are told he learned English before he spoke German[4]—Schrödinger prefers to use the German word *Wissenschaft* to connote science, a term that connoted not only natural science, but also other domains of knowledge cultivated at universities and centres of advanced learning. These domains included what was pursued here as research on languages, history, philosophy, geography, history of music, archaeology, pre-history, and the so-called sciences themselves. None of these activities for Schrödinger (2014) were associated with the practical aim

[3] Schrödinger's lectures were possibly published before Snow's lectures titled *Two Cultures* were published. This means that Snow's book appeared later. However, one can guess that much of what appears in both books covers the spectrum of views and tropes that were shared at the time.
[4] Schrödinger's mother, Emily Bauer was half-English.

of the improvement of society's condition as he wrote, "I cannot see that sciences has, in this respect a different standing" (Schrödinger, 2014).

Schrödinger's (2014) second response begins by reminding his reader that among the spectrum of the natural sciences, there are those "which have obviously no practical bearing at all on the life of human society" (p. 106). In this sphere he counts astrophysics, cosmology, and some branches of geophysics including seismology. However, the evolution of our knowledge in these fields over the past 70 years tells us that the list needs to be revised. His lectures were delivered in the 1950s when several fields he mentions were in different states of development; earth sciences has certainly moved ahead since then. Therefore, while turning to his work for philosophical insight and inspiration his arguments need to be contextualised, and those that do not stand the test of time should be revised.

In his third response, Schrödinger (2014) interrogates the premise that the sum total of the human race's happiness has increased as a consequence of biological and industrial development, themselves a consequence of advances in the natural sciences. Writing at a time when wars had reduced civilisations, nations, and countries to ruins, Schrödinger explains his reservations expressed in what could be considered self-evident truths. The first, naturally, is his dismay over the gruesome consequences of the development of atomic weapons which he refers to as the "weaponisation of the findings of atomic physics" (p. 107). We must not forget that these lectures were delivered not long after World War II had ended, and the shadow of the mushroom cloud loomed large over the imagination of science. Aldous Huxley's dystopian novels were widely read and influenced the deliberations of several intellectuals. While *Brave New World* was possibly the most cited novel in the Anglophone world, Schrödinger was more concerned with dystopian futures and their consequences as discussed in Huxley's *Ape and Essence.*[5] He argued that the emergence of rapid transportation ended up both compressing time and distance that had separated individuals from their families and communities but had also dispersed them across the world as never imagined before in human history (p. 107). Here too, one recognises the shadow of loss and destruction of memory unleashed by the wars.

Against the backdrop of this gloomy picture, Schrödinger (2014) posed the big question: "what, if any, is the value of modern science?" He added a clarification that many would not have expected

[5] This futuristic novel is about the world in 2108, wrecked by nuclear destruction after World War III.

from a scientist at the time: was science in "its scope and value... the same as that of any other branch of human knowledge?" (p. 108). Contrary to the polarisation unleashed by the two cultures debate where science was moving towards the centre of contemporary culture, Schrödinger put science on the same playing field as the humanities and social sciences: "Nay, none of them alone, only the union of all of them has any scope or value at all" (p. 108). Questioning the purpose of a unitary meaning of knowledge, Schrödinger felt this quest was inspired by a query posed by Greek philosophers: "And we, who are we anyway?" (p. 109). He continued the discussion with an annotation by Plotinus (p. 108) analogues to which can be found in several ancient traditions across the world including the *Nasadiya* hymn in the *Rg Veda*. Thus, the fundamental quest of humankind is manifest in all endeavours to do with science, learning, and the pursuit of knowledge (p. 109).

Taming the Barbarism of Specialisation

To Schrödinger, specialist knowledge acquired in any one field or by a group of experts has "in itself no value whatsoever, but only in its synthesis with all the rest of knowledge... as it really contributes in this synthesis." This, in turn, directed him to answering the question: "Who are we?" Evidently, there are two important points that require some elaboration. The first is that Schrödinger is not in way denying the importance of specialist knowledge in a narrow domain. All he is arguing is that its real value lies or can be revealed in synthesis with other branches of learning inasmuch as it enhances our appreciation of the central question posed. In doing so, Schrödinger does not separate the objectives of humanities from that of the sciences but reinforces their relationship through an act of synthesis. This capacity for synthesis has been undermined by specialisation, and can be employed by an intellect such as Schrödinger's given his deep learning across a range of fields.[6] One just has to flip the pages of the volume being referred too, to be overwhelmed by his familiarity with Greek philosophy, and from other sources, we know of his deep engagement with Vedanta.[7] In fact, his early interest in Indian philosophy had to do with his preoccupation with soteriology which then evolved towards the many branches of Indian philosophy (Bitbol, 1999).

Even while he was a student of physics, he displayed a deep interest in philosophy, in particular to the pre-Socratics—which is evident in his volume on *Nature and the Greeks*—Plato, Hume, the

[6] Walter J. Moore tells the story of how Schrödinger's book *What is Life?* was written, in his 2015 biography of the theoretical physicist.

[7] In a collection of his essays, he was to write: "but for the rest, to devote myself to philosophy, being deeply imbued at the time with the writings of Spinoza, Schopenhauer, Mach, Richard Semon and Richard Avenarius" [Schrödinger, 1964, p. 8]

Viennese philosopher of science Ernst Mach and, as mentioned above, to Indian philosophy. His epistemological orientation in physics was inspired by the work of Ludwig Boltzmann and their style of thinking in terms of pictures of physical processes. From Mach he imbibed the critique of metaphysical realism and its claims of the existence of scientific entities and structures (Bitbol, 1999, p. 1). Bitbol points out that prudence characterised his approach to Eastern and Western thought, and it could be argued that the same was true about the way he thought of metaphysics. Thus, he reckoned that:

> there are philosophical problems that have been enhanced rather than solved by the development of Western science, and that they could be easily resolved within the framework of Indian thought, but he [Schrödinger] remains reluctant because he is afraid of the loss of scientific efficiency which would result from such a compromise" (p. 3)

The same attitude is reflected in Schrödinger's discussion on metaphysics. He reckons that we cannot eliminate metaphysics from science but at the same time cautions us of its exaggerations.

The need to embed the sciences and humanities on the same plane was an urgent one in the years immediately after the end of World War II. In light of Schrödinger's wide reading, he was aware of the criticism that intellectuals had levelled against some of the social transformations that developments had produced in society. One of these worrisome transformations was discussed by Jose Ortega y Gasset (1932) in his book, *La Rebelion de las Masas* (The Revolt of the Masses). Schrödinger (2014) concurred that the Age of Machinery has contributed to an explosion of consumerism:

> The Age of machinery has resulted in sending the numbers of the population and the volume of their needs to enormous lengths... The daily life of everyone becomes more and more entangled with the necessity of coping with these numbers" (Schrödinger, 2014)

Schrödinger also recognised that technology had increasingly empowered the state's ability to control human freedom.

But as a practising scientist, Schrödinger (2014) focuses more on the chapter engaging with *La barbarie del especialismo* (barbarism of specialisation). In y Gasset's view, the specialist is no different from the ignorant *hombre masa* (mass man) who endangers the survival of civilisation (p. 111). The passage Schrödinger quotes from y Gassett is abridged here:

> [The specialist is one who] is familiar with only one particular science, nay even of this science only that small portion is known to him in which he himself is engaged in research... outside the narrow domain he himself cultivates and denounces as dilettante the curiosity that aims at the synthesis of knowledge (p. 111)

We can see the salience of y Gasset's understanding of specialisation to Schrödinger's argument for developing the faculty of synthesis that is essential to making individual specialisations meaningful. Thus, the specialist "in the narrowness of his field of vision succeeds in discovering the facts" (p. 111) thereby promoting science but is unable to recognise its full importance from a synthetic perspective. Part of the problem is the poverty of the synthetic perspective itself. As per y Gasset (1932), "experimental science had been advanced to a considerable extent by the work of fabulously mediocre... persons."[8]

The passage can be interpreted in different ways, one of which is the transformation of the scientific research system into one of knowledge production, analogous to the system of industrial production. This in turn results in reification of knowledge and alienation that impedes the articulation and, when required, a critique of the synthetic vision. However, Schrödinger (2014) does not wish to reject specialisation. He recognises its importance, but he is also looking for ways to make it more meaningful, for ways to create "real value in the context of the integrated totality of research" (p. 111). Schrödinger's big question is reframed as: how does a university that is fragmented into faculties, schools, centres, and departments work towards cultivating such a vision?

y Gasset (1932) cites a *Report of the Commission of University Reform in Germany* that suggests ways of overcoming the negative effects of specialisation. The recommendations include that (a) lecturers in technical universities be encouraged to envision the "... limits of the subject matter," alert students of those limits, and show them that beyond these limits, forces come into play which are no longer rational but arise out of life and human society itself; (b) "to show in every subject the way that leads beyond its own narrow confines to broader horizons of its own" (Schrödinger, 2014, p. 112). Schrödinger adds that these recommendations be applied not only to technical

[8] The founder of Scientometrics, Eugene Garfield once wrote as late as the 1970s: "Actually the growth of science is dependent upon an accumulation of many 'mediocre' results that are produced by hard work" (1970).

universities but to all universities. He closes this section with a synthetic vision that has somehow remained ingrained in my memory when I first read it as an undergraduate student (although I do not claim that I understood it then):

> Never lose sight of the role your particular subject has within the great performance of the tragi-comedy of human life; keep in touch with life – not so much with practical life as with the ideal background of life, which is even so much more important and, keep life in touch with you. If you cannot – in the long run – tell everyone what you have been doing, your doing has been worthless (p. 112–113)

In short, specialisation can dehumanise unless its findings are integrated with other contemporaneous human endeavours dedicated to the generation of knowledge, viewed against what Schrödinger calls an "... ideal background of life."

Locating the Origins of the Instrumentalist Conception of Science Education

Having thus embedded science within larger humanist endeavours, Schrödinger (2014) proceeded to critique the instrumentalist pedagogy of science education that has globally "obliterated its true impact" (p. 115). Science education, he argued as far back as 1951, has been widely neglected worldwide, but this neglect is more at the level of the imagination of science than in terms of the volume of science instruction that passes for "science education" in universities, colleges, and schools. Since science education in schools and colleges is framed by an instrumental conception of science as "problem solving"[9] and since school curricula insist on some science education for students, the idea that "science education forms part of the idealistic background of human life" never takes root. Thus, for the majority, the role of science is reduced to the "ancillary task of inventing machinery" to improve the human condition (p. 115).

We are predisposed to thinking that this curricular defect is particularly an Indian pathology, but going by Schrödinger's lecture, the instrumentalist imperative of science education was at the root of science education—if not dominant—in the global academy. When exactly did the imaginary of an idealistic conception of science begin to recede into the background? Schrödinger, as do historians of the sciences, traces this to the second half of the 19th century when there was a concurrent explosion in the development of the sciences with developments in the industrial realm

[9] It is interesting to observe that scientific activity seen as problem solving rather than an attempt to understand or theorise the world as a concept pre-dated both Popper and Kuhn's use of the term.

(Schrödinger, 2014, p. 114; Bernal, 1971; Fara, 2009). These connected developments "had such a tremendous influence on the material features of human life that most people forgot any other connections" (Schrödinger, 2014, p. 114). This material development produced a "materialistic outlook."

By the mid-20th century this phase began to peter out, for although the "learned men" of his time had begun to think differently, it took time for their views to percolate into society at large (Schrödinger, 2014, p. 114). Perhaps Schrödinger spoke and wrote a little too hastily and did not envisage that Big Science would turn to close cohabitation with the military-industrial complex (Capshew & Rader, 1992). Critiques of modern science also appeared in those very decades of scientific optimism. In Critical Theory's critique of the enlightenment, critics expressed the dominant role that instrumental rationality had acquired in the sciences (Horkheimer & Adorno, 1947/1972). Similarly, studies have shown the importance of the Cold War in instituting a new imaginary of science that was indeed platformed on the older one (Dennis, 1997; Fuller, 1997; Schaeffer, 1997).

Teaching Exemplars in an Exemplary Text

However, there are a few issues we need to address here. Schrödinger (2014) was under the impression that it would take a long time to gain a comprehensive understanding of 20th-century scientific developments that not only changed society but also revolutionised our understanding of the world (p. 115). Further, he noted that elaborating upon a philosophical understanding of how science transformed our understanding poses new tasks for philosophy itself. This comes out tellingly in his interpretation of several experiments in quantum physics as well as in *Nature and the Greeks*.

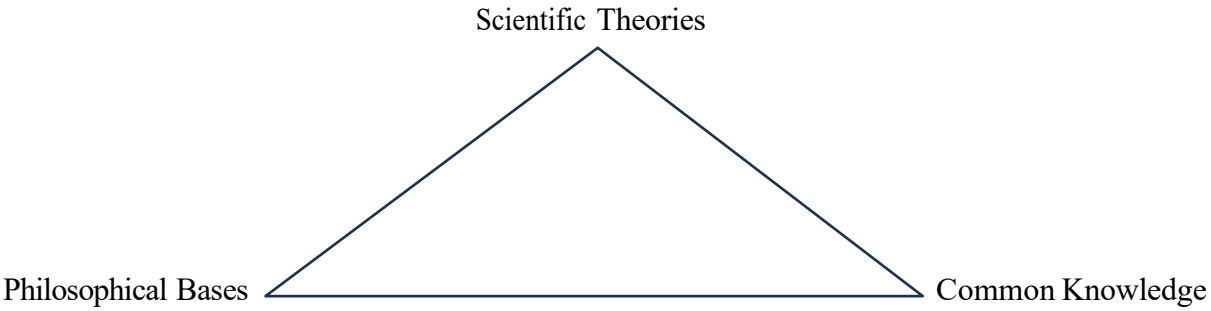
In these discussions on physics and philosophy, Schrödinger unpacks the manner in which developments in the sciences—beginning with the middle of the 19th century—have altered our understanding of nature and the reality out there. A philosophical elaboration of his arguments merits a separate paper. Nevertheless, there are several issues that need to be flagged. The first is the common misapprehension of many physics students that underpins their preconceptions about the world around us, such as our understanding of atomism and space. Much of our understanding of the world through the sciences runs counter to an empiricist conception as well as to common-sensical understanding (Bunge, 1967). The theories of relativity (special and general)

and quantum physics perhaps even more so—and by extension, we could run this argument to other sciences as well.

In other words, I wish to suggest that exposure to the original writings of exemplary scientists such as the work being discussed here are indeed germane to the training of students across the sciences and liberal arts. It could be argued that Schrödinger's entire discussion in this work elaborates upon a relationship best represented by the semiotic triangle below:

Figure 1

Semiotic Triangle



Schrödinger inventories the changing understanding of the nature of reality, but more importantly, sets out the connectedness between the sciences, humanities, and common knowledge while also identifying how scientific understanding departs from everyday conceptions. The lectures are instantiated by exemplars—in the Kuhnian sense—that highlight the changing understanding of atoms, elementariness, and the identity and individuality of elementary particles, followed by a deeply insightful section for any researcher on the nature of models. It is here that his underlying disagreement with metaphysical realism is most explicit.

There is much here for students of the sciences and social sciences to think about at the undergraduate level. Underlying his elaboration of the idea of a model is a deep epistemological reflection. The underdetermination of theory by evidence—no matter however extensive our base of experimental facts, our knowledge of the domain is still incomplete, and hence it is difficult to draw any exact conclusions about the nature of reality. This is why a precise model is needed to

render the thought itself more precisely, so that in turn, the derived consequences can be less imprecise (Schrödinger, 2014, p. 129).

However, a model is by nature ever deficient and sooner or later prone to revision, even though Schrödinger (2014) writes that "one still had at the back of one's mind the thought that the true model exists... in the Platonic realm of ideas – that we approach to it gradually, without perhaps ever enriching it, owing to human perfections" (p. 129).

We have here an assertion from a working physicist about the kind of knowledge we end up acquiring on nature when we use models. What is most striking about this discussion is its appearance around the time when historians and philosophers of science were developing their ideas on similar lines, based on the interpretation of experiments in physics that had been performed in the first half of the 20th century.

However, there is more to the lectures than one imagines. Schrödinger goes on to discuss many of the physical issues that have troubled physicists over the decades. In this debate the Copenhagen interpretation—whose leading proponents were Bohr and Heisenberg—has, for a long time, been considered the primary interpretation of quantum mechanics, while the interpretations of Schrödinger, Einstein, and others were portrayed as outdated orthodoxy. Reading through Schrödinger's account of the physics involved and his view of Bohr and Heisenberg's interpretation, the manner in which he sets out his point of departure reveals the dialogical processes that underpin the making of a revolutionary theory. In this dialogical process there is a spectrum of viewpoints and internal differences that are retrospectively swept into a fundamental set of differences that separate two groups—the winners and the losers.

The dynamics of this process have been systematically discussed in Maria Beller's book, *Quantum Dialogue* (2001). Schrödinger's (2014) lectures, too, provide an illustration of the dialogical process at work in the making of science, and are less about how one school of interpretation came to dominate over another (p. 152–3). Here, too, one observes how often debates in science can involve both metaphysical and epistemological concerns that are analogous to what happens in the humanities and social sciences. There is nevertheless a paradox that marks Schrödinger's philosophical engagement. His deep immersion in philosophical ideas and thinking may have surpassed that of many other scientists of modern times, as Moore claims in his biography. However, he rejected many philosophical conclusions that other scientists inferred from his work.

As Moore (2015) writes, Schrödinger rejected the idea that "such far reaching ideas could be drawn from a work in theoretical physics."

Science as an Integrating Force

Schrödinger (2014) takes us through the historical course of the development of physics in the 20th century and indicates both the philosophical concerns and common conceptions that are challenged by these developments in order to finally illustrate the importance and nature of science from a purely human point of view. As per this view, science is a central force that integrates all endeavours that are out seeking a response to what he considers the most important philosophical question: "Who are we?" Schrödinger argues that this is not just one of the tasks of science, but is "...the task of science, the only one that really counts" (p. 155). For many today, this would be considered an outdated, scholastic assertion out of tune with the times, but it requires recapitulation not only because it evokes visions of another kind of science but also because it joins the sciences to other domains of human inquiry.

Science and Humanism (*S&H*) alongside the series of lectures entitled *Nature and the Greeks* really became part of the introduction to the question of science and humanism, delivered at a time when the role of scientific and technological knowledge were deeply implicated in wreaking human devastation. Schrödinger's attempt was to bring back into the academy science's fundamental fraternity with endeavours in the humanities as an integrating force rather than of a domineering hegemon, as later imaginations made science out to be. Perhaps today it is time to learn something from the scientific humanism of the 1950s. In order to do so, Schrödinger's lectures can serve as a bridge text for students of both the sciences and humanities.

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