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Patrick Aidan Heelan's *The observable: Heisenberg's philosophy of quantum mechanics*, EPUB, ISBN 978-1-4541-9011-0 (New York: Peter Lang, 2016)

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As the tremours of the Sokal hoax dissipate, the publication of Patrick Aidan Heelan's book, with forewords from Michel Bitbol, editor Babette Babich and the author himself, offers a timely invitation to reconsider the relation between quantum physics and continental philosophy. Heelan does so, as a contemporary of and interlocutor with Werner Heisenberg on these issues, as a physicist himself who trained with leading figures of quantum mechanics (QM), Erwin Schrödinger and Eugene Wigner. Moreover, Heelan highlights Heisenberg's interest in phenomenology as 'a friend and frequent visitor of Martin Heidegger' (p.55).

Written originally in 1970 and unpublished then for reasons Babich explicates in her foreword, the various nuanced layers of this book offer a rich tapestry of interwoven arguments with multifarious appeal. It is stamped with the imprimatur of Heisenberg as an accurate account of his understanding of QM, including his philosophy of science—and as a socio-historical account of the unfolding of the QM debate in terms of the mutually interacting positions of the key historical players, for example, Bohr, Schrödinger, Einstein, Planck, Pauli, Wigner, as well as, most centrally, Heisenberg. The book also serves as a beautifully lucid, yet nuanced, account of quantum theory for the non-specialist reader.

Heelan reopens the issue of the background relation underpinning the subject-object dualism for a QM that interacts with phenomenology; this is done in a disciplined way that avoids the excesses of postmodern discourses in QM, as part of a questioning in need of revitalisation after Sokal. Heelan investigates phenomenological conditions, as a structure—a structured precondition of knowledge—impacting on the quantum realm, through an 'overtly

phenomenological methodology' Babich (xvii) in the philosophy of science. Allied with a hermeneutic foregrounding of language in scientific explanation, Heelan's *The Observable* is a call to arms for a renewal and acceleration of focus on the relational phenomenological background between subject and object, the observer and observed, as pertinent to QM.

Heelan's scrutiny of language in QM explanation is not simply a concern with terminology shifts between contexts of observation and explanation along the well-worn terrain of Wittgenstein (1958) where even terms such as 'pain' are not transferable from one linguistic context to another (Malcolm 1995, pp. 100–2). If so, Heelan would be going no further than Pais' (1982) acknowledgment of Bohr's preoccupation with the role of language in the appropriate interpretation of quantum mechanics, so that terms such as disturbance of phenomena by observation need to distinguish words like 'phenomena' and 'observation' from common usage to avoid confusion. Heelan treads further into linguistic questions, in terms of identification of the hermeneutic circle between theory and theoretically informed observations. A hermeneutic circle is a mutual relation between a set of contextual preconceptions (about a text or domain of investigation), and the way preconceptions shape description of those facts used to test them. This linguistic questioning in scientific explanation is examined by Heelan via prior structure and spaces informing this language.

Heelan goes a step beyond mere acknowledgment of theory-ladenness in observation, a default assumption already in Duhem, Freud, Popper, Lakatos, Kuhn and Feyerabend, to adopt a kind of foreground–background questioning as part of the hermeneutic circle between the language and meaning system of observation (L1) and the translation of this into the wider language and theoretical framework (L2) informing and being informed by the observation. Perceptual observation involves for Heelan a combination of 'event recognition coupled with the appropriate horizon recognition'

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(p.96), as ‘the present author’s view that there are necessarily two descriptive languages in quantum mechanics, a QM event-language and its QM contextual language; the latter describes the a priori context in which the QM event occurs and that necessarily conditions the description’ (p.128). Heelan again asks, ‘What relationship did Heisenberg suppose existed between the descriptive frame of the sign-fact and the descriptive frame of the signified QM fact when a QM observation is made?’ (p.102). This is not simply Quine’s (1961) rejection of discrete event falsification. Heelan’s concern is with the hermeneutic and spatial structure of this translation process between both levels of scientific language and explanation for QM.

Here it is tempting to invoke a Gestalt figure-ground relation between these two language levels of description/explanation, building on Hofstadter (1979). Chiming also with Hofstadter’s preoccupation with conceptual and linguistic self-reference, including for Gödel’s theorem in mathematics, Heelan’s concern with the background structural relation between these two levels of language is a first cousin of Heidegger’s self-referential question in *Being and Time*, regarding the domain over which the ideal and real correspond and whether this is itself real or ideal? The hermeneutic circle offers a self-referential lens upon this background structural relation, though not explicitly stated as such by Heelan here.

Heelan’s work is far from being merely a historical account. His is an explicit engagement with the ghosts of the future. He envisages a revolution to come via Heisenberg’s quest for a reformulation of QM into a meaningful language that challenges default everyday assumptions about reality, rather than the Bohr compromise that fits it into the Procrustean bed of classic mechanical assumptions imbued in everyday common sense. In Heelan’s words, ‘When relativistic space–time was absorbed into common language, the description of reality changed. Heisenberg’s early proposal to reinterpret the kinematical variables of physics was not, however, absorbed by common language. Instead, the paradigm of complementarity was embraced which did not change or add to the descriptive predicates of nature but merely claimed to control their applications by a higher logic’ (p.106).

The Observable serves as a prolegomenon for a revolution envisaged by Heisenberg, a thwarted revolution that became flattened in the compromise of the Copenhagen interpretation agreed by Bohr and Heisenberg. This Copenhagen interpretation filled new wines in old bottles, through a commitment to QM scientific explanation in the language of everyday common sense concepts, a commitment of Bohr that Heisenberg questioned on philosophical grounds and as ill-suited to the reframing of traditional assumptions of reality. However, Heisenberg ultimately acquiesced to Bohr’s more conservative explanatory predilections. Nevertheless, as Heelan highlights, ‘The Gifford Lectures [1955–56]

marked Heisenberg’s return to the germinal principles of his original insight, namely, to the principle of E-observability (“Whatever is E-observable belongs to the descriptive ontology of nature”), and to the principle of implicit definition (“In the case of a physical theory, the descriptive concepts are defined by and through the mathematical physical theory”’) (p.112).

Intriguingly, this book opens up fresh vantage points on a dual layer of silence, uncovered most directly in its final sentence, that Heisenberg’s future revolution needs to be unmuted: ‘It was while exploring the epistemological foundations of quantum mechanics that I rediscovered the revolutionary vision of reality glimpsed by Heisenberg in 1925 and lost soon after in Copenhagen. I hope that others too will discover this vision and that it may contribute towards the responsible development of quantum physics.’ p.148. As significant is his statement here that even this book is infused with a prior silencing, that it is adapted to a British and US audience to limit its phenomenological concerns, ‘I have muted the contribution of phenomenology to Heisenberg’s philosophy of science because it is of little interest to my American and British readers whose objective interest tends to be disconnected from the study of the hermeneutical meaning-making processes’ (p.140). This invites the question as to what an unmuted phenomenology here might be composed of and if there are clues to these contours in Heelan’s own text?

It is here that a further step can be made to the Pauli-Jung correspondence (1949) on seeking a neutral bridge language between psyche and physis, this neutral language was not available to Pauli. Despite drawing upon a possible language of archetypes, parables or in subsequent correspondence of Pauli (1953) with Jung, where he proposed mathematics as this neutral language, this issue remained no more than a promissory note in Pauli’s thought. Perhaps Heelan’s book points the way towards key components of such a neutral bridge language, building on phenomenology, though not explicitly seeking to envision phenomenology in terms of such a neutral language? Treatment of mathematics as itself a kind of language would invite scrutiny of prior background shaping conditions and structures as part of Heelan’s phenomenological questioning of language more generally. Such a phenomenological structural conditions concern for mathematics as a language would not simply interrogate correspondences between mathematics and real-world quantum phenomena. It would ask the question as to the background domain over which both aspects correspond, as Heidegger (1927a, b) interrogates the questioning of being as background itself to the ideal and real, *intellectus* and *res*. However, rather than treating mathematics as expressive of merely abstract rationalism, as later Heidegger does in his assault on calculative thinking, with roots of similar concerns in his *Basic Problems of Phenomenology* (1927), the

phenomenological search would be for structures underlying mathematics that are shared prior conditions with lived experience. Can at least some structural features of some domains of mathematics be embedded in a common realm with structural conditions for experience? This might move a phenomenological quest into territories of the unconscious rather than simply a structure of intentionality, and would offer resonance with, for example, Matte Blanco's (1975) framework of infinite sets and symmetry as an underpinning structure for certain kinds of symbolic associations in experience. Moreover, Hofstadter (1979) has highlighted a common structural feature of mathematics and language, namely, self-referential truth dimensions. While Heelan is not treading in these waters, his concerns with phenomenological conditions as structures of experience, allied with mathematics as a language of explanation, and reshaping spatial assumptions, pave the way for such future steps for a phenomenology of and through space pertaining to mathematics, in a tradition also of Pauli's quest for a neutral bridge language between psyche and physis.

An array of spatially imbued terms inform Heelan's discourse on language and thought in QM explanation. He recognises the need to shift spatial horizons of understanding and the threads of barely touched upon assumptions, 'The possibility of such new geometrical conventions demonstrates that spatial language is not restricted to the a priori of classical physics' (p.105); 'the spatial relationships... anomalous according to our usual conventions, do correspond well to the peculiar spatial relationships painted by Van Gogh and Cézanne.' (p.105). Space mediates between the material and symbolic; it involves theory-laden spatial projections into thought and empirical QM observations, and our language for this.

Heelan's QM discourse includes reference to closed systems, cut, boundary, horizon, hermeneutic circle. This ineluctable reliance on spatial assumptions, on a spatial assumption structure is alluded to by Heelan, though not as an explicit discourse or system of meaning of itself. How does this spatial discourse interact with physics, is it merely metaphor or a prior system of conditions? Ricoeur engages in a similar hermeneutical exposition in *The Rule of Metaphor*, invoking a plethora of spatial assumptions (proximity, distance, tension, displacement, the 'open' structure of words, closure, transparency and opaqueness) to interrogate metaphor, assumptions that are tantamount to a prelinguistic discourse, a prior spatial system of meanings (Downes 2016a). Such a phenomenological discourse is not simply of space as perception but through space, as preconditions structuring experience.

A more overtly phenomenological concern can run through paths beyond simply the body or influence acknowledged by Heelan of a 'neurophysiological system' (p.61) in the relation with the QM measuring instrument to interrogate

the role of the instrument in the shift in conditions of experience. Intentionality as a structure gives expression to different modes of being, expressed in the measuring instrument. A further step, building on Heelan's concerns with space underpinning language, is to interrogate this as a relational space; relational space is not opposed to the physical in Cartesian fashion, but is also physically embedded, though not reducible to mere place or change of place. A focus on the measuring instrument or body of the observer can be, at least in initial terms, allied with a relational space focus (Downes 2016b), as spatial conditions with physical effects at a QM level.

What is the common system of relations, prior to the subject-object division, within which the measuring instrument and observer is embedded interactively with the QM world? This is a prior system with real-world impact; it is embedded in some way. Heelan suggests that, 'The union between the sensory organs of the human subject and the external instrumentation is a physical union—but not exclusively physical' (p.97). It is arguably a relational space. Building on Heelan's words 'the possibility of a wholeness that unites the object and the instrument and, on the other, the possibility of a wholeness that unites the scientist and the instrument.' (p.97), a relational totality is implied—a relational space.

Heelan opens up a spatial vista for QM language and interpretation at two distinct though related levels. Firstly, as the background hermeneutic structure underlying the transition between the two levels of language of scientific explanation—direct observation framed in diametric spatial terms of yes/no experimental feedback and the wider theoretical framework of meaning interpreting the QM data. Heelan asks, 'How are these frames related to one another?' (p.102). Secondly, he invokes a spatial conception of cut, and speculates on the site of this cut between observer, measuring instrument and observed. Heelan's own foreword, acknowledges that this conception of the cut draws from leading thinkers in QM, 'All three, Wigner, Schrödinger, and Heisenberg, 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.' (Xxxiii). Thus, the background relation between subject and object at a QM level is interpreted by Heelan and leading QM physicists in terms of a quasi-spatial discourse.

In Heelan's account, 'For Heisenberg, the process of measurement is a continuously connected process within which the QM observer-subject is bodily joined to, yet mentally distinguished from, the QM observed-object; the epistemological dividing line between these two is called the 'subject/object cut' or just the 'cut' (p.95); 'In the first 'reading,' the 'cut' is in position (1) between the scientist and the measuring instrument... In the second reading, the 'cut' is between the measuring instrument and the QM object in its descriptive horizon. In the second reading, the

cut is in position (2), with the scientist joined physically and epistemologically to the measuring instrument' (p.95). Interrogating a principle of division in spatial terms, Heelan states, 'One principle of division is spatial: it makes spatial 'cuts' which divide physical space into two parts, one which is 'internal (spatially)' to the subject and the other which is 'external (spatially)' to the subject' (p.135); 'The second principle of division is subject/object intentionality of meaning making... This divides the 'space' of cognitive awareness of the world by a 'cut' that distinguishes the noetic-subject (knower) from the noematic-object (known)... the known object is not separated from the subject in any physical or spatial sense—both subject and object are 'within the intentional space of human consciousness' and it is within this intentional space that the 'cut' between subject and object is made. Such a distinction is not described in physical or spatial terms, but in phenomenological and epistemological terms' (p.135). Heelan can be construed as engaging in a spatial turn through interrogating the spatial assumption structure of phenomenological conditions framing QM, a spatial turn invoked in different ways across many disciplines (Downes 2020b). Heelan's spatial turn is far from reduction to mere place or change of place.

Yet I would argue that Heelan could take this spatial argument further, through unmuting a Heideggerian concern with being prior to intentionality. Intentionality as a phenomenological structure needs and builds from the subject-object dualism, rather than being a constituting condition or process for the construction of this very distinction. The division principle of cut at the level of intentionality is predicated on a prior spatial cutting process as a mode of being. This cut of assumed separation is an implication of Heidegger's phenomenological interrogation of objectness, and through a specific dividing space, a concrete structure of cut, namely, diametric structured space. As Heidegger's *Basic Problems of Phenomenology* highlights, the realm of objectness is a standing against, as in the German word for object, *Gegenstand*, 'but instead the being as standing-opposite, as standing-over-against'; diametric space underpins this opposition as 'an object... counterposed to the subject' (p.157). Heidegger does not take the further step of interpreting this spatially imbued oppositional standing-against, as being a concrete spatial structure of diametric opposition. Diametric spatial opposition is one aspect of a relational spatial system, to be contrasted with a more connective space of being-in, dwelling, being-alongside in Heidegger's *Being and Time*—argued elsewhere as expressing an underlying concentric space (Downes 2012, 2020a).

This cut can also be construed as a compression process, a condensing process of division, a diametric spatial process. The 'kind of physical union' (p.98) is construed by Heelan as a text, moving into the territory of postmodernism. It is also a relational space, a relational space encompassing the

physical. Heelan recognises that this is a reading process, a hermeneutic process of interpretation. This textual process is placed as a relation between subject and object that occurs after the subject and object are constituted. A more Heideggerian phenomenological approach would interrogate conditions prior to the subject-object dualism. The subject-object duality is a later emanation from a prior background process, a prior relational spatial process. Prelinguistic space mediates between structure and meaning, with real-world impact as system conditions.

Building on Babich's apt comments in her foreword to *The Observable*, 'Beyond the phenomenologically attuned resources characteristic of Husserl's famed "return" to the things themselves, perhaps more valuable, at least from the perspective of an explicitly Heideggerian or even Nietzschean philosophy of science is the questioning (or critical) component of such an approach' (xx), an unmuting phenomenology is needed for philosophy of science in QM that is not simply in Husserlian terms of intentionality but a prior background level of being, resonant with Heidegger's ontological priority given to possibility. Deconstructing a diametric split between quantum physics and continental philosophy need not invoke caverns of relativism or nihilism. While the 'centre' of a Kantian epistemology and the rigid edifices of subject-object dualisms cannot hold, Heelan offers a pathway, far more than mere promissory note, towards a loosening of traditional frames for a prior truth domain that is more than the deliberated anarchy of reversals of Feyerabend (1988). Heelan's quest rests on prior structured conditions of experience, a phenomenological relational wholeness between subject, object and measuring instrument. This is tantamount to a relational space, building on Heelan's own spatial discourse here in terms of cut, horizon and hermeneutic circle. Heelan has opened up vital, distinctive phenomenological and hermeneutic avenues for philosophy of science in relation to QM, and in doing so, implies a further spatial-phenomenological vista of questioning for a hermeneutics through space. Heelan's material, embedded spatial hermeneutical concerns, applied to QM, are directly pertinent to this special issue "Material Hermeneutics, Technoculture and Technoscience."

With Bitbol's foreword recognising that 'Schrödinger did not hide the breath-taking similarities between his philosophical ideas and Schopenhauer's.' vii, while Bohr drew from William James for his conception of complementarity (Zabriskie 2001, p. xxx), interplay between physics, psychology and philosophy is a fact of history, despite postmodern excesses in QM and reservations of some leading physicists on this interplay. For example, Nobel Prize winning physicist Steven Weinberg (1996) rejects a dialogue between physics and the social sciences in general. However, he views some notable exceptions to this, specifically regarding space, time and matter, where he recognises that the insights

of physics on these dimensions may have implications for the social sciences. Can, as Heelan suggests, the influence work the other way, in particular for space to reshape future languages of QM explanation? Can space offer the neutral bridge language between psyche and physics that the Pauli-Jung correspondence seeks?

An array of Heelan's distinctive conceptual contributions include the following aspects of *The Observable*. He extends a hermeneutic focus in philosophy of science beyond simply recognition of theory-ladenness in observation and a concern with language in scientific explanation to interrogate structural conditions of experience influencing explanation and relates these to a hermeneutic circle of explanation in the interplay between different interconnected levels and languages of scientific explanation. In doing so, he also distinctively highlights the malleability of spatial framings in languages of explanation. His further phenomenological contribution is to interrogate the structure of intentionality and the 'cut' location in the interaction between observer, measuring instrument and the observed at QM levels of explanation. Implications of these contributions are that seeds are emerging of a spatial phenomenological discourse prior to language pertinent to QM explanation, requiring further questioning in terms of the ontological status of this spatial discourse. The relationship of this spatial discourse to mathematics as a structuration principle underlying some mathematical explanations relevant to QM, invites further interrogation if mathematics is construed as itself being a kind of language with a pre-shaping spatial assumption structure. While Heelan's phenomenological focus on the observer/observed relation is in terms of intentionality, it leaves open the intriguing phenomenological question as to whether a prior level of being, as a relation, may also be pertinent to QM scientific explanation. A further step towards a neutral bridge language sought by Pauli invites interrogation of diametric spatial and wider spatial structural dimensions of this. Heelan has both directly and indirectly opened a range of intriguing and innovative vistas for inquiry, as part of a replenishment and expansion of Heisenberg's original revolutionary interpretation of QM, stalled in the Copenhagen wave-particle duality explanation.

The time-lag delaying the publication of this vital book across several generations, 50 years in fact, is a salutary warning against a complacency that assumes that science is not distorted by power. This is an extension of the point that competing narratives as Kuhnian paradigms may be sustained as much by social considerations as by merit of argument, by institutional and interpersonal incentives to promote and suppress various lines of inquiry. It locates such a point in a further set of preconceptions allied not only with scientific traditions but with epistemological commitments that Western cultures may be loathe to shed. Heelan's book serves as an inspiring and highly insightful invitation

to shed the fabric of taken for granted realities as part of an ontological truth quest for QM, as a step beyond the Copenhagen interpretation of complementarity between quantum waves and particles, towards fulfilment of a lost vision of Heisenberg.

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