Johntology:
Participatory Realism and its Problems

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Abstract
A new term has entered into the lexicon of quantum mechanical interpretation: “participatory realism” (a term coined by Chris Fuchs to describe his own QBism, borrowing from John Wheeler’s later participatory universe ideas). This paper briefly explores this idea and the extent to which sense can be made of its claims of realism. I find that attempts to render it into a realist stance hark back to Max Born’s broadly structuralist idea that there are objective invariants within the apparently ineffable quantum world.

Nothing is more astonishing about quantum mechanics than its allowing one to consider seriously on quite other grounds the same view that the universe would be nothing without observership as surely as a motor would be dead without electricity.

Wheeler (1977, p. 21)

1. Preamble: From Observers to Participators

John Wheeler’s fashionable “it from bit” meme lies at the heart of much recent work on the foundations of quantum mechanics. At its most basic it implies that the world is in some sense “built from information”. However, this slogan omits the most crucial element of Wheeler’s ontology: the participator – “it from bit + participator” doesn’t sound nearly so catchy, but it more accurately encapsulates Wheeler’s viewpoint. In his writings he is quite explicit about this expansion (Misner et al. 1974, p. 1273):

The vital act is the act of participation. ‘Participator’ is the incontrovertible new concept given by quantum mechanics. It strikes down the term observer of classical theory, the man who stands behind the thick glass wall and watches what goes on without taking part.
And elsewhere (Wheeler 1974, p. 689): “We have to cross out that old
word ‘observer’ and replace it by the new word ‘participator’.”

This way of expressing things puts one in mind of the great shift in
the picture of spacetime from what Julian Barbour (2001, p. 618) calls
Newton’s “perfectly uniform and translucent block of glass [that has] all
the properties of such a block of glass except the glass!” to the dynamical,
active spacetime of general relativity, which itself becomes a participator
in the drama of the Universe. In the literature on spacetime theories this
manoeuvre is known as “background independence”, understood as the
elimination of immutable, absolute spatiotemporal structures from physics.
In a sense, participatory positions like Wheeler’s extend such background
independence to classical (Cartesian) observers, bringing them in as part of
the show, rather than remaining inertly as mere audience members (see
Fig. 1). As Wheeler (1983, p. 185) poetically expresses it:

Nature at the quantum level is not a machine that goes its inex-
orable way [rather, we] are inescapably involved in bringing about
that which appears to be happening.

A participatory reality is, then, a productive or creative one, in some sense
with us as reality’s architects. Given this, one might even label such a
worldview “existentialist” rather than merely participatory.¹

The conceptual problems of quantum mechanics will doubtless be too
well known to rehearse them again here. Let me simply state the rele-
vant aspects. The main issues concern how it is that we appear to have

¹Of course, existentialism usually concerns humans and their values, but it is not
so far fetched if one considers the following characterization of existentialism by Irving
Yalom (1980, p. 1, my emphasis):

The existentialist position challenges the traditional Cartesian view of a
world full of objects and of subjects who perceive those objects. ... The
existentialist position cuts below this subject-object cleavage and regards
the person not as a subject who can, under the proper circumstances,
perceive external reality but as a consciousness who participates in the
construction of reality.

Sartre put it more succinctly: “The world is a mirror of my freedom.”
In recent QBist developments (e.g., Fuchs 2017) of the participatory universe idea,
this core tenet of existentialism appears to be even more to the point. However,
one purported implication of this neo-existentialism is that the block universe picture
cannot be true, for that gives the world “once and for all”, while here the world is
built up from participator interventions. This strikes me as wrong-headed: one can
well encompass this core idea within a block universe, just as one can encompass
free will in a block by making the switch from an allocentric (block) to an egocentric
(embedded) perspective (cf. Ismael 2016) – a heroic attempt to incorporate in physics
located agents, with first-person perspectives, can be found in James Hartle’s IGUS
(information gathering and utilising system) concept (see, e.g., Hartle 2005). One
could perhaps imagine a similarly operational account of a participator as anything
that sets up measuring equipment of a certain sort, to elicit a binary-valued response
from the world and is able to irreversibly amplify the response.
outcomes (or discrete events) in quantum mechanics, given the latter’s linearity and unitarity. Various accounts exist, including several locating the resolution somewhere in the mental domain – it is not completely clear whether participatory realisms demand some special mental domain; this requires an adequate definition of the concept of participator of course. Wheeler was always keen to point out that it was not consciousness that was necessarily involved, but a split between observer and observed, experimenter and system (Wheeler 1980a, p. 361):

“Elementary phenomena” are impossible without the distinction between observing equipment and observed system; but the line of distinction can run like a maze, so convoluted that what appears from one standpoint to be on one side and to be identified as observing apparatus, from another point of view has to be looked at as observed system.

One might wonder, borrowing from Jung (1954, p. 380), whether, since “the psyche is the ... sine qua non of the world as an object”, perhaps consciousness sneaks in through a back door? But, then again, Jung had a deeper principle: “in the Unus Mundus ... there is no in-commensurability between so-called matter and so-called psyche” (Jung 1976, pp.398ff). Wheeler has his own version of this in the form of his so-called “pre-geometry”, which is neither mind nor matter (nor spacetime),

Figure 1: A Wheelerian participant: one possible alternative to the prevalent elimination of the subject/agent from physics. Here, the participant is actively involved in the way the world develops, rather than sitting in the wings, passively observing. (From Wheeler 1980a, p. 355).
but something underlying all three, best associated with the calculus of
propositions (given the isomorphism between the “yes/no-questions that
can be put by a participator and this propositional calculus: cf. Patton
and Wheeler 1975, p. 589) – a participator is then associated with an
undecidable proposition (see Fig. 1). However, Wheeler soon dropped the
idea that a participator was associated with an undecidable proposition
in favor of something that would fit better with Jung’s (and Pauli’s) Unus Mundus,\(^2\) in which (Patton and Wheeler 1975, p. 591)

the “observer”, far from being isolated from the surrounding world
except insofar as he opens upon it one-way windows of perception,
is in a certain sense coextensive with it.

The expression “participatory realism” is really quite a peculiar one.
Are the participators fundamental in some sense? Are the participators
separate from the rest of reality? If so, why is this not just recreating the
subject-object split that participatory realists wish to transcend? If so,
why are they not subject to the same randomness characterizing the world
they act upon? Or are they built from that randomness themselves? This
is rarely discussed, and the concept is usually taken as axiomatic. Again,
Wheeler’s own view appeared to correspond to this latter approach at
some point, but it raises various problems if viewed ontologically. Indeed,
at one later point, Wheeler apparently pulls a fast one and relegates the
answer to the problem of meaning-assignment by an observer-participant
to some other story outside of the quantum (cf. Wheeler 1983, p. 196).

\[2\text{More along the lines of philosophy, one could perhaps imagine a Russelian neutral monist approach dissolving the problem since there “both mind and matter are composed of a neutral-stuff which, in isolation, is neither mental nor material” (Russell 1921, p. 144). However, merely stating this is not enough: we need an account of how the neutral stuff achieves this feat.}\]
Type-I approaches refer to “intrinsic realisms” in the sense of commitment to the idea that the probabilities of measurement outcomes are determined by intrinsic properties of the observed system. Type-II (participatory) approaches deny this and place commitment at the level of experiences of observers, agents or more generally participants. As Cabello (2017, p. 140) puts it:

Type-II interpretations do not deny the existence of an objective world, but, according to them, quantum theory does not deal directly with intrinsic properties of the observed system, but with the experiences an observer or agent has of the observed system. Type-II interpretations can be “about knowledge” if they view the quantum state as an observer’s knowledge about the results of future experiments, or “about belief” if they view the quantum state as an agent’s expectations about the results of future actions.

<table>
<thead>
<tr>
<th>Type II (participatory realism)</th>
<th>About knowledge</th>
<th>About belief</th>
</tr>
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<tbody>
<tr>
<td>Copenhagen (Bohr 1998; Faye 2014)</td>
<td>QBism (Fuchs 2010; Fuchs and Schack, 2013; Fuchs, Mermin, and Schack 2014)</td>
<td></td>
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<tr>
<td>Relational (Kochen 1985; Rovelli 1996)</td>
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<td>Zeilinger (Zeilinger 1999, 2005)</td>
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<td>“No-interpretation” (Fuchs and Peres 2000)</td>
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<td>Brukner (Brukner 2016)</td>
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Figure 3: A table of participatory realisms according to Cabello (2017, p. 139).

This table is somewhat peculiar in that Peres’ strict instrumentalism (an anti-realism for sure) is placed in the same column as both Wheeler’s approach and also Rovelli’s approach, and at least in the same category as QBism. These are quite distinct. It appears that mere interactivity (in the sense of an extrinsic relationship) is being conflated with participation or agency. In my view, Type-II approaches as listed in this table would best be called “extrinsic realisms”, and a separate column for participatory realism should be constructed for QBism and Wheeler alone.

For Fuchs, participatory approaches acknowledge that a first-person perspective is not sufficient to describe a world: elements of reality will be missing from any such account. Wheeler made similar remarks, yet, so far as I can tell, nothing of this sort pervades the other interpretations.

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3Indeed, David Wallace has recently referred to these Type-II entries as “non-realist’ strategies” (Wallace 2018, p. 2).
presented in Cabello’s table. Indeed, the whole point of participatory realist approaches is to go beyond mere passive knowledge-gathering from the world (i.e. an observer-based approach) and develop instead a metaphysics where the world is “co-created” by the agents or participators – the other element of co-creation is the world of quantum systems which quantum mechanics helps the participators navigate. This is the way of Wheeler, and I give it the tongue-in-cheek label of “Johntology.”

Cabello is quite right, however, that the existence of some kind of objective world is present in participatory realist accounts, providing the random events in response to the participators’ questions (i.e. experiments) – this derails charges of idealism and solipsism. But saying what this world outside the participator amounts to is no easy task – again, Cabello is right to bring out the absence of a world populated with independent objects with their intrinsic properties carried without regard for experimenters’ whims, but most scientific realists demand more to be said.

2. Johntological Investigations

What I’m calling “Johntology” can be encapsulated in two inter-related principles:

No question, no answer.
No participator, no world.

These principles are nicely illustrated through Wheeler’s own example of 20 Questions (only here played without an answer established in advance). This brings out the participant quality of questioning. The example was something that in fact happened to Wheeler. He had been sent out of the room while the other players were to agree on a word. But they in fact agreed to not settle on a word at all. When Wheeler came back into the room, he asked his questions as usual (“is it mineral?” etc.). As the game continued, the answers to his questions became longer and longer, with the answerer having to think about a word or object that would be consistent with all the answers previously given. There was no pre-given answer: Wheeler’s questions played a role in creating the final answer: “a cloud”.

But Wheeler’s questions alone didn’t make this answer emerge unaided; neither did the answers given. It was a co-creation. Wheeler had no idea whether a “yes” or a “no” would come from his specific questions. So it is in a quantum mechanical experiment, according to Wheeler, with reality built up from a great many such questions and answers (Wheeler 1980a, p. 359):
Each query of equipment plus reply of chance inescapably do build a new bit of what we call “reality”. Then for the building of all of law, “reality” and substance – if we are not to indulge in free invention, if we are to accept what lies before us – what choice do we have but to say that in some way, yet to be discovered, they all must be built upon the statistics of billions upon billions of such acts of observer-participancy?

The unpredictability is a real feature of the world: we do not know what specific outcome we will get, though we get some say in what kinds of outcome we get in our choices of experiment (e.g., whether we get interference in a double-slit setup or not). This reality is what is supposed to take such participatory positions out of mere instrumentalism and into realism, despite the fact that the world does not exist independently of the questions (thus making it rather unorthodox from the perspective of scientific realism, which standardly invokes a “way the world is” independently from observers: Cabello’s Type-I approaches from above).

Taken to its extremes, Johntology leads to a mechanism for the Universe to come into being: this was Wheeler’s (1980a, p. 362) early hope for it (‘Why the quantum?’ and ‘Why existence?’ each feeding the other):

Beginning with the big bang, the universe expands and cools. After eons of dynamic development it gives rise to observership. Acts of observer-participancy – via the mechanism of the delayed-choice experiment – in turn give tangible “reality” to the universe not only now but back to the beginning. To speak of the universe as a self-excited circuit is to imply once more a participatory universe.

In this way, we have a view with “participatory observership as the source of all useful meaning” (Wheeler 1977, p. 21), or: “meaning itself powers creation” (Wheeler 1986, p. 372). But the philosophically problematic (weasel-phrase) “tangible ‘reality’” is present in this Cosmogony: what are we to make of the Universe’s development, which is clearly occurring in order to generate observer-participants? Even if this difficult task of making sense of the emergence of the participator can be achieved, there remain, then, these ontological problems of another sort, stemming from the peculiarities of quantum mechanics. By way of segue into this issue, we first look at the Bohrian origins of Wheeler’s (and other participatory realist) ideas.

3. The Bohrian Background

It is well known that Wheeler was heavily influenced by Niels Bohr’s philosophical views, though he took them in a very different direction that Bohr himself likely would not approve of. What Wheeler took from
Bohr can be summed up in his maxim (Wheeler 1983, p. 184): “No elementary phenomenon is a phenomenon until it is a registered (observed) phenomenon”. And observed phenomena require a split into a system and an observer-participant to establish the context. This idea can be seen in operation in the Kochen-Specker paradox. Here we find that even for individual particles it is not always possible to assign definite values (i.e., measurement outcomes), independently of the context established by a measurement apparatus in an experiment. One of Wheeler’s greatest contributions was to follow this kind of logic into unintuitive places, leading to his delayed-choice idea (Wheeler 1986, p. 370):

Ascribe a polarization, a direction of vibration, to the photon that began its journey six billion years ago, before there was any Earth, still less any life? Meaningless! Not until the analyzer has been set to this, that, or the other chosen orientation; not until the elementary quantum phenomenon that began so long ago—and stretches out, unknown and unknowable, like a great smokey dragon through the vast intervening reach of space and time—and has been brought to a close by an irreversible act of amplification; not until a record has been produced of either “yes, this direction of polarization” or “no, the contrary direction of polarization”; not until then do we have the right to attribute any polarization to the photon that began its course so long ago.

For Wheeler, this was a perfectly direct consequence of Bohr’s above maxim. That the idea has been experimentally realized (on small scales) is surely support for the broadly philosophical stance from which it was born.

Bohr himself viewed physical theories as structures systematizing our sensory experience: the phenomena. It wasn’t for physicists to probe beyond this veil of experience to discover the real essence of things in themselves. For this he is often lumped in with anti-realists. However, that does not mean that quantum theory was not discovering something true of the world. The great successes of quantum mechanics were due to the correctness in some sense of the quantum postulate as something “residing in the world” (cf. Faye 1991, p. 228).

One can draw out similar sentiments from the recent QBist literature, in which while the framework of quantum mechanics is a tool to help us, qua agents, navigate our world, the fact that it is so successful in navigating that world tells us something about the world itself, if only its structural contours. Wheeler gives a vivid representation of this discovery of structural outlines of reality in Fig. 4.

The world shows us that it is quantum through our observations, through experience. But what is the nature of this quantum world outside of those observations? Only those iron posts? On that, according to Bohr, we must remain silent. Wheeler too spoke of the fact that “what
we call reality consists ... of [these] few iron posts of observation between
which we fill in an elaborate *papier-mâché* of imagination and theory”
(Wheeler 1983, p. 194). Indeed, even the iron posts can be interpreted in
a great variety of ways, as solid concrete outcomes or not (e.g., as in the
case of Everettian interpretations). This leads us into the major problem
with participatory realist positions.

4. Ineffability and the Great Smokey Dragon

Wheeler once quoted approvingly the following passage from William
James (Wheeler 1974, p. 20):

> Actualities seem to float in a wider sea of possibilities from out of
> which they were chosen; and somewhere, in determinism says, such
> possibilities exist, and form part of the truth.

It seems that participatory realists might have to adopt some such rad-
ical acceptance of what Wheeler called Bohr’s “Great Smokey Dragon”: apparently actual and concrete where outcomes occur (at its teeth and
tail), but with no way to express its interior (Fig. 5). It is by its nature
intangible, ineffable. Faced with this, Wheeler was led into a study of
Parmenides and the ancients in a study of being and nothingness.

Harvey Brown has recently commented that he finds “the ineffable
nature of the external world in QBism troubling” (Brown 2019, p. 78).\(^4\)
As we have seen, Brown isn’t alone. Wheeler wracked his brains over it for
decades. He was, as he says, “driven crazy” by this issue of what to make
of elementary quantum phenomena that are not put to use” (Bernstein
1985, p. 12). Hence, Wheeler was well aware of the problem, and we saw

\(^4\)The same presumably holds for Wheeler’s stance, and any that holds that there is
a world out there without saying anything about its nature as a result of interpreting
the core elements of the quantum formalism subjectively.
him looking outside of quantum mechanics for answers: deeper neutral structure such as pre-geometry. Indeed, this led him on a deep search for the meaning of existence: why quantum and why world were bound together in his mind as mentioned above.

Anton Zeilinger keeps within a kind of orthodox realism, despite Wheelerian elements, by retaining the fundamentality of the random event, writing that (Zeilinger 2005, p. 743) the “randomness of the individual event is the strongest indication we have of a reality ‘out there’ existing independently of us”\(^5\). However, in basing the ontology on information alone, he misses the importance of Wheeler’s participator: to assign meaning. Information without some agent to determine the meanings of symbols is utterly inert. Thus, a theory based on pure information is incoherent.

Can we make the participatory accounts more coherent as worldviews? *Prima facie* one might think that the situation is impossible, that there is simply no external world in QBism, only subjective experience. It’s sim-

\(^5\)Of course, one can always adopt alternative interpretations of the formalism in which this random element is understood in a very different manner. Everett’s original thesis title was “Wave Mechanics without Probability” (see, e.g., the letter from Wheeler to Bohr, 24th April, 1956; from John Archibald Wheeler Papers, Box 130), so that strictly speaking *all outcomes occur*. Such an approach, however, still faces problems in making sense of the quantum probabilities, and recent attempts to deal with it have invoked subjective elements of decision theory to yield agent-centric uncertainty (with credences fitting the Born rule) about which future branch of the wavefunction they will occupy (e.g., Wallace 2018).
ply not *modelled* within the quantum formalism according to this stance: the mapping relations between formalism and reality involve agents’ experiences and not quantum systems in the world out there. To get around this seemingly demands the addition of something external. In his probing critique, John Earman (2019, p. 419) finds just this implication:

Something outside the formalism is needed to break the standoff. Those of a realist bent will tend to side with the pluralists, the idea being that the impressive empirical success of the probabilistic predictions of QM calls for an explanation that the monists are seemingly incapable of providing. But as philosophers of science are all too aware, this line of argumentation leads directly into the swamp of the realism vs. instrumentalism debate from which none who enter ever return.

So the problem looks severe: Bohr’s great smokey dragon is mostly smoke. The formalism does not map elements to the smoke in such a way that we have a nice world populated by things. Can we say anything then? What is it, this smoke? Potentiality, as Wheeler appears to accept? Nothingness, as he was once veering towards? Really, what is the world like “out there” when nobody looks? One can see here, perhaps, why Cabello chose to insert Wheeler alongside Bohr and Peres’ instrumentalism, for what, other than the detection events, are we to be committed to here?

Of course, the digging of the heels in (and merely stipulating a world out there) is to avoid being tarred with the brush of idealism: few are brave (or foolhardy) enough to follow Henry Stapp who advocates genuine idealism on the basis of quantum mechanics in the sense that there is simply no substantive physical world at all.  

Despite the fact that QBism’s external world seems to be a stipulation, Brown (2019, p. 78) agrees that “it would seem that QBism is not strictly idealism in Berkeley’s sense; it does not ‘deny the existence of an observer-independent reality’”. However, there is more that can be said to get beyond mere stipulation.

One way out, which most participatory approaches seem to follow (if not explicitly), is that of Max Born: to focus attention on structural invariants exposed by our empirical experience which, however, are in themselves “pure form, void of all sensual qualities” (Born 1969, p. 144).  

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6 As Robert Solomon has noted, idealism here does not in fact demand that we identify objects apparently out there with minds (which is a specifically Berkeleyian idealism) (cf. Solomon 1985, p. 186).

7 Zeilinger’s approach is of this kind, though as mentioned does not adopt the more radical participatory framework. In his essay “Symbol and Reality,” which really strikes at the heart of these issues, Born notes how his stance came from a more general understanding of the problem of perception, where the “problem was not to distinguish the subjective from the objective, but to understand how to free oneself from the subjective and to arrive at objective statements” (Born 1969, p. 133).
Though we cannot probe the details of the smoke (there might be none), we can say something about its broad outlines, and establish some kind of mapping between quantum mechanics and the world out there away from the phenomena (or the experiences of QBism’s agents). Born (1969, p. 141) says:

These [symbols of quantum mechanics] are structures of pure thinking. The transition to reality is made by theoretical physics which correlates symbols to observed phenomena. Where this can be done hidden structures are coordinated to phenomena; these very structures are regarded by the physicist as the objective reality lying behind the subjective phenomena.

Bohr had some correspondence with Born on this point, with the latter trying to bring Bohr to his side, and against instrumentalism. Born wrote to Bohr:8

What I mean by “behind the phenomena” is in mathematical language just “invariants” in the most general sense of the word. The various aspects of phenomena which we consider in quantum mechanics have also a theory of “invariants”, or in less learned language, common features which do not depend on the aspect, and it is this which I would like to preserve as something beyond our direct experience.

Bohr in fact responded enthusiastically, registering his agreement with Born (26th March, 1953: Niels Bohr Archive). Indeed, on his deathbed, 30 minutes prior to the end, he is stated as having said that quantum theory (complementarity) “was an objective description” (as quoted by Wheeler 1986, p. 373).9 Of course, that simply restates the problem: how exactly is it an objective description? Presumably along the lines Born suggests.10 But this still requires that we find some elements in the quantum framework itself that will reach beyond the phenomena. We have already seen the role of the random individual event which Wheeler also made much of.

There do indeed seem to be some such additional objective features (relating to complementarity) that can be found in participatory realism. Referring back to Fig. 2 above, Wheeler (1980a, p. 354) writes:

Even when we want to observe, not a galaxy, not a star, but something so miniscule as an electron, we have in effect to smash the

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9Whether this is Bohr’s “true” view is debatable, given the notorious difficulties in pinning his statements down. Recall, for example, that the symbol placed in Bohr’s coat-of-arms was the taijitu, or Yin-Yang symbol. This suggests a duality of observer (subject) and observed (object), rather than an assignment of truth to objects, whether it is the invariants or not.
10See Folse (1985, Chap. 8) for an argument against Bohr’s being a phenomenalist.
glass so as to reach in and install measuring equipment. We can install a device to measure the position \( x \) of the electron, or one to measure its momentum \( p \), but we cannot fit both registering devices into the same place at the same time. Moreover the act of measurement has an inescapable effect on the future of the electron. The observer finds himself willy-nilly a participator. In some strange sense this is a participatory universe.

In other words, complementarity imposes constraints on what we are capable of doing: it is an objective feature of quantum mechanics mirrored in the world. QBists too have a similar response to the ineffability issue (and so for making quantum mechanics “ontically safe”). Here one can locate a definite piece of the structure of quantum mechanics that corresponds to something “out there in the world”. A genuine Bornian invariant. This is the Hilbert space dimension of the measured system.\(^{11}\) The Hilbert space dimension of a quantum system is “in the object” in the style of intrinsic properties. They give us reason (along with Wheeler and Zeilinger’s random kickbacks from the world) for believing in the reality of quantum systems in the world. They give some substance to the Smokey Dragon’s inner constitution. One cannot subjectivize the dimension away once the observer-observed split has been made.

However, we have to be a little careful here in that we first made a decision about what the measured system would be (and what the measurer would be). Such a split is a necessary first step in defining the system that will have some objective Hilbert space dimension, hence even at this level the participator makes their appearance felt (Jung’s remarks about the psyche being the \textit{sine qua non} of the world as an object redux!). This is, however, perhaps what we should expect in a participatory universe: co-creation at all stages of reality. It is a task for future participators to see if more structural details can be isolated to represent features of Bohr’s Dragon.

5. Conclusion: The New Existentialism?

Here is a commentary by Wheeler (1986, p. 373) about “existence”, in particular about Einstein’s view of it:

Does the very concept of existence imply that there must be a world sitting “out there”? That was the view of many a great thinker before the advent of quantum theory and of Einstein himself to the end of his days. Nothing made him more unhappy than the thought

\(^{11}\)Fuchs (2010, Sec. VI): “Dimension is something one posits for a body or a piece of the world, much like one posits a mass for it in the Newtonian theory. Dimension is something a body holds all by itself, regardless of what an agent thinks of it.”
that the observer-participator has anything to do with the establishment of what one is accustomed to call reality. In the last talk he ever gave, some months before his death, to my seminar on relativity, he explained how he had come to relativity and what relativity meant to him but went on to express his discomfort with quantum theory: “If a person, such as a mouse, looks at the universe, does that change the state of the universe?”

One can find in participatory realist views a response to Schrödinger’s “exclusion principle.” As he put it in his Tarner Lectures (Schrödinger 1958), the world-pictures of physics are “colourless, cold, and mute”, they are constructs of the mind, and yet the mind is a “stranger within that construct.” Likewise, in his Nature and the Greeks (schrödinger 2014, p. 95): “we do not belong to this material world that science constructs for us”. We are excluded.

William James (1983, p. 96) earlier made strikingly similar remarks:

> The scientific world-picture vouchsafes a very complete understanding of all that happens – it makes it just a little too understandable. It allows you to imagine the total display as that of a mechanical clockwork, which for all that science knows could go on just the same as it does, without there being consciousness, will, endeavour, pain and delight, and responsibility connected with it – though they actually are.

In participatory accounts this is flatly denied. Not only do we belong in the world, we join in its very construction. Fuchs, channelling Wheeler, puts it thus (Schlosshauer 2011, p. 172):

> Our actions matter indelibly for the rest of the universe, for quantum mechanics signals the world’s plasticity ... With every quantum measurement set by an experimenter’s free will, the world is shaped just a little as it participates in a kind of moment of birth.

Will is at its heart, for “the observer-participator converts conceivability into actuality” (Wheeler 1980b, p. 5). In this context, Wheeler spoke of “acts of creation”. These are random events, taken individually. The world’s future (and past) is determined in part by the questions posed by observer-participators, and by measurement-induced random quantum jumps. Yet the statistical phenomena look orderly through sheer numbers. The randomness cannot, however, be willed away. It thus satisfies what we might label the Philip K. Dick criterion of reality (Dick 1995, p. 261): “Reality is that which, when you stop believing in it, doesn’t go away!” As with the QBist’s Hilbert space dimension above, at some level participators are involved in this process too: the kind of random kickback is a matter that is partially determined by the experiment one chooses to perform.
One pertinent point on which we end is the association participatory realists make between the apparently troubling “ineffable” component and the creative “existentialist” component: one is simply not possible without the other. As Wheeler puts it, the “untouchability” of the elementary quantum phenomenon is inextricably linked to creation (cf. Wheeler 1983, p. 189). Without an ineffable realm of some kind we are back in the realm of “real essences”: objects sitting out there with intrinsic properties. If we choose to read such results as the Bell and Kochen-Specker theorems, and even basic complementarity, as forbidding “essence preceding existence”, then we must bite the bullet and accept some ineffability in the world as par for the course.

The question then remains whether the degree of non-ineffable structure as given in the broad contours of facts about the world revealed through experience is enough to ground a scientific realism. In my view it does – provided we are willing to dispense with realisms based on objects possessing properties and switch to a more structural position. One is then free to debate, as philosophers of science are wont to do, whether or not there are some deeper things-in-themselves of which the structures we see are only shadows. I prefer to side with Born on this point and allow that the structures themselves are, in the context of quantum mechanical theories, adequate things-in-themselves.

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And, again, there are of course alternative routes such as Bohmian interpretations which do not require us to accept this.


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