

Phenomenology, Ontology, and Quantum Physics

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Abstract This essay is dominated by three themes that recur contrapuntally in Heisenberg’s writings: *observation*, *description*, and *ontology*—prompted always by a concern about the role played by the subjective inquirer in scientific meaning-making, and by the ontology of scientific claims. Among the related themes are; *the tension between paradigmatic concerns with structure and philosophical concerns with reality, the possibility of scientific revolutions, such as relativity and quantum mechanics, that can overthrow the classical traditions of natural science, and the inadequacy of a psychophysical parallelism for an epistemology of reason.* The influence of Husserl and Heidegger is in his neokantian concern about the role of subjectivity. Heisenberg was a long-time friend of Heidegger and familiar with Heidegger’s hermeneutical phenomenology and its critique of Greek philosophy; he also contributed an essay to a *Festschrift* in Heidegger’s honor in 1959.

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Robert Scharff, in his excellent and authoritative essay “Displacing epistemology: Being in the midst of technoscientific practice” (Scharff 2011), makes us aware of the principle that both natural science and philosophy do not get their meaning and authority from an epistemology that is ultimately based on intuitions of the embodied imagination or revelations by spiritual (or divine) powers, but from foundational socio-historical narratives about nature and society that have been passed on as “*ontologically*” credible *within a socio-historical tradition*.¹ Scharff’s “ontological” narratives begin with the work of Wilhelm Dilthey and move

¹ See Heelan (2008); and a forthcoming paper (Heelan 2010).

² M. Heidegger called this new hermeneutical phenomenological ontology, “*Dasein*” (translated as the human “Being-in-the World” or “human consciousness of living in the cultural historical world”). Scharff focuses on Heidegger’s *Being and Time* (1962), but he does no more than mention Paul Ricoeur, whose work *Time and Narrative* (1984) is especially relevant for his argumentation, e.g., Part 1, Chap. 3 on *Mimesis*.

³ Heelan (1965).

on to Edmund Husserl, and finally to Martin Heidegger.² Heidegger's "*Dasein*" (translated as "Being-in-the-World") contextualizes hermeneutically the lived experience of people in a culture, and sets forth a new and enriched meaning for the term "*ontology*" as the study of what is "evident to human consciousness while living in the midst of its cultural history."

The foundational narratives of the modern scientific world then represent a new and enriched meaning of "*ontology*"—and one that is reached only through a hermeneutical phenomenology of modern scientific culture, characterized, as Scharff insists, by society's absorption of science-based technologies into the general culture of the World we experience. With this analysis, the *truth of science* merges with the critical truth of common ontological language as intended by the experience of "living-in-the-(modern technological)-World."

I was, as far as I know, the first to write a doctoral dissertation in the philosophy of quantum physics using the phenomenology of Edmund Husserl and Maurice Merleau-Ponty, and the hermeneutics of Martin Heidegger.³ I chose to use those authors as the foundation for my analysis of the quantum mechanics of Werner Heisenberg. Heisenberg was the founder of that branch of the quantum theory which was called "quantum mechanics."

I became interested in Heisenberg because he had a philosophical and phenomenological concern about *the role of human consciousness* in quantum and relativity physics. In preparing my doctoral dissertation, I came to know Werner Heisenberg personally, and this led to correspondence between us for many years until his death in 1976. I found him to be a person well read in the history of philosophy and of science and interested in probing the paradoxical turns in contemporary physics which quantum mechanics, and relativity, took. Moreover, his focus on the role of human consciousness in quantum mechanics was clear, explicit, and well announced in the titles of the two famous foundational papers he published on quantum mechanics; a paper he published in 1925,⁴ in which he introduced quantum mechanics itself, and a later paper, he published in 1927,⁵ in which he deduced the Uncertainty Principles. The theme of the first paper, taken from its title, was the "quantum-theoretical *re-interpretation* of kinematics and mechanics" (emphasis added). The theme of the second paper, also taken from its title, was "the *intuitive content* of quantum-theoretical kinematics and mechanics" (emphasis added).

Both papers explicitly claimed that quantum and classical physics differed in matters related to the *functioning of human consciousness*. When observed, quantum objects became *present* in the 'world', not because they were endorsed by classical intuition but because they presented themselves *via* human action in our 'world' within the measurement process. Such a 'presence in our world' he called *ontological*; he meant the new 'post-classical world'; it was the *lifeworld of human scientific culture* and not the old world of 'objective nature.' Such a transition was consistent with the *hermeneutical phenomenology* of Heisenberg's philosopher-friend, Martin Heidegger,⁶ which itself was a development of the philosophy of the Husserl circle at the University of Gottingen where the young Heisenberg taught. That this philosophical transition constituted a major break with assumptions that otherwise prevailed in scientific circles and, more broadly, in the intellectual debates of the time, is beyond dispute.

Such considerations entered my world of physics and became a matter of interest to me because philosophical questions regarding the connection between the quantum theory and the human lifeworld had also been raised by my former teachers, Erwin Schrödinger and

⁴ Heisenberg (1925).

⁵ Heisenberg (1927).

⁶ Heisenberg contributed an essay to honor Martin Heidegger in 1959 on his seventieth birthday, cf. bibliography.

Eugene Wigner.⁷ They too were interested in *the role of human consciousness* in quantum physics. Wigner, however, was not a philosopher but a very intuitive physical chemist and mathematician. As for Schrödinger, his interest was transcendental and his religious concerns would have led me far beyond the philosophy of quantum physics.

All three, however, were united in their concern with the nature and meaning of the ‘cut’ (*Schnitt* in German) between the subject and the object in quantum physics. They recognized that quantum physicists, equipped with their bodily sensibility and assisted by a laboratory bench, claimed that micro-entities, such as electrons, could be ‘observed’ in the process of measurement, *despite the failure of human intuition to represent their kinematic place and motion with respect to the space and time of the laboratory*. Today, we tend to look to cognitive science rather than philosophy for answers to problems of this sort, but in post-war Europe the crisis in quantum physics was seen as part of a cultural, philosophical crisis ushering in a new ‘post-modern’ or ‘post-classical era.’ The new era was focused on philosophical themes and methods of philosophical research that used *phenomenology*—namely, concern with *how human consciousness makes meanings*—and *hermeneutics*—namely, concern with *how meanings are communicated within a community*. Among the major intellectual resources for this kind of thinking were the works of Edmund Husserl, Martin Heidegger, Maurice Merleau-Ponty, and Hans-Georg Gadamer. The University of Leuven, being the home of the *Husserl Archives*, where I pursued my doctoral studies in the philosophy of science, was deeply involved in the new trends.

As for my prior philosophical resources to tackle these problems, I brought to the task a university training in classical philosophy in which I had been deeply influenced by Bernard Lonergan’s appropriation of Aquinas’ appropriation of Aristotle and Plato.⁸ I also brought to it an interest and inclination to venture into the new fields of *phenomenology* and *hermeneutics* that stemmed from my studies prior to Leuven. So it was not surprising that I began to be intrigued by the problems raised by Schrödinger and Wigner, but raised more strikingly by Heisenberg when he named them in the titles of his epoch making papers on quantum mechanics. Thus, when I left Wigner’s Palmer Laboratory at Princeton in 1962 and moved to Leuven/Louvain, an opportunity presented itself to seek counsel on these matters from Heisenberg himself in Munich.

I had found that phenomenology and hermeneutics⁹ were helpful in making sense of the distinction between classical and post-classical physics because the physical transition was founded on a philosophical transition from the ‘classical’ (universal and absolute) to the ‘contextual’¹⁰—or, to use phenomenological language, the “horizontal”—in each tradition. The ‘context’ of real presence was arguably the central innovative component of the physical theories that revolutionized twentieth century physics.

Specifically, the notion of *context* can be thought of as having two parts: a part *internal to human consciousness*, comprising the functions of *meaning-making*, *meaning-using*, and

⁷ I studied relativistic cosmology with Erwin Schrödinger at the Dublin Institute for Advanced Studies in 1946–1948; and I was a Fulbright Fellow in high-energy physics at Princeton in 1960–1962 where I studied with Eugene Wigner.

⁸ Lonergan’s (1957) major philosophical work.

⁹ In the USA, the post-classical part would have been called “(Continental European) Philosophy of the Post-war Epoch,” or simply “continental philosophy.”

¹⁰ ‘Context logic’ as applied to quantum physics was a major theme of my publications in the 1970s; among them, “Quantum logic and classical logic: Their respective roles,” *Synthese*, **22** (1970), 3–33; “Complementarity, context-dependence and quantum logic,” *Foundations of Physics*, **1** (1970), 95–110. These papers were summarized and applied to binocular vision in my book, *Space Perception and the Philosophy of Science*. The role of contextuality in quantum physics has recently been successfully explored and verified experimentally, see *Nature*, **460** (2009), 464–465 and 494–497.

meaning-testing; and a part *external to human consciousness*, comprising the *physical processes* associated in human life with *meaning-making, meaning-using, and meaning-testing*. The *internal part* draws on the *hermeneutic resources* of (what phenomenology calls) ‘*intentionality*,’ which is a technical term for the making, using, and testing of meanings. These hermeneutic resources include not only the habitual practices of *categorizing* what is represented in the sensory flux, but also habits of relating groups of categories to one another through higher order *explanatory laws* (or *theories*). The *external part of context* acknowledges the physical aspects of the *embodied—usually laboratory—practices* of meaning-making, using, and testing, such as the *organization and practices of the laboratory bench* governing how the observer engages and defines the ‘reality’ of the ‘world’ through acts of *measurement*; these are performed only by qualified observers embodied in instrumental technology who—in his/her community of practice—have become skilled in ‘interpreting’ the scientific *phenomenon* as a *datum, present and described* usually by a *numerical code* that has *meaning* only within the *dual context* of the *laboratory bench* and the *relevant categories and theories* that define the *measurement process*.¹¹

Such an approach to quantum mechanics turned out to be especially helpful when I approached Werner Heisenberg in 1962; he was at that time the Director of the *Max-Planck Institute for Physics and Astrophysics* in Munich. He was interested in philosophy and he was well read in the Greek and German philosophical classics as well as in contemporary German philosophy. He welcomed me at the Max-Planck Institute on many occasions during my two years at Leuven and we had many fruitful discussions there, in particular about the *context of measurement in quantum mechanics* and about his work in *elementary particle physics*.

On both sides of the Atlantic, Heisenberg’s orientation towards quantum mechanics, however, was from the start seen as problematic. It was problematic in terms of its implications for physics and just as much for its implications about deeply held philosophical positions. As for the former, Heisenberg came to see physics, and all science, as the study of the ‘ontology’ or ‘the real,’ of nature. In taking that position he was fully aware that philosophical terms such as ‘ontology,’ and ‘the real’ get their meaning from the context of their use in a community of philosophical discourse. His own way of acknowledging this fact is well manifested in his essays, which took the form of conversations with his physicist colleagues in Europe. These conversations addressed the variety of meanings and applications that his colleagues gave to quantum mechanics and the dialogues sought out core areas of agreement among them. From his standpoint disagreements in physical theories were always disagreements about ‘*the real*.’ This was encapsulated in the question: *Can a quantum entity that is ‘non-intuitable’, but nevertheless is said to be ‘observed’ in a laboratory measurement be ‘real’ in the ‘ontological’ sense?*

But there was more to his choice of the literary genre of essay as the textual environment in which complex matters were discussed in an openly dialogical and dialectical way. In expressing a philosophical problem as a conversational text he was well aware that no text, like no conversation, simply speaks for itself. Rather, it is the product of a particular *discourse* in a particular *context*, which involves many elements: a speaker (or writer), an intended audience, and the public linguistic practices of the community within which the textual meanings have been honed, polished, and shared. In such practices, the first recipient

¹¹ See my treatment of these matters in the volume on space perception, Heelan (1983), in which I applied hermeneutic context-dependent analysis to the binocular experience of visual and pictorial spaces, and was able to show in a new way that different context-dependent data expectations can lead to different visual geometries, Euclidean or Riemannian. This evidence can be taken to support the view that the natural binocular animal heritage of humans enables us to intuit visually finite curved 3D Riemannian geometries.

of the meaning is not solely the recipient, but the recipient's circle of discourse. As time goes on, however, the same text gets passed on to others beyond the original circle. One way in which this happens is by the publication of collections of already used texts—texts, that is, used by different people in different contexts of discourse. When a number of such texts are brought together in a collection, and subsequently cited from the collections, I believe that it is proper for hermeneutic reasons that the citation be accompanied by an appropriate paraphrase or commentary that gives the reader access to the original dialogical moment as related dialectically to later and re-interpreted dialogical moments. This paraphrase or commentary is omitted where hermeneutic reasons are excluded as they are excluded when, in the philosophy of science, analysis is based on a classical truth-functional logic of texts. Texts, like measurement events in a scientific laboratory, are just social-historical events, they are not univocal, nor independent of the reader; instead, they are heteroglossic and embedded in a physical, social, and historical context.

Heisenberg's philosophical conception of *physics as an ontological science* in the sense just described was considered problematic within the larger intellectual environment comprising philosophers of science in the USA and other Anglophone countries, as well as within an important group of his philosophical and scientific contemporaries in Europe. Among scientific intellectuals in Europe at that time, some stressed continuity with the classical tradition in both science and philosophy, which, with Kant, took space and time to be known realistically by *intuition*. Others looked to the Neo-Kantians of the Marburg School, which took the categories of human thought to be practice-oriented human inventions. Finally, those who exercised the most influence looked either to the positivism of Ernst Mach, or the logical positivism—later called 'logical empiricism'—of Rudolf Carnap and the Vienna Circle. The new academic discipline of the "Philosophy of Science" worldwide was largely due to the initiative of *émigrés* members of the Vienna Circle School. In this orientation, it was generally assumed that a scientific text in the 'authentic' scientific tradition could speak for itself in a univocal way and, consequently, could be analyzed and questioned by any reader as long as he or she had received adequate training in mathematics and classical formal logic.¹² Few among such readers shared, much less appreciated, the subtle hermeneutic, social, and historical dimension that tempered Heisenberg's otherwise classical mode of thinking.

Heisenberg disagreed strongly with the logical empiricist approach, considering it to be an abuse of logic and (while disregarding its actual European origin!) he referred to it as peculiar to "Anglo Saxon"—meaning chiefly US and English—cultures.¹³ Heisenberg's own cultural circle included the circle of scientific and philosophical colleagues who met yearly with Heidegger in the Black Forest. The foundational rule of this group was that *no text is univocal apart from the contexts of its dialogical use by a particular community*. He believed that the relevant meanings of any text are found only by negotiating one's way through the social maze of historically and socially motivated, many-voiced, and multi-contextual discourses of those who used the text in their common discourse.

He himself expressed this belief in many ways, most significantly by choosing, in line with Plato's model, the literary form of *dialogue* for his public essays. He imagined

¹² Camilleri (2009). Camilleri has chronicled a vast number of relevant texts about quantum mechanics that were exchanged in the form of dialogues among European physicists in the 1920s and 1930s. Camilleri's book is a scholarly and very useful study from the side of the history of the philosophy of science. It does not, however, throw much light on Heisenberg's own neokantian hermeneutic philosophy of science by exploring the dominant question in those scientific dialogues—a question which, after all, was then and remains today—about the "ontology," the "reality"—of that which quantum mechanics represented and modeled.

¹³ For example, in a letter written to Heelan, dated November 10, 1970, he refers to his distrust of the philosophy of "Anglo-Saxon" writers. Also see note 14 below.

himself as participating in such dialogical conversations with his scientific colleagues as they explored the multiple dimensions of a chosen question. As these conversations followed the many hermeneutical dimensions through which the question could be brought to a focus, they would also begin to reach for the core of closed, foundational, and authoritative meanings that operated at the center of the conversational exchange. It was through such a literary genre that he sought to communicate the *exemplary contextual richness in invariance* of, in this case, quantum and relativity physics.

Why was Heisenberg's philosophy of science not represented in the Anglophone world? And why is it that no other book on Heisenberg's philosophy of science has been published since my 1965 dissertation until the publication of Kristian Camilleri's book in 2009? For one, the post-war academic and cultural milieu in the USA in the 1960s and later was not yet ready politically to enter into a dialogue with Werner Heisenberg who had become primarily identified in the USA as the former head of Nazi Germany's nuclear program during World War II. There were also ideological, cultural, and philosophical reasons that counteracted his otherwise honored academic role and the recognition of his scientific achievements, inasmuch as Heisenberg's philosophical views about quantum mechanics were, as late as the 1970s, deeply alien and alienating to the culture of both physicists and philosophers of science on both sides of the Atlantic. This probably explains why Camilleri (2009) could remark that "[Heelan's *Quantum Mechanics and Objectivity*], published in 1965, remains to my knowledge the only major study published in English of Heisenberg's philosophy of physics."¹⁴

I wrote a follow-up manuscript to my 1965 doctoral dissertation in 1970, it was called "*The Observable: Heisenberg's Philosophy of Quantum Mechanics*." The manuscript was reviewed and given a strong endorsement by Werner Heisenberg, and his physicist/ philosopher colleagues in Germany; but it was refused publication in the USA. Eventually I set it aside because I saw that Heisenberg was not *persona grata* in the Anglophone academic world. I still hope that in the changed circumstances of our times it will eventually be published, if only as a historical document in the history of the philosophy of science.

Conclusion

To return to Robert Scharff's philosophical analysis and critique of the current official analytic foundations of science: I agree with his analysis and conclusions. The foundational narratives of the modern scientific world then represent a new and enriched meaning of "*ontology*"—and one that is reached only through a hermeneutical phenomenology of modern scientific technological culture, characterized, as Scharff insists, by society's absorption of science-based technologies into the general culture of the World we experience. With this analysis, the *truth of science* merges with the critical truth of a community's common ontological language as intended by the experience of "living-in-the-(modern technological)-World.

The passage of time since the 70s has largely becalmed the political and ideological sides of the past debate within the 'academy' and in the 'cultured world.' This opens up the possibility for the kind of conversation Heisenberg favored for scientific-philosophical inquiry into the inherent complexities of the notion of a "foundational knowledge of nature through science." Drawing some conclusions from those that he had, we can recognize that the intention of a univocal 'objective' accounting provided by an 'objective' science of nature detached

¹⁴ Camilleri (2009), Introduction, p. 8.

from any traces of human life, society, and history is a myth—one perhaps that is useful on certain political occasions—but the *real* Truth is that natural science, being a context-dependent account of how we shape and give meaning to our surroundings, celebrates humanity's *creative responsibility for the techno-scientific world we choose to make into the lifeworld of our choice*.

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