

QBISM: AN ECO-PHENOMENOLOGY OF QUANTUM PHYSICS¹

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Abstract:

A discrepancy between the instrumentalist and the realist inclinations of QBism, or between its experiential and interactional concepts of measurement, has been repeatedly noticed. Here, we show that this discrepancy can be resolved by adopting a phenomenological approach throughout. In other terms, the difficulty can be overcome by unambiguously choosing a first-person standpoint as a radical starting point, and by ascending from this situated lived experience of a knowing and acting subject, to the structure and use of the quantum formalism. To reconstruct some crucial features of the objectivity promised by science, and to accommodate the most uncontroversial realist intuitions of QBist authors, a phenomenological analysis of what is commonly called “the world” is proposed. This analysis is based on Bruce Bégout’s “Eco-Phenomenology”, that replaces the concept of a somehow external relation between subject and world, with the immersive experience of a subject partaking of the world.

Introduction

Since its inception, QBism has been torn apart between two seemingly conflicting ontological inclinations.

QBism has inherited from Asher Peres a strong instrumentalist commitment (Fuchs & Peres 2000). But QBism is simultaneously developing an original realist research program (Fuchs 2016).

QBism holds a conception of quantum theoretical statements that embraces “two levels of personalism” (Fuchs & Stacey 2020), about probabilities and about possible experimental outcomes, thereby ascribing them a decidedly first-personal status. But QBism is also looking for aspects of quantum theoretical formalism that would “take advantage from a third-person perspective” (Fuchs 2019). It is striving to find an objective rationale for the most efficient subjective betting strategies, and especially to extract an objective component from the procedures used for combining subjective probabilities.

Even more strikingly, it is essential to the QBist dissolution of celebrated quantum enigmas, such as the Wigner friend “paradox”, that measurement outcomes are equated to *lived experiences*, rather than to properties of macroscopic experimental devices (Fuchs et al. 2014). So much so that, in this

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context at least, discourse about the entities of the world (including laboratory furniture) tends to be set aside in favor of an insistent reference to their manifestation in (and *qua*) the personal experience of scientists. Yet, QBism defines the phenomenon as something new that *really happens in the world* (Fuchs 2002a, 2016) when two of its material fragments meet: the “physical systems” belonging to the external world on the one hand, and the body of the agent (together with its experimental instruments construed as prostheses) on the other hand.

The latter reified conception of the phenomenon and its production prompted a crucial criticism from Hervé Zwirn (2021). If experimental outcomes only occur as (personal) experiences, he writes, one cannot consider that something new happens *in the (external) world* as a result of experiments.

A proper reply to Zwirn’s criticism is certainly not beyond the reach of QBism. It just requires two moves. The first one consists in a careful restatement of the nature of the “something new” produced by measurements, that can indeed be found in some QBist writings. “A measurement does not, as the term unfortunately suggests, reveal a pre-existing state of affairs. It is an action on the world by an agent that results in the creation of an outcome — a new experience for that agent” (Fuchs et al. 2014). What is newly produced by a measurement, what happens through it, is nothing else than an agent’s *experience*. The second indispensable move is that it is only if one suspends the traditional dualist distinction between experience and world, and/or tends to construe experience as the basic stuff of the world (section 2), that a new experience is *ipso facto* a new event of the world.

But this is not yet enough to dispel Zwirn’s qualms. For, although the latter non-dualist ontology is by no means unfamiliar to QBists, it is far from being consistently adopted in the bulk of their literature. In the same paper where an outcome is equated with an experience (and especially in the quoted sentence), the QBist account of a measurement process persistently relies on a dual (and object-like) description of its protagonists: an agent with body and prostheses on the one side, and the acted-upon world on the other side. Here, the usual description of a world made of a multiplicity of “physical systems” external to the agent and to one another, is maintained throughout: “Acting as an agent, Alice can use the formalism of quantum mechanics to model any physical system external to herself. QBism directs her to treat all such external systems on the same footing, whether they be atoms, enormous molecules, macroscopic crystals, beam splitters, Stern-Gerlach magnets, or even agents other than Alice” (Fuchs et al. 2014). This language raises a serious problem of conceptual consistency. If one acknowledges that “What is real for an agent, rests entirely on what that agent experiences” (ibid.), the real-world-out-there should not be posited *a priori* as a pre-existent being whose inter-action with the agent gives rise to an experienced outcome. The so-called “external” world made of various

“physical systems” should be seen as a problem, not as a given; its concept should be elaborated out of a careful analysis of experience, rather than taken for granted before any such analysis.

Satisfying the latter requirement is the task of phenomenology. Starting all over again, from a reflection about lived experience, in order to clarify the meaning we ascribe to the entities of our “natural” ontological attitude, such as macroscopic bodies, microscopic physical systems, fellow agents, or “external world”, has been attempted by Husserl under the (Kantian) label “constitution of objectivity”. Husserl here advocated a two-step procedure: first, suspend beliefs and preconceptions about the world; and then show how (and to what extent) those beliefs and preconceptions can be justified on the basis of the reflected-upon experience. In his own terms, “I must lose the world by the *epoché*, in order to regain it by a universal self-examination” (Husserl 1960, 157 [183]).

This is a daring endeavor indeed, one that has been painstakingly pursued by Husserl during his whole life, and has discouraged Carnap (1967) despite a remarkable effort in this direction. Moreover, as a consequence of this endeavor, Husserl has been accused by some of his own students of having (apparently²) missed the fact that experience is immediately suffused by a sense of embodiment, community, and being-in-the-world, before any complex operation of constitution of this world (and the bodies in it) has been performed. But it is only at the cost of adopting this kind of uncompromising phenomenological attitude throughout, that QBism can be protected against the inconsistency of patching together a common-sense view of the world and a phenomenological construal of measurement outcomes. It is only at this cost that the QBist dissolution of quantum “paradoxes” can be defended against acute criticisms such as Zwirn’s. It is only at this cost that the two conflicting views, ontologies, and standpoints that coexist in QBism can be reconciled.

Things are not entirely settled at this point however. Assuming that we have indeed approached quantum mechanics with this thoroughly phenomenological attitude, we still have a challenge to meet. How can one rescue the most uncontroversial aspect of the realist intuition of QBism (section 3), despite the methodologically idealist option of Husserl’s phenomenology? How can one overcome the standard dualist epistemology that is the standard presupposition of scientific realism, and yet retain a sense that ‘something’ is beyond our direct control? These questions will be addressed by borrowing from the French tradition of the phenomenology of embodiment and belonging, from Merleau-Ponty and Henry to Bégout and Barbaras. In particular, we will see in sections 4 and 5 of this paper that Barbaras’ (2016, 2019) “cosmological phenomenology”,

² That Husserl was not oblivious of embodiment, community, and the sense of being-in-the-world can be seen in his *Ideen II* and *Krisis*. More on this later.

and Bégout's (2021) concept of "Eco-Phenomenology", remarkably fit with the difficult philosophical synthesis QBism is half-consciously heading to.

1-Naturalized versus transcendental theories of knowledge: another name for the dilemma of QBism

As a preliminary, let us notice that the QBist discrepancy between its instrumentalist and realist inclinations, or between its experiential and interactional concepts of measurement, is one among many expressions of a fundamental strain that haunted epistemology throughout its history. It is the tension between an actor's and spectator's standpoint on cognition, between a first-person and a third-person approach of the process of knowing, between a transcendental/normative and a naturalized/descriptive theory of knowledge. At first sight these two types of conceptions of knowledge are antinomic; but they can be shown to be complementary and even synergic under appropriate conditions (Bitbol 2010, chapter 7).

A transcendental/normative epistemology aims to formulate rules to achieve a very high goal in knowledge: universal *a priori* certainty in its Kantian version, or domain-bound self-consistency in several neo-Kantian versions such as Cassirer's (Friedman 2009). It pretends to establish the validity of the body of evidence offered in support of a proposition or a theory, and to ensure the (absolute or context-dependent) *truth* of such propositions or theories. Since it purports to justify in advance the capacity of science to reach some sort of truth, a transcendental/normative epistemology is not (and should not be) scientific. A transcendental/normative epistemology does not offer any scientific representation or description of the process of scientific knowledge: it is *a priori* rather than *a posteriori*; it precedes (and *should* precede) the material, the contents and the methods of the science it pretends to found. A transcendental/normative epistemology adopts the standpoint of an actor who wishes to build a science and who makes a preliminary reflection on the conditions of possibility of her own projects and methods, before a mature science has provided her with a description of these very methods from the standpoint of a spectator. The sought pre-scientific normative foundation of science is then supposed to be an absolute starting point which testifies to its own validity. This self-obvious starting point includes lived experience, rules of inference, anhypothetical³ principles (such as the principle of non-contradiction) etc.

By contrast, a naturalized/descriptive theory of knowledge is concerned with the actual formation of beliefs in concrete knowing subjects. It sets out to

³ An "anhypothetical" principle is one that is not freely chosen (as an axiom would be), but is incontrovertible (see Plato, *Republic*, 6, 511b3). Some "anhypothetical" principles are deemed to be incontrovertible in virtue of the impossibility of denying them without presupposing them (see Aristotle, *Metaphysics* 4, 1005b).

describe the interaction between the knowing subjects and the world, as well as the subsequent modifications of the subjects' beliefs about the surrounding world, from the standpoint of a spectator of the knowledge process. Deprived of any self-justifying source of certainty, naturalized epistemology declares that it has nothing better to do than adopt the methods of the science of nature it aims to elucidate (Quine 1969). It thus offers a scientific representation of science from the standpoint of a (scientific) researcher taking scientific research as her object of study. As a result, a naturalizing epistemologist no longer dreams of some ground firmer than science, on which science can be founded; she acts to defend science from within, against the doubts it has about itself (Quine 1974).

Let's notice at this stage that the actor's standpoint is associated with a normative approach of knowledge, whereas the spectator's standpoint implies a descriptive approach of knowledge, including the knowledge of knowledge. Let's also remark that, from the actor's standpoint, it would be absurd to presuppose the objects and properties of a mature science before science is adequately founded. Even more strikingly (according to Kant), it would be wrong to presuppose the objects and properties of *ordinary language and common sense* before they are appropriately founded in a procedure of "constitution of objectivity", performed by due ordering and selection of fractions of the actor's experience. Instead, from the spectator's standpoint, the entities and categories of ordinary knowledge and science are used unproblematically for the description of everything, including the procedures by which ordinary and scientific knowledge are acquired.

The orientations of the two types of epistemologies are so antinomic that they tend to accuse each other of being self-defeating. Advocates of a naturalized/descriptive epistemology usually reproach transcendental/normative epistemologists to posit norms in the name of a superior kind of knowledge, whereas this alleged knowledge has never been submitted to the stringent tests of scientific knowledge. According to naturalists, there is no better procedure than extracting the scientific methods *a posteriori*, from the very science of nature that has obtained success by letting them emerge in the course of its development; for positing these methods *a priori* would put us at risk of arbitrariness. Conversely, supporters of a transcendental/normative epistemology accuse naturalized/descriptive epistemologists of vicious circularity. How can they pretend to found science on a scientific description of itself, without committing a *petitio principii*? How can they not see that, by affording a scientific, purely *factual*, description of science, they weaken the traditional ideal of a science capable of approaching *truth*? For, does truth not reach beyond the domain of facts to attain the domain of norms and values?

One of the most vocal critics of naturalism along this line was Husserl (1973, 16). According to him, if one accepts (say) a scientific evolutionist account of the acquisition of knowledge, it turns out that no kind of knowledge (not even

science itself!) will have any significance other than adaptative. And therefore, evolutionism itself is not true, but only adaptative.

Beyond this antagonism, the two kinds of epistemologies (naturalist/descriptive and transcendental/normative) need one another; and if they become mindful of this need, they are likely to borrow features from each other.

A naturalist/descriptive epistemology can benefit from recognizing the normative element in its own approach. After all, a naturalist/descriptive epistemology *prescribes normatively* to use scientific methods, and to adopt, in its description of any process of knowledge, the ontology of scientific theories.

Conversely, a transcendental/normative epistemology is *de facto* dependent of the science it is meant to found. Just consider the way Kant (1781) derived his normative framework of knowledge by a regressive (transcendental) deduction starting from the strong credentials of the mathematics and physics of his time, and then deriving their condition of possibility.

Moreover, a transcendental/normative epistemology can benefit from representing the knowledge process by means of a naturalized description of it, while ascribing this representation no status other than heuristic. A transcendental/normative epistemologist can indeed exploit the isomorphism between her theory and a naturalized theory of knowledge, to take the first steps of her conception, and to illustrate it.

Here again, we may find a good example in Kant himself, who progressively converted an earlier naturalized/descriptive epistemology of relational knowledge into his later transcendental/normative relativizing epistemology.

In his first works, written before 1770, Kant had not yet formulated his transcendental epistemology, and he expressed himself in a characteristic mixture of metaphysical and scientific styles. A central thesis of Kant (1755), was that the *relations* between “substances” are irreducible to (sets of) their immutable intrinsic *properties*. Indeed, if this were not the case, relations would be epiphenomenal to properties, and there would be no basis for real *changes* in natural “substances”. Applying this relational thesis about nature to the particular relation between the knower and the known, Kant was led to the conclusion that the knower cannot disclose the intrinsic properties of things (substances), but only their *dispositions* to *relate* to her. This is the naturalized/descriptive source of a well-known principle of Kant’s transcendental/normative epistemology: the principle that knowledge is not meant to be faithful to the thing-in-itself; that knowledge can only pre-organize the phenomenal byproduct of our interaction with the thing-in-itself, so that we can think and act *as if* these phenomena were objects independent of us.

The latter example is especially relevant to QBism and its own struggle between a normative and a naturalized approach of microphysical knowledge, between the actor's and spectator's standpoint on microphysics. In QBism as in Kant, one starts with a naturalized picture of knowledge as an interaction between an agent (ordinary human being or scientist, endowed with her hands and sensory organs or with her measurement devices) and entities out there (the external "physical systems", substances, or things-in-themselves). In QBism as in Kant, this interaction is supposed to yield an experienced phenomenon that is not just a copy of the (hypothetical) "primary" qualities of the thing out there, but an emergent byproduct of the relation with it, i.e. a so-called "secondary" quality. In QBism as in Kant, also, the standpoint of experience is eventually adopted, and the whole process of knowledge is tentatively seen anew from there.

But Kant became more and more consistent in his choice of the first-person agent's standpoint, and he tended less and less to think of the "thing-in-itself" literally as an intrinsically existent "thing" facing the knower. In his subsequent writings, the thing-in-itself names both an inarticulate starting point, and an inaccessible horizon of knowledge: it refers both to the formless "*Grund*" (Ground) of phenomena, and to a "regulative ideal" of research. Kant then progressively dismissed the naturalized scaffolding of his early thought, and stucked more and more consistently to the first-person, experiential and normative, standpoint of his mature epistemology. It seems to us that this is precisely the result QBism should strive to obtain: considering the whole process of microphysical knowledge from the standpoint of the actor, the knower, the experiencer, and putting at rest those representational scaffoldings that involve agents-with-protheses acting upon physical systems pre-given out there. In other terms, it seems to us that QBism should progressively decrease the import of its pragmatist representations, and bring to completion its phenomenological inclination (to the point where even pragmatist pictures are given a phenomenological meaning). For, if it does *not* do so, it exposes itself to the risk of inconsistency mentioned in the introduction.

Several subsequent naturalized theories of cognition followed Kant's pattern, and they can be equally inspiring for QBists. They include Jakob Von Uexküll's (2010) "biosemiotics", and James Gibson's (1986) "Ecology of perception".

Von Uexküll's central concept is that of "*Umwelt*" (environment) *qua* different from "*Welt*" (world). The *Umwelt* of an animal, or an animal species, is a set of features that co-emerge with the activity of the animal, and are significant for the basic concerns and the survival of this animal. But, from the first-person standpoint of the animal, what *we* call its *Umwelt* is (mis)taken by it for The World (*Welt*); and the significant features that co-emerge with the activity of the animal are (mis)taken by it for objects of The World. In other terms, Von Uexküll invites us to distinguish between the world *of* an animal,

namely the apparent world seen from its first-person standpoint (*Umwelt*), and the “real underlying world” (*Welt*) which, by its interaction with the animal, lets its *Umwelt* emerge.

Now, can we say something about this “real world”; can we characterize it further? Von Uexküll makes clear that what we call “the real world”, what we represent as interacting with animals to give rise to their *Umwelt*, is nothing else than *our own Umwelt*, the *Umwelt* of the human species. Just as animals do, we tend to (mis)take our own (collective) *Umwelt* for *The World*. Our naturalized, third-person, description of knowledge once again turns out to be nothing else than the misleading form taken by an unnoticed first-person-plural approach. This being granted, we can conclude that Von Uexküll’s concept of *Umwelt* finally yields the dissolution of the very counter-concept of “*Welt* (real world)” by opposition to which it was initially defined. Similarly, Kant gave such a convincing demonstration that we tend to mistake our objects for things-in-themselves, that the very concept of thing-in-itself became suspect of being an expression of (a sophisticated version of) this very same mistake. This is why the “thing-in-itself” was progressively set aside by Kant as a “regulative ideal” or an open problem for reason, and then overtly criticized by most of the post-Kantian philosophers.

Let us now come to James Gibson. His original concept is that of “Affordance”. An affordance of the environment is what this environment offers (affords) a living being, relative to the latter’s needs, capabilities or vulnerabilities; namely a disposition to satisfy its needs, to preserve its vulnerabilities, and to fit with its capabilities. In the same way as the elements of Von Uexküll’s *Umwelt*, Gibson’s affordances emerge from the activity of the living being in *what there is*.

Rom Harré’s (2006, 2014) Gibsonian philosophy of physics is especially interesting for us, since it has breathed new life into the concept of affordance, as a powerful way to express Bohr’s interactional conception of quantum phenomena. According to Harré’s definition, “affordances are dispositions that are created in the interplay between an agent and the possibilities that the target of the agent’s activity makes available”. This enables one to make sense (e.g.) of the (in)famous wave-particle duality without creating an ontological chimera, since by using “a different apparatus, the experimenter can get the World to afford interference phenomena with the same starting point as the experiment that afforded particles” (Harré 2013). But what about this “*World*” that plays a capital role, together with agents and apparatuses, in the onset of affordances; and what about “what there is”? Just as Von Uexküll’s, Harré’s concept of “World” is bound to remain problematic, since any characterization we can ascribe to it, is derived from the affordances we arouse in it by our experimental activities. What we call *The World* thereby identifies to *Our* world. This is the reason why Harré (1997) coined a new, somehow onomatopoeic, term to refer to

his highly indeterminate concept of a truly “independent” world: *the Glub*. Harré thinks of his Glub as a reservoir of dispositions, or even as a second-order disposition: a low-level disposition to let experimentally or biologically relevant higher-level dispositions (affordances) come up. A seemingly third-personal concept of “world”, named “Glub”, is thus reconstructed regressively out of the first-person-plural *Umwelt* of mankind.

The latent presence of the first-person standpoint, in all these naturalized epistemologies that pretend to give a third-person description of the process of cognition, is striking, and full of lessons for QBism. But another kind of naturalized epistemology would be even more useful to defuse the conflict between the two QBist ontological orientations: a full-blown third-person naturalized epistemology of Kant-Uexküll-Gibson kind that be designed from the outset as a pathway towards the first-person standpoint of phenomenology. This is precisely the case of *Enaction* (or *Enactivism*), a theory of cognition initially formulated by Francisco Varela, with the collaboration of Evan Thompson and Eleanor Rosch (Varela et al. 2017). Its biological forerunner, the “autopoietic” theory of cognition, also involved a circulation between the third and the first-person approach of knowledge (Maturana & Varela 1980).

According to the enactive theory, cognition is neither tantamount to a passive reproduction of some external reality by a subject, nor to a mere projection of subjective operations onto this reality. It rather arises from an intermediate level that stands between the knowing subject and the reality-to-be-known: the *activity* of the subject of cognition embedded in her environment. By her activity, the subject selects, and retroactively alters, the features to which she is sensitive. By this combination of selection from, and feed-back on, her environment, the subject (the agent) determines, and even molds, her own specific *Umwelt*. Conversely, the molded *Umwelt* exerts a pressure on the cognitive organization of the subject-agent. Here, the subject and the environment constitute one another. Here, cognition is construed as a process of co-emergence of the knower and the known (Bitbol & Luisi 2004).

Thus far, the theory of enaction has been presented as a naturalized, third-person, epistemology; an epistemology of the productive interaction between agent and environment, as seen by a spectator of the process. But, according to its complete agenda, the theory of enaction promotes a displacement from the third to the first-person standpoint; it seeks a self-revelation of the enactive nature of knowledge in the lived experience of the enacting subject; and it then aims to reformulate the whole problem of knowledge in terms of the first-person experience of knowing subjects.

Eleanor Rosch has successfully clarified this point in the preface to the second edition of *The Embodied Mind* (Varela et al. 2017). There, she establishes a clear-cut distinction between phase 1 enaction and phase 2 enaction. Phase 1 enaction refers to a description of the process of sense-making achieved by an

agent in her effort to define features of her environment that are available as targets of her actions, and relevant to the maintenance of her organism. This is the third-person aspect of enaction, which involves a duality of subject and world, together with a description of the co-emergence of the form of the subject and the form of her world (her *Umwelt*). Phase 2 enaction, instead, investigates *what it is like* (in the first person) to realize that one is caught in such co-emergence of the two poles of the process of knowledge; and, more precisely, *what it is like* to partake of a process of knowledge that is based neither on the firm ground of a pre-formed external world, nor on the firm ground of a pre-formative cognizant *ego*. It turns out that “phase 2 enaction is a non-dual mode of knowing that allows for a *direct experience of groundlessness*” (Meling 2021). An experience of one’s significant targets of action, together with the dizzying awareness that these experienced targets are not grounded on any intrinsic properties of inner or outer entities, is the non-dual first-person aspect of enaction.

Retrospectively, it appears that Phase 1 enaction, namely the naturalistic description of a co-emergence of the subject’s knowledge and the structure of its environment, is just a mental tool to figure out why we have the kind of experience outlined in Phase 2 enaction. *Actually Phase 1 enaction can by no means be more than a mental tool*. For, someone who believes that the (Phase 1) enactive naturalistic description of the subject-world interaction is a *true representation of a real process (of cognition) unfolding out there*, would be caught in a self-contradiction. Indeed, believing this means considering that our knowledge of the process of knowledge is not enacted, but rather obtained quasi-passively like a “mirror of nature” (Rorty 1981). Believing this means that we do not take the concept of enaction seriously enough to apply its consequences to itself. In other terms, taking enaction at face value, immediately undermines the third-person dualistic *picture* of an enactive transaction between subject and world. This picture is decidedly nothing more than an ancillary tool for imaginative minds.

Such reasoning, in which the consequences of a naturalized picture of knowledge *qua* interaction turn against the very acceptability of the interactive picture and of naturalization in general, can easily be extended to QBism. Just as enactivism, QBism makes use of a naturalized picture of quantum knowledge *qua* interaction. To draw this picture, QBism imposes a “conceptual split” of the world into “one part treated as an agent” and another part treated “as a kind of reagent” (the “quantum system”) (Fuchs 2010). Then, an “agent’s taking an action on the quantum system” results in “a unique creation within the previously existing universe” (Fuchs 2010). The problem is that, in virtue of its own consequences, this picture cannot be a *faithful representation* of the process of quantum knowledge. Indeed, in the framework of QBism, if an agent wants to know quantum knowledge, the only strategy she can use is the one she uses to

know any other process or system: she must “take an action” on this quantum (epistemic) process or system, and trigger “a unique creation” that inextricably combines her own contribution with the contribution of this “reagent”. Such unique creation being usually called a *phenomenon*, one is concerned in this case by the phenomenon of *quantum knowledge*. But then, by such procedure, the agent has not disclosed the (alleged) true intrinsic nature of quantum knowledge. She has only co-produced an experienced novelty: her own phenomenon-of-quantum-knowledge. This is enough to show that the QBist’s dual image of an agent “really” acting on a “real” quantum system is self-defeating (or self-dissolving). What remains of it is just the *experience* of some partly unexpected, and therefore creative, phenomena of any kind.

The previous reflections are not without consequences on the QBist defense against the charge of solipsism. According to Chris Fuchs (2010), “Two points are decisive in distinguishing this picture of quantum measurement from a kind of solipsism: (1) The conceptual split of agent and external quantum system (2) Once the agent chooses an action ... to take, ... the actual outcome is not a product of his whim and fancy”. Point (1) has just been proved to be self-defeating. Therefore, only point (2) remains to avoid integral solipsism. The only sign that the individual agent is not “alone” (*solus ipse*) is “that the consequences of measurement actions are beyond the agent’s control; (that) the world can *surprise* the agent” (DeBroda et al. 2020a). If a phenomenon surprises us to a certain extent, this indicates that we have not entirely manufactured it.

Beware, at this point. Surprise is not sufficient to prove that subject and object, agent and quantum system, are two ontologically different poles of the world. Surprise is also an experience; it is a compound experience that arises from a discrepancy between experienced expectations and experienced outcomes. Far from representing a break in the fabric of the experience, surprise thus partakes of its continuity. But it plays a highly non-trivial role in it.

To begin with, remind that, from Husserl’s standpoint, experience is made up of two poles - effectivity and potentiality. And notice that this is remarkably parallel to QBist thought, in which the agent makes bets about the potential outcomes of future measurements, and then observes an actual outcome as soon as she can testify that the measurement has been performed. But then, how would surprise not be a challenge to the phenomenologist? If there is only room for anticipated and actual phenomena in the fabric of experience, how can we accommodate surprise within experience itself? And how can we avoid to jump immediately to the conclusion that surprise proves the existence of an outside world beyond any possible experience? If surprise were to fit in the standard minimal framework of Husserlian phenomenology alluded to above, even it should be anticipated, even it should be deemed possible to a certain extent. This would immediately deprive surprise of its own definition: that of a phenomenon that escapes any anticipation. But let’s take a closer look at what

phenomenology has to tell us on this precise point. In the phenomenological theory of perception developed by Husserl, there is room for what he calls “the disappointment of expectations”. Here, a true surprise represents “the tipping of the possible into the impossible” (Serban 2016, 89). It is true that, for there to be a surprise, there must be the disappointment of an expectation, a frustration, or to put it another way, a *non-fulfilled intention*. But what, in the shock of the event, appeared impossible, immediately afterwards acquires the value of an open, yet indeterminate, possibility. A surprise should then be construed phenomenologically as a “defeat of possibility motivated by open possibility”. “Its emergence shows [...] that the ‘impossible’ is nothing other than a more open possibility” (Serban 2016, 89). According to Husserl, surprise then represents a lived condition for the unfolding of ever more open possibilities within lived experience itself. As for its standard interpretation as evidence of the impact of something that transcends experience, Husserl brackets it by the *Epoché* that prepares the ground for phenomenological inquiry. At most, he makes such metaphysical interpretation conditional on an internal analysis of its credentials in experience.

To recapitulate, in a phenomenological framework, an unexpected phenomenon is both a disappointment (*Enttäuschung*) and the metamorphosis of the impossible into an expanded field of open possibilities. Surprise just recasts the lived sense of the possible, by broadening it to an indeterminate extent. Reciprocally, we should understand that “[...] experience [...] consists of a horizon of ‘open possibilities’ (Husserl 1972: 108) which, precisely, creates room for the emergence of surprise.” (Serban 2019, 179). Surprise therefore does not go against prior motivated possibilities; it adds to them a larger domain of open, indeterminate, possibilities; it constitutes a space for experienced indeterminate possibilities somewhere in between motivated anticipation and recognized actuality.

From what has just been said, we tend to infer that the lived experience of agents is the unique domain in which every challenge to QBism (including the challenge of the solipsistic *reductio ad absurdum*) should be addressed. Even the desire to reach something of a world deemed to be “external”, arises in experience, and its credibility must be evaluated on the basis of experience. Even the project of disclosing an aspect of the quantum formalism that would “take advantage from a third-person perspective” is bound to find its justifications in the first-person perspective.

2-Experience first and foremost: The phenomenological ghost that haunts QBism

The pre-physical, and not physically definable, concept of *experience* plays a pivotal role in QBism. In one of the most emblematic presentations of QBism,

(Fuchs et al. 2014), the word “experience” appears 58 times, initially in relation to Bohr’s claim that physics is just a set of “methods for ordering and surveying human experience” (Bohr 1987, 10), and then in the more specific context of discussing the status of experimental outcomes. And that’s not all. In a collection of written debates between discussants of QBism (Fuchs 2015), the word “experience” appears ... 595 times; and it serves as the central theme of several of these dialogues.

Such intensive use of the word “experience” (that is preferred to “consciousness”, presumably in view of the strong reflective connotation of the latter), is one of the key features that bring QBism dangerously (or happily) close to phenomenology. Another phenomenology-like feature of QBism is its conception of both ordinary and microscopic entities as “bundles of expectations”, made of (i) a central perceptive or experimental nucleus and (ii) a “horizon” of anticipated experiences (De La Tremblaye 2020). Our task in this section will be to clarify the role played by the concept of experience in the QBist approach of quantum mechanics, and to evaluate the strength and limits of the phenomenological commitment of QBism.

Some QBist sentences are among the stronger statements of the role of experience that can be found in the literature about the interpretation of quantum mechanics. Thus, “according to QBism, quantum mechanics is a tool anyone can use to evaluate, on the basis of one’s past experience, one’s probabilistic expectations for one’s subsequent experience” (Fuchs et al. 2014). Here, there is no question of a previous knowledge of the world, and no question of writing down some “state” of the world, but only of a probabilistic connection between two successive experiences. This is how the age-old conundrums of quantum mechanics (or rather of its clumsy interpretations) are immediately defused. First of all, “The notorious ‘collapse of the wave-function’ is nothing but the updating of an agent’s state assignment on the basis of her experience”. No mysterious influence of gravity is required to impose the “spontaneous collapse” of the “state of physical systems”. No baroque multiverse, and no cumbersome emergence of classical univocity from quantum plurivocity, are required either. Besides, in QBism, the quantum “paradoxes” that involve the comparison between several observer’s/agent’s outcomes are put to the decisive test of their formulation within a single agent’s experience. This is the case of the comparison between the outcomes and memories of Alice and Bob in the Einstein, Podolsky, Rosen correlations; and this is also the case of the outcomes and predictions of Wigner and his friend in Wigner’s friend paradox. The key to the dissolution of this family of “paradoxes” is the thesis that “Bob’s answer is created for Alice *only when it enters her experience*” (Fuchs et al. 2014). This crucial thesis extends a general principle of QBism to the issue of intersubjectivity: the principle that phenomena are created in the experience of

each agent by the meeting between this agent and a reagent, rather than observed passively by the agent.

This being granted, the alleged discrepancies between the descriptions various observers give of the “state” of “physical systems”, are immediately defused. Indeed, such discrepancies can only be certified from an external standpoint, and they vanish whenever a process leading to an agent’s lived experience is completed. They only arise as the illusory byproduct of a “view from nowhere” of the experimental processes, and they are dissolved within a “view from somewhere”. No non-local influences are then needed to account for the *experienced* quantum correlations. No spurious action of consciousness on the physical world is required either, to avoid the apparent contradiction between Wigner’s friend being in a definite state of observation of an experimental result, and Wigner’s *representing* his friend as being in a state of superposition.

Such clarification is obtained at what a majority of (realist) physicists would consider a high cost. Some of them (those who were educated in the Copenhagen interpretation) would concede to Bohr that the experience accounted for by quantum mechanics is an experience of macroscopic events displayed and recorded by quasi-classical apparatuses. This Bohrian doctrine at least gives them the sense of something real *of which* observers get an experience: the events of the macro-world. But QBists resist this remnant of realism that takes the form of macro-realism. They essentially agree with other interpreters of quantum mechanics (Brukner 2020) that no observer-independent notion of experimental outcomes can be maintained; and they go as far as declaring that experimental outcomes only make sense *qua* experiences of agents-observers. We have seen that QBists have good reasons to do so. But other reasons can be adduced at this point. In particular, if they maintained the Bohrian notion that an experimental outcome is a macroscopic event described by way of classical concepts, they would be caught into the endless debate as to which level of the measurement process can be considered classical rather than quantum.

At the end of this operation of defusing any ontological commitment about events that first happens out there, and are then secondarily noticed by an observer, QBists willy-nilly end up with a phenomenological *tabula rasa*. Here, no pre-given world is supposed, no pre-given events, processes, or objects, but a flux of experience organized into a network of quasi-invariants that can be dealt with *as if* they were appearances of intrinsically existent objects and properties. “*Any user’s own experience constitutes all of the raw material out of which she constructs her world*” (Fuchs et al. 2014). The latter sentence is a short and (perhaps too) dry statement of the previously sketched Kantian and phenomenological procedure called the “constitution of objectivity”.

Among the members of the QBist circle, Jacques Pienaar is probably the author who is most willing to bite the bullet and endorse a fully

phenomenological approach. His endorsement is bold, and stated in a few strong words. To begin with, “in QBism, *an element of reality is an experience*” (Pienaar 2020). The latter sentence is tantamount to adopt a phenomenological ontology, in the strongest sense of the word. It is analogous, e.g., to Eugen Fink’s concise definition of the central doctrine of phenomenology: “(Phenomenology) merely claims that Being is identical to the phenomenon” (Fink 1994, 120). In the latter sentence, “phenomenon” is the phenomenon of phenomenology, not the phenomenon of classical physics; it means an appearance in experience, not a macroscopic event occurring in a laboratory. Then, just after his decisive ontological claim, Pienaar goes on: “(An experience) contains as a fundamental internal structure a pairing of an experiencing subject with an experienced object; such experiences are called *Events*”. Here, the split between agent and system, between subject and object, is no longer taken as a pre-phenomenological assumption aimed at preserving something of the usual concept of an “external” world; it is itself a phenomenological structure that turns the concept of an external world into a problem of “constitution” for phenomenology. And the term “event” is redefined accordingly as an *experience* of pairing.

By the way, this represents an unambiguous rejection of the first strand of the QBist standard defense against the accusation solipsism, which implied maintaining a naturalized description of the transaction between an agent and an external reagent called the “physical system”. To make things even clearer, Pienaar insists that “since the Agent and World represent *internal aspects of Events*, one should be careful not to think of the Agent and the World as being causes of the Events”. In the former sentence, the naturalized picture of an agent acting on “physical systems” of the world, thereby triggering (causing) objective events to occur in the world, is entirely replaced with a phenomenological redefinition of Events *qua* experiences, and of Agent and World *qua* internal structures of experience. Here, the very distinction between agent and some outer world relies on an inner feature of experience. It relies on the difference we make *in experience* between voluntary acts and partly unexpected outcomes (Pienaar 2020).

To sum up, our experience includes *everything*, including our aiming for a transcendent whole called “the world”, and for transcendent entities called the “objects of the world”. “QBism ... acknowledges that an agent’s experience encompasses both subjective and transcendent elements (i.e. relating to a world beyond the agent)” (Pienaar 2021). Accordingly, the objects of the world, which include what physicists call “physical micro-systems”, are endowed with a purely phenomenological meaning: “Phenomenologists emphasize that every object given in perception is given within a certain context or ‘horizon’, against which it takes on certain significance. This significance might include the object’s being a concrete instance of some theoretical abstraction, or embodying

some formal mathematical model” (Pienaar 2021). For a phenomenologist, and for a QBist as well, an object or a physical system is (or should be) nothing more than that: a nucleus of perception(s) surrounded by a fuzzy background together with a more or less (mathematically) formalized horizon of expectations, and whose becoming is constantly monitored within the agent’s experience.

As we have seen previously, even Fuchs comes (dangerously?) close to such a fully “constitutive” conception of the world. And this is apparently confirmed when he quotes approvingly a post-kantian idealist view stated by Schrödinger (1951): “In *Nature and the Greeks*, (Schrödinger) takes a QBist view of science more generally and hardly even mentions quantum mechanics. He stresses that because *everything any of us knows about the world is constructed out of his or her individual private experience*, it can be unwise to rely on a picture of the physical world from which personal experience has been explicitly excluded, as it has been from physical science” (Fuchs et al. 2014). Even the adumbration of a fully phenomenological ontology, such as the one offered by Pienaar, has been a permanent temptation for Fuchs. This can be seen in two emails Fuchs wrote to Manuel Bächtold in January and June 2009: “I try to view these ‘pure experiences’ as the active monads of the world, similar to James and similar to John Wheeler with his ‘elementary acts of observer-participancy’ being the building blocks of the world”. Even more directly “What I am aiming for is a pluralistic ontology of something like ‘pure experience’” (Fuchs 2015, 1661, 1738).

Yet, when Robert Crease (Crease & Sares 2020) tried to push Fuchs all the way down in this direction, the answer was an expression of reluctance, and a renewed realist act of faith. “The starting point for me is that there is a world external to any agent”, Fuchs replied. He accordingly insisted on his agreement with the basic presupposition of pragmatist thinkers about this point. Such pragmatist presupposition can be stated in two steps. According to the first step, “the starting point of Deweyian pragmatism is that *there is a world out there* for each of us” (in: Crease & Sares 2021). According to the second step, borrowed from F.C.S. Schiller, “The actual situation is of course a case of interaction, a process of cognition in which the ‘subject’ and the ‘object’ determine each other, and both ‘we’ and ‘reality’ are involved, and, we might add, evolved”; so much so that “it is meaningless to inquire into (reality’s) nature as it is in itself” (Fuchs 2015, 1366). By this second step, pragmatism is clearly the philosophical source of the semantic, enactive, ecological, naturalized theories of cognition we presented in the previous section. And just as these naturalized theories of cognition, pragmatism retains a (more or less nuanced) form of realist approach to the world. Crease then concluded that Fuchs’ construal of QBism “remains in the natural attitude by adhering to the idea of a world that pre-exists and exists independently of the subject”. According to Crease, the pragmatist basis of

QBism is then definitely averse to the phenomenological attitude, since a phenomenologist would necessarily ask: “how do we *know* that quantum mechanics refers to anything ‘external’ in the world, beyond our own experience of using quantum mechanics?” (Crease & Sares 2021).

Now, there is a momentous difference between the two documented steps of the pragmatist presupposition borrowed by QBism. If taken in isolation, the first step may easily be mistaken for plain “external realism”, namely for the crude belief that the world “has a determinate nature which the knowing reveals but does not affect”. It is only through the second step that this misunderstanding is retrospectively dispelled, and that one acknowledges that, in pragmatism, “the ‘determinate nature of reality’ does not subsist ‘outside’ or ‘beyond’ the process of knowing it”. But, as we saw in the previous section, this second step of the pragmatist presupposition doesn’t content itself with downplaying the naïve interpretation of the first step. It surreptitiously undermines it. For when, at the first step, we say “there is a world out there”, do we not tacitly assume that this real world is something determinate, located in some determinate place (outside), even before we have undertaken a process of knowledge of it? How can we reconcile this with the lesson of the second step, namely that “the Real is *nil*, as unknown: it is only potentially real” (F.C.S. Schiller, quoted by Fuchs 2015, 1359)? And how can we even speak of this latter *potentiality* as if it were completely independent of the gestures of actualization an agent performs on it, and independent of their manifest consequence *in/qua* lived *experiences*?

The pragmatist philosophy borrowed from William James here repeatedly collides against itself, and insistently calls for another aspect of William James thought: his doctrine of “pure experience” as the primordial stuff of what there is, his *radical empiricism* (James 1912), his proto-phenomenology. If a form of complementarity of the pragmatist and (proto-)phenomenological sides of James’ thought is to be achieved, this can only happen within a phenomenological framework. And this observation also applies to the pragmatist and phenomenological aspects of QBism.

To outline a strategy we will use to articulate these two aspects, the shortest way is to comment on a biological picture offered by Fuchs as an analogue of the QBist view of quantum knowledge. “We are like euglenas—tiny single-cell organisms with little tails—swimming in the big environment surrounding us. The tail is a tool the organism uses to move in the direction of better nutrients. We are not much different than that” (in: Crease & Sares 2021). The analogy is sound, and it closely fits with the spirit of autopoietic and enactive theories of cognition. Since the world (*Welt*) of the euglena is an ocean, this little organism is immersed in it instead of facing it. The euglena then co-defines its own *Umwelt* made of opportunities and threats, nutrients and predators, by its very behavior within the oceanic world. The euglena has no map of its environment, but it can count on a repertoire of stereotyped conducts that anticipate on the

affordances it is likely to meet. In other terms, instead of relying on some exhaustive description of the world for its survival, it contents itself with a genetically encoded “user’s manual” for coping with the *Umwelt* it lets emerge as it acts.

As stunning as it may sound, we, human beings capable of formulating and using quantum mechanics, “are not much different than that”. We co-define our physical *Umwelt* made of opportunities and obstacles, by our technological interventions. We have no pre-defined map of the world (*Welt*), but (within our *Umwelt*) we can count on an integrated system of probabilistic anticipations that obey conditions of Dutch-Book coherence. Instead of relying on some theoretical description of the world as it is independently of us, we content ourselves with a mathematically encoded “user’s manual” for coping with the *Umwelt* of phenomena that our agency lets emerge.

But let us push the analogy even further, beyond what Fuchs stated explicitly. The euglena does not reflect on its own cognitive behavior; it does not have a representation of its transactions with its environment; it cannot disengage from its own life and see it from outside. As far as we can tell (but who are we to tell that, beyond our “heterophenomenological” interpretation of a living being’s behavior?), the euglena just has a primitive experience of what it is like to be immersed in its oceanic environment, and to cope moment after moment with the reactions of this bath. Here again, *we are not much different than that*, despite our grand claims about the superiority of the human intellect.

What do we mean? Are we not able to reflect on our own condition? Are we not capable of providing a representation of ourselves while we engage in our epistemic endeavor, unlike the euglena? Yes and No. We are indeed capable of providing pictures of our knowledge process: this is precisely what naturalized theories of cognition claim to do. However, we have realized in the previous section that, at the end of the day, any such picture is nothing more than a mental instrument for our effort of orientation in a technologically co-defined *Umwelt*. Any such picture is an aid *in* the process of knowledge, not a faithful imitation *of* some alleged object of knowledge (not even of the process of knowledge taken as a meta-object). Just as the euglena, we are entirely immersed in the only habitat of habitats we ever had: the first-person experience of being there, acting, and coping moment after moment with what we make occur by our actions. With respect to the euglena, our knowledge has both a disadvantage and an advantage. Our disadvantage is that, precisely because we elaborate pictures of our knowledge process, pictures of ourselves in an imagined world-out-there, we tend to make a major mistake that the euglena cannot even figure out: the mistake of looking, beyond our *Umwelt*, for something else called *Welt*, or thing-in-itself. Our advantage with respect to the euglena, is that human experience is likely to be populated by many more intellectual tools than the algae’s: it includes mental patterns and fictions that

allow us to universalize our biological strategies of coping. But knowing, in us as in the euglena, is still experience throughout; experience first and foremost. The pragmatist component of the QBist approach is bound to be embedded into its phenomenological component.

Embedding the pragmatist component of (quantum) knowledge into its phenomenological component. Embedding the (realist) claim of transcendence of the world into the immanence of *lived experience*. Embedding what is beyond the agent's control into the horizon of possibilities of her present *experience*. Embedding the notion that what occurs is “(not) plastic to our every demand” (Fuchs 2015, 1359), into the stringent rules of those actions that we *experience* as promising. This is our program of thorough phenomenologization of QBism for the subsequent sections. But this program will be prepared, in the next section, by an analysis of the carefully weighed realist demand of QBism.

3-Participatory realism from the standpoint of the participator: preliminary steps

QBism walks on the thin line that separates a wholly subjectivist construal of most quantum theoretical symbols, and a rejection of flat solipsism. It walks on the thin line that separates the conviction that phenomena are (co-)created by us, and the observation that phenomena can nevertheless surprise and resist us *as if* they were provided by something external to us. The metaphysical response of QBism to the challenge of reconciling these seemingly antagonist tendencies has been coined “participatory realism” (Fuchs 2016). It develops what we may now call “the euglena approach to knowledge” into a doctrine that comes remarkably close to the pragmatist and enactivist epistemologies.

According to such doctrine, the oceanic reality in which we are immersed remains irrepresentable from a strictly third-person standpoint; but it *constrains* our predictions of its reactions, and *imposes normative rules* to our actions within it, if they are to become efficient. This being granted, even the second (disputable) point of the QBist's defense against the charge of solipsism, i.e. the split between agent and world, and the idea of their mutual interaction, is elegantly subordinated to the oceanic image of participatory realism. To see this, it suffices to read one of Fuchs' (2015, 26) most lucid criticisms of the subject-object, agent-world, dualities. “Within a given context, classical descriptive concepts can be used to describe phenomena, our intra-actions within nature (we use the term intra-action to emphasize the lack of a natural object-instrument distinction, in contrast to interaction, which implies that there are two separate entities; that is, the latter reinscribes the contested dichotomy) ... Our characterizations do not signify properties of objects but rather describe the intra-action as it is marked by a particular constructed cut chosen by the experimenter”. These sentences make clear that the agent-world split is not

given out there, but rather defined (or “constructed”) by the experimenter in the course of her activity. Accordingly, there is no “inter-action” *between* the entities on the two sides of the split, but an “intra-action” *within* the unsplit oceanic reality of which we partake. Interaction is a mediated or unmediated collision between two things, whereas intra-action is a budding or a surge out of a single, initially undifferentiated, *continuum*. Interestingly, another physicist and specialist of science studies, Karen Barad, has developed a connection between the philosophy of quantum mechanics and general epistemology, by basing it on a similar concept and term of *intra-action*. She writes “According to my agential realist ontology, or rather ethico-onto-epistemology ... , ‘individuals’ do not preexist as such but rather materialize in intra-action. That is, intra-action goes to the question of the making of differences, of “individuals,” rather than assuming their independent or prior existence” (Kleinman 2012, Barad 2007).

In Fuchs’ writings, however, this new intra-active concept of a measurement is sometimes put aside and replaced by other formulations that tacitly presuppose the division of the world into a plurality of objects. For instance, in (Fuchs 2015, 64), the split between the “measuring system” and the “measured system” is still posited unproblematically. But we should definitely consider such characterization of the measurement process as an unfortunate remnant of a common prejudice, that lags behind the cutting edge of QBist research. For, unlike the old-fashioned inter-active concept of measurement, the intra-active concept is the only one that does full justice to participatory realism.

Now, can we take advantage of the surprises that impinge on us, of the constraints that are felt by us, or of the form of the normative rules that maximizes our success, to extract some information about this “oceanic reality” we are exploring technologically from the midst of it? More specifically, can we go beyond the internal constraint imposed on our system of bets by the clause of Dutch-Book coherence, and identify an external or interfacial constraint that might perhaps teach us something about the “oceanic reality”? QBists have offered a positive and carefully argued answer to these questions. This quest for indirect signs of the transcendent “oceanic reality” in the immanence of our experimental endeavor, is probably the core of their participatory realist research program. According to QBists, the trace of the transcendent “oceanic reality” manifests by way of a non-trivial determination imposed to the normative rules that govern our most successful predictions and actions within it.

One of the few places in which this can be seen is the Born rule. In its ordinary form, the Born rule allows one to calculate the probability of some experimental outcome, from the state vector or the density operator of the “physical system” on which the experiment is performed. In its QBist form, the Born rule connects probabilities bearing on two successive experiments; more specifically, it connects the probability an agent assigns to some outcome in the

second experiment, to the conditional probability of obtaining this latter outcome O_2 if the first experiment resulted in a certain outcome O_1 . Now, in both forms (the standard form and the QBist form), the Born rule can be derived from two classes of assumptions: (1) assumptions bearing on the internal coherence of probability assignments, and (2) assumptions that seem to go beyond any clause of internal coherence.

In its standard form, the Born rule has been derived out of two such assumptions, initially by Paulette Destouches-Février (1946, 1951), and later on by Andrew Gleason (Pitowsky 1997, Caves et al. 2004). The original derivation of Paulette Destouches-Février starts from the *contextuality* of quantum phenomena (what she calls the “*subjective*” character of quantum phenomena), together with the mutual incompatibility of certain pairs of experimental contexts corresponding to conjugate variables (Bitbol 1996a, 2014). Then, she proceeds by wondering what is the condition for maintaining the *probabilistic* nature of the prediction of quantum phenomena, throughout the variety of mutually incompatible experimental contexts (this is what we may call a clause of *non-contextuality* of probabilities). And she finds that the Born rule is the only one that makes the probabilistic nature of predictions, especially their additivity to 1, invariant across the various experimental contexts. Indeed, adopting the rule of squared amplitudes (i.e. of squared projections of state vectors on the eigen-directions of the observables corresponding to each experimental context), allows one to apply the Pythagoras theorem to these projections. The sum of the probabilities thus defined is equal to the square of the norm of the state vector, which is constant across time and equal to 1.

Now, what can we say about the *meaning* of Paulette Destouches-Février’s two assumptions? The assumption of *non-contextuality of probabilities* is a clause of robustness and coherence of the system of probabilistic valuations across the manifold experimental situations. It is purely internal to the procedure of agent’s prediction (or gambling). In other terms, it is a type (2) assumption. Instead, the assumption of *contextuality of phenomena* is of type (1) since it reaches beyond the internal rules of coherence agents impose to their predictions. It is tempting to see the contextuality of phenomena as a fact of the world, though an essentially negative one: the fact that the world *cannot* be neatly separated into an observing system and an observed system. This fact, in turn, may be derived from the fact that “the quantum of action” (as Bohr would have said) takes on a non-zero value, namely the value of the Planck constant. Later on, the *amount* of the quantum contextuality of phenomena, gauged by the Tsirelson bound, has been taken as a further fact of the world (Aerts and Sozzo 2014).

The QBist approach retains the general strategy of deriving the Born rule from an assumption of internal coherence of predictions, plus a constraint that may perhaps manifest the contact of agents with some “transcendence”. But it

differs from Destouches-Février's and Gleason's approach on two points. Firstly, QBism tends to avoid the misleading concept of "quantum state" entirely, and stick to the concept of probability throughout. Secondly, when it deals with the issue of contextual phenomena, QBism refuses to posit in advance (or even to uniquely derive, as Paulette Destouches-Février did after Jean-Louis Destouches 1942) the standard structure of observables in a Hilbert space, together with the commutation relations between them. Here is what Fuchs wrote one of us (MB) on 04/10/2021 in connection to this: "I am resistant to previous foundational efforts (even heroic ones like that of Destouches-Février) that take noncommutivity or contextuality (as it is usually posed) as their starting points. I instead want to see noncommutivity and all the other things come from this most QBist-conducive starting point: A statement that 'unperformed experiments have no results' (Peres)". The statement that 'unperformed experiments have no results' is clearly less determinate than an axiomatically imposed contextuality plus noncommutativity. It introduces additional intellectual degrees of freedom, that can be exploited to explore a larger space of derivations of formal elements of quantum theory such as the Born Rule. It also expresses a fundamental option recently taken by QBism (see Stacey 2019): identify *two* levels of personalism in quantum predictions, instead of just one; assume not only personalism in probabilities, but also personalism in the choice of observables. "Both the probabilities *and* the choice of POVM (Positive Operator-Valued Measure) elements are personal judgments, expressions from the agent's own mesh of beliefs cashed out as gambling commitments" (Fuchs & Stacey 2020). But not even the second level of personal judgment is arbitrary; not even it is immune from normative constraints. Indeed, for the set of POVMs to be "informationally complete", i.e. for the probabilities of their experimental values to be sufficient to generate a state vector, quantum theory requires that its cardinal be equal to the square of the number of dimensions of the corresponding Hilbert space. It is precisely this exponent 2 (which appears in the *square* of the number of dimensions of the Hilbert space) that, according to QBists, is the mark of the quantum nature of the "systems", or more broadly of the environment, in the normative structures of quantum formalism. Here is their conclusion about the status of the Born rule (DeBroda et al. 2020b): "The Born rule ... can be viewed as a normative constraint on an agent's probability assignments. It is a normative constraint above and beyond the standard rules of probability theory. On their own, the rules of probability theory do not tell an agent how their probabilities for one experiment (Experiment Two) should constrain their assignments to another slightly different experiment in which one of the measurements is missing (Experiment One). To make this connection requires some extra empirically motivated assumptions about the physics relevant to these two experiments. We identified a set of such assumptions, the first three of which represent general assertions about physical systems and are compatible with both classical and quantum

systems, while the last (the rule of squared dimension) represents a minimal requirement for believing the systems to be essentially quantum in spirit if not letter". In other terms, to generate the Born rule, one needs two classes of assumptions. The first one is plain Dutch-Book coherence (the internal constraint): it is a type (1) assumption. Instead, the second assumption is "a little more", namely an external constraint, a constraint that can be suspected to express the "physics" of the environment under investigation: it is a type (2) assumption.

But are we thus allowed to think that the second class of assumptions represent "assertions *about physical systems*"? Are we allowed to suppose that the second class of assumptions are *about something completely separate* from the agent that makes normative use of them to guide her bets? That the norms of our agentivity into the "oceanic reality" are not arbitrary, that they are strongly constrained by a factor that exceeds the mere necessity of internal coherence of the set of our gambles, does not entail that this constraint tells us anything about what we are exploring, independently of the activity of exploration. What is revealed by the type (2) constraints imposed on the norms of our bets and actions, cannot be entirely disentangled from our betting and acting. They inform us that we are not dreaming reality, but they disclose no feature that can be said to belong to a reality allegedly distinct from us. The transcendence has put its recognizable mark on the norms of our actions, but it has not been cut from its roots in the immanence of our lives.

Let us recapitulate. The participatory realist picture of the knowledge process allows one to dissolve the usual "external realist" picture. But it also has enough resources to achieve the dissolution of its own (quasi-dualist) narrative. Acknowledging that we are radically immersed in what we intend to know, acknowledging that we fully "participate" in it, implies that a faithful account of knowledge can be obtained only by adopting the standpoint of the knower-participant. But approaching knowledge from the standpoint of the knower, focusing on the direct experience of what it is like to know, turns the picture of an agent-immersed-in-oceanic-reality into a mere propedeutics to a radical change of priorities, from a third-person to a first-person stance. In other terms, what the participatory realist conception willy-nilly pushes us to develop, is a thoroughly *phenomenological* approach of knowledge, and in particular of quantum physical knowledge.

This being granted, the challenge we have to meet is to accommodate the realist intuition of "participatory realism" within a conception that has the reputation of being thoroughly idealist⁴. Think of Husserl's insistence that the

⁴ That Husserl's mature philosophy is *narrowly* idealist is disputable, however. It is true that "at the heart of phenomenology lies a claim according to which the phenomenal stream of lived experience (*Erlebnisstrom*) derives its meaning and its being from itself, rather than from some external or underlying reality". But here, the insistence on lived experience should not be understood as a choice of the subjective sphere against the objective

field of *pure experience* is “*the All of absolute being*”, unlike the *objects* of experience, that are only given by incomplete adumbrations and just “claim being”. Think also of Husserl’s thesis that “Nature cannot be the condition for the existence of consciousness, since *nature itself turns out to be a correlate of consciousness*” (Husserl 1983, 116 §51). Is this not one of the boldest statements of idealism in the history of philosophy? Husserl acknowledged his own idealist inclination, but with a momentous nuance. In phenomenology, he wrote, “Idealism is not a metaphysical construction ... but the only possible and absolute truth ... of an *ego* recollecting on itself, on its own doing and its own capacity to give meaning” (Husserl 2007, 48). This is what we may call Husserl’s *methodological* idealism: any claim about the existence of something ultimately derives its credibility from the contents and structure of experience; as for the “real” existence/inexistence of anything independently of such source of credibility, this is just a matter of metaphysical speculation.

Even more importantly (for us), Husserl’s root-*ego*, together with its lived experience, is not necessarily to be construed as an isolated abstract point facing its object-like intentional correlates. Husserl’s reference to the “*ego*’s” doing, and capacity to give meaning, may be read as a suggestion to flesh it out as an embodied and participating agent. This is exactly what he did in the second volume of his *Ideas* (Husserl 1982) and in his *Crisis of the European Sciences* (Husserl 1989). But in what follows, we’ll mostly rely on the lineage of French phenomenologists who extrapolated the latter tendencies in Husserl’s pioneering work, by pursuing a thorough exploration of embodied experience.

Before pursuing the inquiry in this direction, however, we have to acknowledge an obstacle that has hindered it until now. Relying on phenomenology is usually perceived as superfluous or cumbersome by the community of physicists (see Crease 2020, French 2020, Berghofer & Wiltsche 2020). The opponents to QBism are even likely to get the feeling that this amount of (“continental”!) philosophical intricacies is a *reductio ad absurdum* of any interpretation of quantum mechanics that would require it. As for QBist physicists themselves, they may prefer to retain a form of discourse that does not depart too much from what can be easily understood by their colleagues. But we definitely think the phenomenological option is not just a luxury in this case. If we wish to retain the QBist *experiential* dissolution of quantum paradoxes, without remaining caught into a conceptual “omelette” (Jaynes 1990) that mixes up realism, pragmatism, and a touch of phenomenology, the only viable approach consists in trying to make sense of every ingredient of the “omelette” within a unified framework. Since Phenomenology is the only contemporary philosophical research program that does not turn lived experience into some ghostly epiphenomenon, and that takes instead experience as its absolute starting

world. It is rather a decisive option in favor of a non-dualist ontology from which the two poles of the theory of knowledge, and the intentional directedness that unite them, are derived (P. Blouin 2021).

point, we claim that it is the only unified framework suitable for making sense of QBism. At any rate, the attempt is worth making, because it represents one of our best hopes to get out of the quagmire of quantum “paradoxes”. If it proves successful, this will confirm that nothing less than a “philosophical revolution” (Healey 2017) is required if we want to make sense of quantum physics.

4-From embodiment to en-worldment

How do we know something we partake of? How can we grasp a reality in which we participate? How can we contemplate that with which we have no distance? What does “knowing” mean, when what is to be known is simultaneously presented *qua* experience, and capable (under certain conditions) of experiencing? The paradigmatic ground for testing these questions is *our own body*, that is indeed both experienced and experiencing. No wonder that the most recent phenomenological approaches of a participatory epistemology stem directly from the phenomenology of *embodiment* first developed by Edmund Husserl at the end of his career, and then by Maurice Merleau-Ponty.

To start with, which features distinguish my own body (that I partake of, to the point of *being it* in a way) from standard material bodies (that I can only perceive in outer space)? Four major distinctive features have been identified and described by Husserl and Merleau-Ponty.

The first one is that our own body is the site *from which* any standard material body is perceived and prehended.

The second one is the subject-object reversibility, or double-faced nature, of our own body, that differs from the purely object-status of standard material bodies.

The third one is that our own body immediately moves at will, whereas standard material bodies can only be moved mediately.

And the fourth one is the exceptional mode of presentation in experience of our own body, to a large extent different from the perspectival presentation that characterizes standard material bodies.

About the first feature, Husserl (1982, 223) writes: “Things appear under such and such a facet; and in this mode of appearance is included ... the relation with a ‘here’ and with its fundamental directions. ... The own-body then possesses this distinctive trait, unique in its kind, that it carries within itself the *point zero* of all orientations”. Notice that this fundamental feature of our own body is revealed as a mirror effect of the mode of presentation of standard material bodies. At any given moment, standard material bodies (or “things”) are presented only by one facet or one profile; therefore, one is bound to acknowledge the situatedness of “that wherefrom the facet is seen”.

Beware at this point: according to Husserl, such mode of presentation by facets or profiles is essential to the concept of a thing, rather than just accidentally connected with our particular relation with it. Indeed (unlike a realist), the phenomenologist does not say that things have several facets simultaneously available in space, and that (unfortunately) we discover them as we go along instead of seeing them all at once. Instead, the phenomenologist considers that the mode of donation by incomplete facets, and the expectation that we have of their completion, constitute the unsurpassable concept of a thing.

But this difference between two interpretations of the facet-presentation of things is irrelevant to the main lesson we are drawing from it. In both cases the perspectival presentation of what we tend to consider as “things” implies that they are perceived *from* a certain site, *relative to* a certain standpoint. It also implies that varying such perspective and standpoint will give rise to the manifold facets of those putative objects.

The intricacies arise when the phenomenological status of our own body is at stake. On the one hand, we can perceive parts of our own body in the space of standard material bodies’ presentations. These parts of our own body are perceived perspectively, almost in the same way as standard material bodies. But on the other hand the “here” of point zero, which is the core part of our own body, remains an unperceived perceiving origin of perspectives. Yet, this initial distinction between perceived and perceiving parts of our own body must be refined. When carefully attended to and analyzed, even the parts of our own body that can be perceived in the standard thing-like way manifest a capacity to be perceiving.

This introduces us to the second, most crucial, feature of the bulk of the own-body: its double-faced, perceived-perceiving, ability. Such remarkable characterization of the own-body *in* and *qua* lived experience was first formulated by Husserl. When he did so, Husserl distinguished the case of the visual own-body from the case of the tactile own-body. According to him, the visual own-body is pure seeing, since the site of seeing (the eye) is not directly seen. On the contrary, the tactile own-body is both touching and touched. Indeed, whenever we touch something with one of our hands, we simultaneously (or alternatively) feel this hand’s being affected by this gesture. Moreover, we can also feel this hand with the other hand. “What I call my seen own-body, is not a seeing-seen, unlike my body *qua* touched body which is a touching-touched” (Husserl 1982, 211).

Unlike Husserl, Merleau-Ponty subsequently downplayed the difference between the visual and tactile modalities, and he emphasized in both the primacy of the perceiving over the perceived: “My visual body is certainly an object as far as its parts far removed from my head are concerned, but as we come nearer to the eyes, it becomes divorced from objects It is no different, in spite of what may appear to be the case, with my tactile body, for if I can,

with my left hand, feel my right hand as it touches an object, the right hand as an object is not the right hand as it touches: the first is a system of bones, muscles and flesh brought down at a point of space, whereas the second shoots through space like a rocket to reveal the external object in its place. In so far as it sees or touches the world, my body can therefore be neither seen nor touched” (Merleau-Ponty 2002, 105). To sum up, the own-body can be both perceiving and perceived, but what can be perceived is by no means the perceiving itself. The fact of perceiving is the core of one’s intimate participation in the own-body, whereas the fact of being perceived manifests an act of (necessarily incomplete) distancing from oneself.

Now, when I bring back my attention closer and closer to this core, what I find is ... nothing: what I find is just “a quasi-space to which (I) have no access”, writes Merleau-Ponty (2002, 105). This is the site of the perceiving. But this is also the site of the first impulse to act. What we call our “will” is a source of motion situated in this inaccessible quasi-space, in this extended point zero to which we identify. We are thus introduced to the third distinctive feature of the own-body: “(our own-body) is the organ of will; it is the one and only object which can be set in motion spontaneously and immediately by my will, and the one and only means to produce the movement of other things” (Husserl 1982, 215). The limits of my body are the limits of those changes that are sensed as immediately originated in the point zero to which I identify. Beyond these limits, changes are experienced either as mediately produced by my body, or as occurring independently of my will altogether.

That the core of our participation in our own body bear the negative characteristics of being un-perceived, un-accessed, un-traceable, has further consequences. Although its core is nothing more than a blind spot in the field of our experience, our own body remains stubbornly present to us at every moment. This is the fourth feature by which our own body radically departs from the mode of presentation of standard material bodies: its massive, permanent, and unanalyzed presence, that contrasts with the partial, transient, and sharp presentation of “things”. “An object is an object only in so far as it can be moved away from me, and ultimately disappear from my field of vision. Its presence is such that it entails a possible absence. Now the permanence of my own body is entirely different in kind: it is not at the extremity of some indefinite exploration; it defies exploration and is always presented to me from the same angle. ... The presence and absence of external objects are only variations within (the) field of (its) primordial presence” (Merleau-Ponty 2002, 104). I can explore an object that is detached from me, see it from various angles, and even get away from it, to the point of making it disappear. But my own body, the body I intimately partake of, is a compulsory presence self-perceived from a single angle, not to say from no angle at all. Exploring (parts

of) my body from various angles becomes possible only at the cost of its *self-splitting* into the core and non-core fractions of it.

This remarkable situation of *embodiment*, of inextricable participation to our own body, has been progressively extended by Merleau-Ponty to our participation to the world. We may accordingly call the broadened participation he suggests a case of “*en-worldment*”. Such extension from body to world has been sketched first in Merleau-Ponty’s *Phenomenology of Perception*, and then developed, with more dramatic metaphysical undertones, in his *Visible and Invisible*. In (Bitbol 2020a) Merleau-Ponty’s extrapolation of the characteristics of the own-body to the characteristics of the world, and its consequences for a phenomenological understanding of quantum mechanics (Merleau-Ponty 1995) were already pointed out. Here, we will briefly come back to the forerunners of the concept of en-worldment in Merleau-Ponty’s *Phenomenology of Perception*, before we ponder on the post-Merleau-Pontian development of a full-blown “cosmo-phenomenology”.

First of all, let us notice that Merleau-Ponty’s bold generalization, that extends our embodied mode of being to the cosmos as a whole (embodiment to en-worldment), is a special case of a non-standard mode of reasoning that was used by a few heroic thinkers of the past who were trying to meet the challenge of the “hard problem” of consciousness by coming back to its very source. The standard method of scientific knowledge consists in deriving singular cases from a general proposition, after the general proposition has been extracted as an invariant of a set of particular situations. But some thinkers soon realized that, in virtue of its very definition, such scientific method is powerless to tackle the issue of phenomenal consciousness, of pure experience, of this exceptional feature that only occurs in the first person singular. They then decided to turn the method upside-down. Instead of using the standard direction of inference, and despite the apparent logical invalidity of such move, they attempted to derive general propositions about consciousness from a first-person singular observation. The reason they had to do so is that the first-person singular standpoint is evidently the only starting point of an inquiry about lived experience that does not pass over it.

A good example of this reverted approach (Bitbol 2020b) was given by Pierre Teilhard de Chardin, a French paleontologist and thinker of the middle of the twentieth century. According to him, the only way to approach phenomenal consciousness, or pure experience, is to “*discover the universal under the exceptional*”. Teilhard de Chardin’s argument in favor of this strategy is both simple and strange: “Consciousness appears with complete evidence *only* in humans, we were tempted to say; so it is an isolated case of no interest to science. Consciousness appears with *evidence* in humans, one should rather say; therefore, *seen in this single flash, it has a cosmic extension*” (Teilhard de

Chardin 1955, 52). The exceptional fact of lived experience in us, is an occasion to discover its universal significance and extension.

At any rate, in those cases where knowledge by acquaintance is the most appropriate form of knowledge, a singular evidence is the only basis for inquiry. And the usual neglect of isolated facts in a science that strives for universality, turns out to be the most challenging of the obstacles it poses to the investigation of such cases. Now, embodiment is among those situations in which we know (part of) the world by acquaintance. No wonder that Merleau-Ponty took the singular evidence of being embodied as our strongest basis for any further inquiry about the world. Several features initially ascribed to the body were found by him to characterize the world as a whole. More precisely, they were found by him to characterize the world *qua* capable of including living bodies. Thus, Merleau-Ponty granted the inaccessibility to knowledge of our body's core a cosmic counterpart and a cosmic significance: "(Our own body) is not merely one object among the rest, which has the peculiarity of resisting reflection and remaining, so to speak, stuck to the subject. Obscurity spreads to the perceived world in its entirety" (Merleau-Ponty 2002, 232). In so far as the own-body has a knowing but unknown face, the entire world that encompasses this body is haunted by this lacuna. The world as a whole must be ascribed a knowing but unknown face by way of this own-body that partake of it. "There can be no question of describing perception itself as one of the facts thrown up in the world, since we can never fill up, in the picture of the world, that gap which we ourselves are, and by which it comes into existence for someone, since perception is the 'flaw' in this 'great diamond'" (Merleau-Ponty 2002, 241). The separation between the perceiving and the perceived we impose in our body by varying the focus of our attention, then extends to the entire world. According to Merleau-Ponty, it is not correct to say that our body is the locus of the perceiving, whereas the world is the perceived. One should rather say that the world *qua* capable of including our own body imposes on itself a variable limit between its perceiving side and its perceived side. This is what Merleau-Ponty stated more explicitly in his *Visible and Invisible*, when he gave the name "flesh" to the stuff that has the double-faced quality of being both perceiving and perceived, and when he finally declared that "the world *is* flesh" (Merleau-Ponty 1964, 182).

This reflection of Merleau-Ponty culminated in the thesis that perception is not an apprehension of the world by a subject, but the consequence of a self-splitting of the world into subject-like side and an object-like side. In line with this thesis, we access to the world in two ways: the object way, and the own-body way. On the one hand, conforming to the object way, we access to the world facet after facet, and not all at once; this expresses the successive steps of the self-splitting of the world within our own (moving) body. On the other hand, conforming to the own-body way, the world manifests as a massive, permanent

and indivisible presence perceived from no angle at all. “From the very start I am in communication with one being, and one only, a vast individual from which my own experiences are taken, and which persists on the horizon of my life as the distant roar of a great city provides the background to everything we do in it” (Merleau-Ponty 2002, 382). The keyword, here, is “background”. The world is not facing me; it mostly manifests as the “vast” background of all my life. The unity of the world is not obtained after a process of synthesis of its manifold facets, as one does for objects; it precedes any effort to theorize the cosmos. “The world has its unity, although the mind may not have succeeded in inter-relating its facets and in integrating them into the conception of a geometrized projection” (Merleau-Ponty 2002, 181).

Beware at this point, however. The world according to Merleau-Ponty is no substantial entity, no metaphysically “external” being that exceeds experience. It should rather be understood as an experienced guiding thread of the flux of lived experience. In-the-world-ness arises as an experience of being immersed, as an experience of partaking of a process greater than our individual lives, as an experience of counting on something sturdy beyond our own failures to master it. “The natural world is the horizon of all horizons, the style of all possible styles, which guarantees for my experiences a given, not a willed, unity underlying all the disruptions of my personal and historical life” (Merleau-Ponty 2002, 385).

A style, like an atmosphere, is no *object* of experience; it suffuses experience, just as a *basso continuo* suffuses the melody; and it serves as a prospective and retrospective binder to fill in the temporal gaps of lived experience. As for a horizon, it is an experience of indefinite promise, that relies on a generalized anticipation of future experiences. From a phenomenological standpoint, an object is composed of a perceptive nucleus surrounded by a horizon of expectations. And, since the world promises the discovery of a host of unseen objects, it surrounds the present experience of seeing objects with a higher-order horizon of expectations. *Qua* horizon of horizons, the world is what we *experience as if* it were “the inexhaustible reservoir out of which things are drawn” (Merleau-Ponty 2002, 401). This fits with what has been said earlier, provided we remember that a thing, in this phenomenological context, is itself to be understood as nothing else than a series of experiences whose endless and sometimes unexpected unfolding makes it *look* transcendent. To sum up, here, neither the nature of the world nor the nature of its objects is fundamentally different from the nature of experience.

Such is the starting point of Renaud Barbaras, in his attempt to draw the ultimate consequences of Merleau-Ponty’s concept of the *world’s flesh*: that “*there is nothing more in the world than its appearing*” (Barbaras 2019, 83). As a preparation of his inquiry about the world, Barbaras borrows his uncompromising conception of phenomenology from Jan Patočka. Barbaras

considers, after Patočka, that the phenomenological *epoché* must be pushed to a point of completion, beyond what Husserl and Merleau-Ponty did. The suspension of judgments and interpretations must be pushed to a point where none of the old divisions of epistemology subsists, not even the difference maintained by Husserl between consciousness (with its flux of lived experiences) and its intentional objects, a residue of the difference between subject and object. After this relentless *epoché*, nothing else remains than “the ‘there is’ as such, in its neutrality between subjective and objective” (Barbaras 2019, 83): a ‘there is’ that identifies with ‘there appears’.

Among the concepts that are dissolved by this exhaustive *tabula rasa*, we find Merleau-Ponty’s concepts of flesh and own-body. Barbaras thus criticizes Merleau-Ponty’s concept of *flesh* because it is applied in two different ways to the body and to the world, thereby conveying a persistent form of dualism: “The duality of consciousness and object, which had to be overcome, is finally maintained and divides the flesh” (Barbaras 2019, 11). Barbaras also criticizes the concept of own-body because it bears the indirect mark of a pre-phenomenological attitude. Indeed, the very fact of using for the experiencing own-body the same word (“body”) as for a standard experienced object, shows that Merleau-Ponty could not completely free himself from the “natural” attitude of non-phenomenologists, and from their “natural” ontology of material bodies.

So, instead of characterizing the fundamental experience of being “embodied” by broaching on half-phenomenological and half-biological *bodies*, Barbaras advocates so suspend any reference to such entities, and to undertake a more faithful and more direct description of the experience itself. As soon as the noun “body” has been dropped, the so-called experience of “embodiment” is more aptly described by verbs that express the situatedness of the experiencer (where “situatedness” means being aware both of holding the *point zero* position in the field of perception, and of being in proprioceptive continuity with what is perceived). In this context, two crucial verbs are: “to belong”, and the weaker “to be embedded”. “How to qualify, in a minimal way, this fundamental experience which is recklessly re-captured through the concept of the body? There is no other answer than to assert that this experience is one of *belonging*. Indeed, saying that I have (or that I am) a body is tantamount to saying that *I belong to the world*” (Barbaras 2019, 13). Beware again at this point. Remember that what a phenomenologist means by “world” is no collection of objects, but rather an experienced presence, a lived sense of the overwhelming “there is”, a “style of styles” a “horizon of horizons”. Remember that the “world”, here, can be nothing more than one of the two shadows cast by the verb “to belong” (and by the lived state of “belonging”). “We” are those who belong, and the “world” is just that to which we belong. That there can be no true phenomenological distinction between the one who belongs and that to which she belongs, that they are inextricably entangled through the very process of

belonging, is clearly stated by Barbaras (2019, 15): “Thinking of *belonging* as an original fact or as the ultimate mode of being of someone, therefore amounts to affirming that *her ‘other’ (the world) is still her*, that she deploys what she fits into, or makes it be. In this sense, belonging must be understood as *participation*”. Here again, there is no question of an ontological discontinuity between the embodied subject, her lived experience, and the world she belongs to: the world is deployed by one’s lived state of belonging; and “participation” is the name given to such co-emergence of subject and world in the lived process of belonging. This is a new sense of “participation”, purely phenomenological in so far as it entirely unfolds within the dynamics of lived experience. This is a sense of participation that does not imply a preliminary division of what is participating from that to which it participates, but directly expresses their radical cohesion within the unique continuum of lived experience.

Barbaras then distinguishes between three modalities of the constitutive relation of “belonging”, according to its time-orientation: present, past, and future. In French, these three modalities are stated in a few short words that are not so easy to translate: “Être *dans* le monde, être *du* monde, être *au* monde” (Barbaras 2019, 27).

“Être *dans* le monde” means being spatially *located* in the world, being somewhere now, occupying at present a particular place marked in a coordinate system.

“Être *du* monde” means *partaking of* the world, being made of the same stuff as the world, having deep ontological roots in the world.

“Être *au* monde” means being *concerned by* the world, being ready to face its novelties and to act on/in it.

Let’s repeat tirelessly that using the noun “world” in this ambience is not a way to refer to a big “thing” awaiting us “out there”; it is just a convenience of language for expressing a lived awareness of belonging. “World” is nothing else than the threefold correlate of the threefold relation of belonging that defines our situation as we experience it. The world is but what we feel to be located in, to partake of, and to be concerned with.

This analysis has precise consequences for the interpretation of each aspect of the relation of belonging.

When a phenomenologist says we are located in the world, this does not mean that our body occupies a little volume in a pre-existing outer space; this rather means, conversely, that our sense of being situated radiates, from within it, a representation of space. The fact that the world looks “external” to us does not mean that our small biological body is encompassed in the big body of the world; it means, conversely, that our lived sense of finitude, our feeling to be

narrowly located somewhere, translates easily into the representation of an external world.

Similarly, when a phenomenologist says that we partake of the world, this does not mean that the world is an exhaustive material body from which our limited own body springs (or from which the molecular constituents of our biological body are borrowed). This rather means that we have the experience of being overwhelmed by something bigger than our individual selves, which has the capacity to support us and make us emerge at every moment. In this case, the world is not our material resource: it is the name we give to our awareness of not being self-sufficient *qua* individuals.

Finally, when a phenomenologist says that we are concerned by the world, this does not mean that there is a pre-existing cosmos we have reasons to beware of or to hope something from. This rather means that we experience a sense of lack, of incompleteness, of desire, that requires from us a capacity to act, and to anticipate somehow the outcome of our action. In this case, the word “world” is to be understood in two ways. “World” is the name we give to what could *a priori* satisfy our desire, and compensate in the course of time for our sense of incompleteness, without providing us with the certainty that things will turn as we would have liked. “World” is also the name of what appears (to us) *a posteriori* as a byproduct of our compensating moves “in it”. “Belonging to the world means to advance in it, to go towards it, and to make it be (appear) by this very commitment; in short, to *participate* in its work of worlding” (Barbaras 2019, 28). Belonging to the world, participating in it, acting in/on it, is coextensive to making it appear, i.e. to “phenomenalizing” it. According to Barbaras (2019, 38), “any *belonging* to the soil of the world is a cosmophany”. Living and moving as an en-worlded being lets the world-phenomenon arise. This is the principle of what Barbaras calls a “cosmological phenomenology”, or in short a “cosmo-phenomenology”.

However, just as the word “body” has spurious naturalist connotations, far from the strict suspension of judgment about standard objects required by phenomenology, the words “cosmos” and “world” irresistibly evoke the old concept of a circumscribed totality accessible to the gaze of some supramundane being. As Merleau-Ponty (2002, 385) pointed out, “belief in the thing and the world must entail the presumption of a completed synthesis”: the synthesis of every actual and possible phenomenon into a holistic entity called “the world” *of which* these phenomena are supposed to be appearances. To fit with the deflationary concept of world that has been favored by the “cosmo-phenomenologist”, it is then appropriate to play down the word “world”, and to retain a minimal sense of it, similar to the “style” or “horizon of horizons” we discussed above.

Such minimal sense of “world” can be developed further by relying on the careful analysis of “ambience” offered by Bruce Bégout (2021). What Bégout pursues in this analysis is an unprejudiced attention to every aspect of lived experience: not only the recognition of salient objects but also what accompanies it, the atmosphere and emotional tonality in the midst of which objects are apprehended (and out of which they are extracted). To help him in his inquiry, Bégout borrows from Husserl an aspect of his phenomenology that is usually overlooked: the observation that “experience does not consist of a solitary face to face between subject and object, but first of all designates an original situation referring to what Husserl calls ‘*Umgebung*’, literally ‘peridonation’, or donation of a periphery” (Bégout 2021, 38). This periphery of experience does not appear in the same mode as a quasi-point-like object, but it retains a form of extended and non-specific presence. What takes on a decisive importance in such experience is then no longer its relation to some object (Husserl’s intentionality), but the non-specific feeling of *belonging* to a broader, somehow indefinite, environment it conveys. Just as in Barbaras, a phenomenology developed along these lines “assumes the primacy of *belonging* over relation” (Bégout 2021, 40). But here, to make full sense of this primacy of belonging, what is undertaken is not a cosmo-phenomenology; it is an “*eco-phenomenology* of ambience”. Unlike a cosmo-phenomenology, an eco-phenomenology does not indulge itself in a renewed discourse about the world as a whole, under the guise of an exhaustive description of experience. Instead, an eco-phenomenology tries from the outset to “respect the *immersive* mode of being of the living, and put forward the ‘*taking place in*’ rather than the ‘*relationship with*’ ” (Bégout 2021, 39). Belonging is a mode of being; it is not a relation with “being”.

5-QBism as an eco-phenomenology: a radical participatory empiricism

At this point, it seems we have gathered enough philosophical tools to overcome the QBist epistemological dilemma. QBists can follow the experiential thread throughout, without betraying their minimal realist intuition that phenomena are not merely fabricated by individual subjects of experience. QBists can put forward their conviction that physics has something to do with the world, while not forgetting Bohr’s lesson that what physics organizes is nothing else than *human experience*. QBists can make good sense of the fact that the world has surprises in store for agents, and still accept (Pienaar 2020) that Agent and World represent *internal aspects of experience*. But there is a condition to this peaceful coexistence. If QBists want to reconcile their interest for the world and their recognition that knowledge entirely develops on the ground of experience, they must adopt the phenomenological, experiential, acceptance of the concept of “world” offered by Merleau-Ponty and Barbaras (2016). If they want to accommodate these two apparently unrelated sides of

their thesis, they must accept, after Merleau-Ponty and Barbaras, that “world” is the name we give to an experienced sense of transcendence with respect to our individual finitude, instead of presupposing (as the dominant naturalist doctrine does) that experience must occur within an inherently transcendent, pre-given, world. In other (Jamesian) terms, QBists can harmonize the pragmatist, realist, and radical empiricist components of their philosophical outlook, but only on condition of entirely subordinating the pragmatist and realist aspects of their thesis to the radical empiricist aspect.

We will give a name to this condition. We will call it “en-experiencing”. En-experiencing the body, the instrumental prostheses, and the world. En-experiencing means putting body, prostheses, and world in ontological continuity with the only status of experimental outcomes that does not create “quantum paradoxes”, namely the experiential status. En-experiencing the world is the correlate and the converse of en-worlding our experience, just as en-experiencing the body would be the correlate and the converse of embodying experience. En-experiencing the world and en-worlding experience are the two directions (from world to experience, and from experience to world) of a single endeavor of founding a non-dualist approach to quantum knowledge, to physical knowledge, and to knowledge as a whole. By en-worlding experience one realizes that experience is by no means severed from what it is experience of, that it is permeated by a sense of being-in-the-world and being-with-others. By en-worlding experience one realizes that experience is haloed by a “horizon of horizons” that holds the promise of its unlimited development. Conversely, by en-experiencing the world, one recognizes that experience permeates what it is experience of by way of (experienced) desire, (experienced) action, and (experienced) anticipation of the consequences of action. Recognizing the body as an “own-body” in Merleau-Ponty’s sense, and the experimental apparatus as a prosthesis that extends the own-body, are two steps of this process of en-experiencing. But these are not (and should not be) limiting steps, since, as we previously suggested, a proper synthesis of the two tendencies of QBism in a phenomenological framework requires to complete en-experiencing by extending it to the allegedly “external” part of the world, called “physical systems”. A good example of this move is Peres (1995). In his book, Peres combined an en-experiencing of physical systems with an en-worldment of the physicist’s experience, when he defined a “physical system” as an equivalence class of experimental preparations, and its “state” as the set of expectations that derive from such preparations. Indeed, “preparation” can be understood as an act performed (and experienced) by an embodied en-prosthesized agent; and a “physical system” arises as a horizon of expectations of this process of embodied experience, thus exemplifying the en-experiencing of the world.

This all-pervasive role of experience sounds strange, and outrageously idealist, only if one forgets its richness. Experience encompasses a sense of

novelty of the perceived, a network of expectations, and a horizon of fulfillment or deception of such expectations, whose abundance has nothing to envy that of a putative “real outer world”.

The systematic en-experiencing of every question about the world compares with what Fine (1996) called Einstein’s “en-theorizing” of questions about physical reality. Adopting a strategy of “en-theorizing” is tantamount to consider that the only proper way to address the issue of “physical reality” is to transform it into an investigation of the empirical success of theories that pretend to provide us with a “description of reality”. In other terms, the strategy of en-theorizing systematically deflects the standard metaphysical concern about the “correspondence” of the physical theory to physical reality, onto the plane of the empirical adequacy of the theory. Here, no theoretical entity is considered to exist *a priori*, independently of both the role it plays within the theory, and the empirical credentials of the theory as a whole. Speaking as if such theoretical entities were “real”, as if they existed “out there”, only makes sense as a “façon de parler” justified by the inner structure of the theory that include them, and by the finding that this theory is globally corroborated by experiments. Entheorizing is just one step short of en-experiencing, since experience includes both a capacity of anticipating events by way of theoretical structures, and a collection of the empirical findings (with their confirmation or disconfirmation of expectations) that follow the interventions of the experiencing agent. Here, speaking as if physical systems were “real”, as if they existed “out there” to be manipulated by agents, only makes sense as a “façon de parler” that is justified by the inner structure of the experience of such agents, and by the experienced success of the actions they perform under the assumption that these systems “exist”.

This being granted, it is time to show in some details the deep connection between the QBist understanding of quantum mechanics and the adoption of an en-worlded standpoint that manifests through our experience of “belonging”. This connection is so strong that it justifies calling QBism a scientific form of “eco-phenomenology” in Bégout’s sense.

In section 4, we listed (though in a different order) four features that testify of our embodiment, and that can be extended to our en-worldment: holding a point zero position, being double-faced (feeling and felt), observing limitations to the perspectival presentation of what there is, and finally having an experience of free will. Let’s consider these four features in the context of QBism.

To start with, the impossibility of eliminating from quantum theory the *de facto* privilege of the point-zero position, is perhaps the defining choice of QBism. QBism was born as a reaction to the fact that any attempt at reading quantum theory as a description of the world “from nowhere” has been, and still is, an inexhaustible source of conceptual intricacies and paradoxes. The lesson QBism learnt from this failure is that each quantum experiment, each feature of

the quantum formalism, must be rethought as a “user’s manual” for situated beings, as a guide to act “from somewhere”. Thanks to this kind of “user’s manual”, situated beings orient themselves in an environment (*Umwelt*) of phenomena that co-emerge with their embodied actions. This uneliminable situatedness, this “belonging” of quantum agents, takes on the three forms documented by Barbaras (2019, 27): “Être dans le monde, être du monde, être au monde”.

“Être *dans* le monde” points towards the spatio-temporal location of agents. In QBism (and in Rovelli’s relational quantum mechanics as well), the ascription of a state vector, or the probability valuation used by agents, depends crucially on their spatio-temporal location. Thus, it is through the dependence of state vectors on the spatial position of agents inside or outside the laboratory that QBism defuses a variety of Wigner’s-friend-like paradoxes. And it is through the dependence of state vectors on the spatio-temporal position of agents inside or outside their respective light-cones, that QBism dispels the spurious “non-locality” usually associated with quantum entanglement. If one did not take the spatio-temporal position of agents thoroughly into account, no such dissolution of quantum paradoxes would be available.

“Être *du* monde” is the second modality of our “belonging”. It refers to our sense of partaking of the world, of being rooted in its soil, of being enmeshed by it. In QBism, this is presumably what is expressed by the adjective “participatory” that qualifies “realism”, but that (according to the analysis of the previous sections) should rather qualify “radical empiricism”: instead of “participatory realism”, QBism should adopt a form of “*radical participatory empiricism*”. We have seen that participation is ascribed such a strong meaning by QBism that, in its most advanced formulations, the very idea that the agent inter-acts with the world is replaced by the idea that there occurs an “intra-action” within the world, and that the standard split between agents and physical systems makes flickering appearances wherever the world thus intra-acts. Instead of saying that experimental events are co-created in the process of the inter-action between agents and physical systems, one should then say that phenomena emerge, or are newly created, at each step of an intra-action. This formulation is still compatible with “participatory realism”. But, if pushed to its ultimate consequences, it should be changed into the “radical participatory empiricist” statement that intra-action does not take place in an objectified world but *qua* phase of a quest of knowledge within the lived world. The latter process is what Barbaras (2019, 19) calls the “*phenomenalization*” of the world in the course of its becoming (a becoming that involves intra-actions). More briefly, this process is what Barbaras calls a self-produced “*cosmo-phany*”.

“Être *au* monde” is the third modality of “belonging”. It denotes our being *concerned* with our world, and with the way our world may undergo manifest (experienced) changes. Such concern involves both the initial vague worry that

motivates our desire to know, and our focused expectations about the “cosmophany” to come. In QBism, this last modality of “belonging” completely determines the status that is ascribed to state vectors and probabilities. State vectors and probabilities are meant to address *our concerns*, by providing us with a bundle of expectations about future intra-active creations, namely about future experimental phenomena.

We have just seen the QBist threefold counterpart of the cosmo- and eco-phenomenology of “belonging”. But what about the double-faced constitution of our “flesh”? Does anything correspond to the duality of the feeling and the felt, beyond the boundaries of our own-body? Our answer is a prudent “yes”. One can indeed extend limitlessly the double-faced constitution of the flesh, provided one substitutes the latter with its topological structure. Let’s remind Merleau-Ponty’s functional characterization of the double-face: “In so far as it sees or touches the world, my body can be neither seen nor touched” (Merleau-Ponty 2002, 105). The most essential difference between the touching and the touched, the feeling and the felt, the perceiving and the perceived, is thus not a difference of nature, but a difference of position and orientation in the attentional field. The perceiving is “wherefrom” perception arises; it lies in the background of the attentional field, and it is oriented towards a potential object of experience. Instead, the perceived is projected in front of the attentional gaze; it is “that towards which” attention is directed. This difference of position and direction between the “wherefrom” status and the “towards which” status, was retained by Heidegger (1962) as a basis for the phenomenological distinction between tools and objects. What holds a “wherefrom” status (the tool) has the “*Zuhandenheit*” (readiness-to-hand) mode of being, whereas what holds a “towards which” status (the object) has the “*Vorhandenheit*” (presence-at-hand) mode of being. The hand itself, in some sense is “ready-to-hand” because it is permanently available for directional action; it usually remains in the background of the field of attention and acts to manipulate or capture an object of attention. But the tools and the prostheses can acquire the same status when one becomes so accustomed to them that they are no longer objects of attention, but rather operate as means towards an end. The same is true of perceptual tools and prostheses such as the “enactive torch” (Froese et al. 2012). The enactive torch is a sensory substitution device that uses an ultrasonic sensor to measure distances to obstacles, and then translates these spatial data into a vibration that can be felt by someone who holds the device in the hand. After an initial phase in which the user just perceives a vibration in her hand, a shift takes place and the user has the feeling of directly palpating walls and doors while losing the sense of vibration. The status of the enactive torch has changed from object to (perceptive) tool, from present-at-hand to ready-to-hand, from “towards which” to “wherefrom”, and then, in a sense, from perceived to perceiving.

This kind of analysis was applied by Pienaar (2020) to the measuring apparatuses of laboratories of quantum physics. Indeed, such analysis is central for making sense of the QBist claim that “the apparatus is to be regarded as an essential part of the agent”, “on a par with the perceptual organs of the agent”. And it is therefore crucial to avoid the age-old dilemma of standard quantum mechanics as to where one should locate the “cut” between the quantum, object-like, part of the measurement chain, and the classical, tool-like, part of the measurement chain. But doing so, accepting that the tool status and the own-body boundaries can be shifted freely up to a putative contact with what is to be explored, means that one is ready to extend indefinitely the domain of validity of the concept of our “flesh”, thereby coming closer and closer to Merleau-Ponty’s statement that “the world is flesh”. In other terms, one thereby accepts that the feeling-felt double face is a basic feature of the world *qua* experienced, rather than a special feature belonging only to a spatially bounded fraction of this world called “a living body”. By so extending the flesh-status of our being embodied, QBism *de facto* endorses the broadest possible vision of our being “en-worlded” beyond our being merely “em-bodied”.

Let’s notice at this point that our being en-worlded accounts for certain well-known limitations of the manifestations of the world. It especially accounts for the lack of relevance of the perspectival model in quantum physics.

The perspectival presentations of a standard bodily object are mutually compatible, in so far as (i) the chronological order of its appearances does not affect them, and (ii) nothing prevents one in principle to let them show simultaneously, in a single compound manifestation (one that uses, say, a set of mirrors).

By contrast, the presentations of what we partake of (such as our body) depart from this perspectival model. We cannot capture our own body all at once in a single manifestation, and under a single gaze. Moreover, in the case of our body, the self-perception mode of presentation is exclusive of the perceiving mode. The first one requires a phenomenological language of reflection to be described, whereas the second one is correctly apprehended by everyday object-oriented language. Interestingly, this mutual exclusivity of modes of perception and languages is a fundamental feature of the concept of “complementarity” Bohr applied to quantum observables (Heelan 1977). Mutual exclusivity is precisely the feature that makes “complementarity” of observables incompatible with perspectivism. This being granted, we can interpret Bohr’s complementarity as the mark left by our en-worldment, on what we (mis-)take for our knowledge of the world.

Last but not least, what about free will? We claim that having the experience of free will is a constitutive feature of our situation of “belonging”, generalized into our “en-worldment”. This has been suspected long ago, first perhaps by early medieval authors (e.g. Boethius, 1999), who examined the differences

between the ability to foresee from a human standpoint (within the world), and from God's standpoint (able to rise above the world). Later on, Spinoza and Kant tended to rephrase and confirm this claim, each in his own language.

Immanuel Kant is well known for having formulated the thesis that we are free according to practical reason, whereas our behavior obeys deterministic laws according to theoretical reason; or that we are noumenally free, whereas we are phenomenally determinate. Kant's dual approach of human freedom has served as the root of Arthur Schopenhauer's (2014) celebrated *World as Will and Representation*. But it has been criticized by several post-kantian philosophers, especially by Charles Renouvier (2013) who is often quoted by Christopher Fuchs. Kant's view of human freedom has thus been rejected on the basis that, by dint of trying to remain compatible with the scientific determinism of classical mechanics, it turns out to be a weak or false defense of free will.

Yet, if properly understood, Kant's dual approach of human freedom is by no means tantamount to accepting some "real" determinism, on the basis of (classical) scientific determinism taken as a revelation of some absolute truth. On the contrary, Kant's underlying thesis is that (classical) science is nothing more than an *as if* mode of knowledge (Vaihinger 2021). According to Kant, (classical) science is a mode of knowledge that works *as if* there were objects ruled by deterministic "laws of nature", and *as if* we were passive spectators of their motion according to these laws. This *as if* ability of classical science arises from the imposition, by human understanding, of an ordering of phenomena that may hold for every rational subject. The pre-ordering of phenomena thus generates a form of epistemic objectivity that is too easily mistaken with the discovery of some ontic stuff.

The fact that our phenomenal bodies appear to be ruled by deterministic laws is then by no means a *reductio ad absurdum* of free will. It does not reveal that we are truly, ontically, determinate, but only on the "as if" mode. It only shows that, in the framework of classical science, the epistemic approach of ourselves from a spectator-like standpoint is bound to submit our phenomenal bodies to a deterministic law. Now, according to Kant, what is more fundamental than this spectator's description of ourselves, is our status as actors of our own deeds, our status of beings who act in tacit accordance to the idea of their freedom (Beck 1963). By contrast, the so-called spectator's standpoint (from which it appears that our behaviors are determinate) is available to no concrete individual human being; it is artificially fabricated out of the coordination of a multitude of actor's standpoints sedimented in our "pure understanding". "In view of our insuperable entanglement with what there is, the standpoint of a spectator of nature is extrapolated out of the only available standpoint, which is that of the actor" (Bitbol and Osnaghi 2014). Free will is therefore fundamental, being a necessary feature of the most fundamental standpoint we can adopt: the standpoint of an

en-worlded actor; the standpoint of an actor thoroughly enmeshed with what she acts upon.

The reason why the experience of free will is a necessary feature of an actor's standpoint is also quite instructive. This reason is that, unlike an external spectator, an engaged actor cannot *in principle* capture the whole field of what is to be known all at once, in a single manifestation, and under a single gaze. A true actor cannot deploy all what is to be known under her gaze, if only because *her own body* is part of what is to be known. Such constitutive inaccessibility of part of the world to an en-worlded being is precisely what Merleau-Ponty (2002, 232) meant when he evoked the "obscurity (that) spreads to the perceived world". Irrespective of whether or not an allegedly objective world that includes our own body is ruled by deterministic laws, we, en-worlded agents, have no other option than acting under the presupposition of our free will. Indeed, the determining factors of our actions, if any, are bound to remain hidden to ourselves in this region of obscurity which is the core of ourselves. And such hiddenness is neither accidental, nor provisional, since any attempt at unveiling the productive core of ourselves would have to be done from somewhere else that would then assume the status of another core, of another blindspot.

The previous analysis of the organic connection between en-worldment and free will is highly relevant to quantum physics. Many connections have been established in the past between quantum physics and human free will. Some of them consist in the (dubious) claim that quantum indeterminism is the *natural basis* of free will (Jordan 1944). Other connections are less trivial, however. Implicitly sharing the spirit of Kant's analysis, they discard the idea that free will is the expression of some underlying natural process, and they consider instead that free will arises as a standpoint-relative presupposition and experience.

The most remarkable approach of the latter kind is likely to be Peres' and Zurek's (1982). These authors first formulate three demands about physical theories: (1) strict determinism, (2) verifiability by free choice of experimental set up, and (3) descriptive universality. Then, it appears that, taken together, the three conditions are incompatible. Indeed, if a theory is descriptively universal and determinist, it is bound to deny that the decision as to which experimental set up one uses to test it, is *really* free. Viable theoretical options should therefore retain only two demands among the three previous ones. Among those viable options, quantum theory overtly satisfies demands (2) and (3), whereas it rejects demand (1). In other terms, quantum theory presents itself *prima facie* as a descriptively universal theory whose indeterminism makes it compatible with the demand of free choice of the experimental set up. But, when carefully analyzed, the quantum configuration turns out to be trickier. To address the measurement problem, the descriptive universality of quantum theory must be qualified somehow. An arbitrary fraction of the observing must be excluded

from the quantum description of the observed. Peres' and Zurek's conclusion is that, "although quantum theory is universal, it is not closed. Anything can be described by it, but something must remain unanalyzed". In other (shorter) terms, "although it can describe *anything*, a quantum description cannot include *everything*" (Peres & Zurek 1982).

Here, all the pieces of the Kantian puzzle of free will are in place; yet they are loosely adjusted. In particular, quantum indeterminism comes together with the recognition that "something must remain unanalyzed"; but no strong relation of entailment is established between these two statements. The reason of this limitation of Peres' and Zurek's approach can easily be found: it is their repeated (but almost tacit) assumption that quantum theory is meant to afford some kind of *description* of the universe. If we now deny quantum theory any descriptive status, and rather consider that quantum symbols are meant to be purely predictive, the situation becomes much more tractable. Indeed, in this case, the fact that some of the factors that influence what is to be predicted are in principle out of sight of the predictor (because they coincide with the predictor herself), immediately accounts for a predictive form of indeterminism (Popper 1988). (Predictive) indeterminism is not only associated with the *en-worldment* of the actor-predictor; *it is an unavoidable consequence of it*. More specifically, the presupposition and experience of free will (construed as self-impredictibility) is an unavoidable consequence of the actor-predictor's "obscurity" to herself due to her embodiment and en-worldment.

It would have been surprising that the most comprehensive and coherent predictive interpretation of quantum mechanics to date, namely QBism, failed to acknowledge this strong knot that binds quantum indeterminism, free will, and "participancy".

The importance of free will in the philosophical background of QBism is suggested by the 210 occurrences of the expression "free will" in (Fuchs 2015). But why is free will so central in the QBist approach?

One possible reason is that QBism chooses to take the agent as its most fundamental undefined primitive notion. The agent is dealt with as a primitive notion because she does not (and should not) belong to the set of objects of the theory. The agent is not endowed with either properties or theoretical "states" (that mostly pertain to her putative past). Instead, she is characterized by her pre-theoretical abilities to act and predict (by which she anticipates on her future). Her past is left in the blindspot of her process of knowing, since she is entirely focused on the acts by which she can trigger future events, and on the possibility of making her ready for these future events. In other terms, her past is dealt with meta-theoretically, whereas theoretical issues entirely pertain to her future.

But Fuchs was not entirely convinced by Howard Barnum's insistence on his option to take the agent as a primitive: "You don't like Everett's resolution because you want to have an unanalyzed primitive around, so that it can be the locus of free will. And I say: 'it is not that'" (Fuchs 2015, 573, 1041). But then, is there another motivation for free will's being so highly praised by QBists? Here it is: "The universe has within its categories two species, one is chance, and one is free will. Free will does not rely on chance as its source. Instead, it's only through the intercourse of the two that we get a real birth" (Ibid.). Free will is said to be one of the two necessary ingredients (together with chance) of the "real birth" of radically stochastic events. Therefore, assuming "real creation" or "real birth" as the most elementary building block of the quantum realm, is a sufficient reason to posit free will.

The problem is that Fuchs' analysis, in the quoted sentence, is utterly dualist, just as much as the picture of agents intervening on "physical systems". Here, we have "free will" on the side of the subject, "chance" on the side of the object, and "real birth" as a result of the interaction of both. If we wished to settle directly in the conclusions of QBism, instead of relying on its false premises, we should take "real birth" as our unique starting point, and then wonder how such starting point can be described on the two faces of an en-worlded "intra-action". This being granted, free will and chance would reduce to the shadows casted by a "real birth" on these two co-emergent faces. *And we would thus confirm the former lesson according to which it is the en-worldment itself which co-produces free will and chance, as a consequence of leaving part of what is to be predicted in that which Merleau-Ponty called the "obscurity" of the predictor.* Here, unlike in physicalist/naturalist approaches, no reduction of free will to chance is implied.

One can hear a perfectly clear adumbration of this non-dualist thesis when Fuchs writes (though reluctantly): "Chance is what you call 'it' when viewed from the outside; free will is what you call 'it' when viewed from the inside" (Fuchs 2015, 574). If "it" identifies with the neutral, or inter-facial, "real birth", the previous sentence fits reasonably well with our previous monistic reading.

The problem is that "inside" and "outside" are themselves remnants of the dualist picture, and that they irresistibly tend to be identified, respectively, with the subject's consciousness and the object of the theory (here quantum theory). Is this standard distribution of roles not misleading? Fuchs points out, in agreement with the founding principle of QBism, that "What we call quantum theory has sadly been misidentified all these years as a 'description from the outside', when in fact it is almost completely a 'description from the inside'" (Fuchs 2015, 1172). The remark is sound, but then, the very fact of maintaining the opposition of the inside and the outside despite the collapse of the traditional locus of a description "from the outside" (namely the physical theory), becomes disputable. If physical theory, this discipline that pretends to afford a

“description from the outside”, has undergone such a radical mutation that it becomes akin with a “description from the inside”, then the very outside-inside opposition lacks a proper foundation. Two major changes in vocabulary should be adopted in this situation: (1) since nothing is “described” by quantum symbols, since quantum symbols only purport to afford a rule to bet about event-like “real creations”, one should rather speak of an “anticipative orientation from the inside”; (2) No “description from the outside” being available any longer, no “inside” is available either, since “inside” is defined only in relation and opposition to “outside”. So, instead of speaking of an “anticipative orientation from the inside”, one should rather use a more neutral expression inspired from the new wave of phenomenology, such as “anticipative orientation from a situated en-worlded experience”.

This quantum configuration in which one cannot even behave *as if* a description from outside were available, completely escapes the Kantian scheme of determinism and free will. As we mentioned earlier, Kant ascribed the (classical) deterministic laws of *phenomena*, to physics working *as if* it were providing us with a picture from outside (from the standpoint of a spectator); as for free will, it pertained to the *noumena*, and to the standpoint of an actor (of an insider). A standard extension of this scheme would consist in ascribing the indeterministic laws of microscopic phenomena to quantum physics (mis)taken for a description from outside, and free will to an approach of the same processes from inside. But when the physical basis of any alleged “descriptions from the outside” is missing, when physics itself pertains to the standpoint of an actor, free will and chance become united in a single “creative” moment: a moment of intra-action within an en-experienced world. Free will and chance are just the reflective and intentional correlates of one and the same lived novelty. Free will and chance are just the right side and the reverse side of the “obscurity” zone of one and the same en-worlded experience of acting.

Conclusion

The birth of quantum mechanics has been an exceptional occasion for physics to turn its self-understanding upside-down. Unfortunately, this “Quantum revolution in philosophy” (Healey 2017) was postponed for almost one century, in favor of a multifarious attempt to maintain or restore the classical epistemological assumptions that had been initially challenged by Bohr (Osnaghi 2017), Heisenberg and even Schrödinger (Bitbol 1996b). Marking the end of this interlude, the recent onrise of QBism represents a renewed attempt to finally make sense of Bohr’s insight, by radicalizing it and pushing its tendencies to an unprecedented point of coherence:

- Founding a science in the first person that be compatible with its “as if” third-personal features.

- Founding a science entirely developed from the standpoint of the user of science, from the standpoint of the experiencer-agent, and yet accounting for the most highly regarded value of science, namely the objectivity of its rules and propositions.

This is a thrilling project, which was pursued by the founders of QBism with continuity, consistency, and a sense of responsibility towards its philosophical consequences that command admiration. But, as we pointed out in the first section of the present paper, this revolution is not entirely accomplished. The QBist attempt remains partly dependent of a pre-quantum naturalist and dualist epistemology, even though, as we saw in the second section, it defends an uncompromisingly phenomenological monist conception of the quantum symbols and of the experimental outcomes they tend to anticipate. This is why, in the last three sections of the paper, every aspect of the QBist conception of knowledge and nature has been reconsidered according to phenomenological standards. In section 3, we dissected the remnant “realist” component of QBism to isolate from it a demand that is both sufficient to address the accusation of solipsism, and still compatible with a purely first-person approach such as that of phenomenology. In section 4, we summarized the latest developments of the phenomenology of embodiment after Merleau-Ponty, and focused on its non-standard, non-objectified, concept of “world” *qua* virtual unfolding of lived experience. This analysis culminated in the mirror-like correspondence between: (i) extending embodiment to an en-worldment of experience, and (ii) bringing the world back to our experience “of it”, a move that we called “en-experiencing the world”. Finally, in section 5 we recapitulated the characteristics of en-worlded experience as stated in recent phenomenological research. We then showed that some characteristics of the en-worldment of experience remarkably fit with major QBist claims, and that enforcing other characteristics of en-worldment of experience would make QBism even more consistent with its own philosophical options. Having thus ascertained its feasibility, the task that awaits us is to take this path again in the opposite direction; it is to reformulate the whole of QBism and quantum physics on the basis of our fundamental situation as revealed by phenomenology: that of a present experience which opens on a world-like horizon of possible future experiences.

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