MAKING SENSE OF NON-SENSE IN PHYSICS: THE QUANTUM KOAN[1]

A Zen approach to the philosophy of quantum mechanics

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in : M. Cappuccio & T. Froese (eds.), *Enactive Cognition at the Edge of Sense-Making,* Palgrave Mc Millan, 2014

Summary

In scientific knowledge, meaning-ascription is usually identified with representation-making. But quantum physics challenges this view. It has consistently prevented scientists from providing a unified narrative about the world, thus making them fear falling into non-sense. Few of them have accepted restricting their attention to the apparently nonsensical surface of micro-phenomena, together with the efficient predictive formalism of quantum theory, rather than telling a tale about putative depths behind phenomena. One wonders, then, whether taking representations as a paradigm of sense-making, even in cases like quantum physics where this looks problematic, is connected to a bias of Western culture. An alternative cultural stance, that of Zen Buddhism, is found to accommodate more easily the kind of non-representational epistemology that makes sense of quantum physics.

Introduction

Quantum paradoxes can be treated as a welcome occasion to test the basic hypothesis of enaction, far beyond its usual sphere of immediate situated know-how. In order to see how this can be done, let me remind some elementary facts about the enactive paradigm. Enaction was originally presented as a middle way between realism and idealism, between the belief that the form of knowledge bears the mark imposed by a pre-structured world (that it "represents" the latter somehow), and the opposite belief that the world is nothing more than a projection of the cognitive system. At first sight, this middle way involves a coupling between subject and environment, out of which their structures co-emerge as knowledge and world. But it was clear from the outset (Varela et al. [1991] 1993, chap. 11) that such relational and dualist characterization is (paradoxically) nothing more than a tentative *representation* of the reason why one should suspend the use of the concept of a "representation of the world" in our understanding of cognition. More rigorously (and less dualistically), one may then understand enaction as a conception that treats knowledge as a transactional process of sense-making which takes place below the level of representations. This sense-making, in turn, is

[1] A former version of this article, in French, was published in Dôgen ([1231] 2007-2011). The title of this version was "La théorie quantique et la surface des choses". English translation by John Stewart.

construed as the operation of associating a procedure of adaptative action with as many classes of environmental configurations as possible. In other terms, when an organism ascribes meaning to some such configuration, this usually does not imply that it holds a picture of the deep recesses of the world, say of its minute constituants and their mutual relations. This only signifies that the organism knows what to *do* next, when it meets (or triggers) certain co-emerging patterns in its surroundings. However, the straightforward anti-representationalist and possibly anti-realist upshot of enaction has been challenged. Some authors have claimed that, notwithstanding the relevance of anti-representationalism for elementary cases of evolutionary fitness, it lacks universality (Clark 1998). The concept of representation indeed looks increasingly indispensible to account for cognitive processes when they get closer to the high level of full-blown scientific knowledge. In the latter case, meaning-ascription is identified with representation-making. As soon as this is accepted, the resistance opposed by a certain domain of investigation to the activity of representation-making can easily be taken for a case of irruption of non-sense: not being able to establish a unique and coherent picture of the field of exploration is said to entail a loss of meaning. Yet, this strong connection between representation and sense-making at advanced stages of knowledge could well turn out to be:

(1) The expression of a misunderstanding about what a representation does in scientific knowledge. Indeed, one can fail to get a (unified and faithful) representation *of* the world, without renouncing to represent parts of it *as* this or that, according to certain models (Van Fraassen 2008).

(2) A mere effect of perspective due to the fact that these foremost stages of knowledge are implicitly likened to *classical* science taken as a norm.

By contrast with it, one can easily figure out an even more advanced stage of knowledge in which: (i) the ability of providing a unified picture of the field of investigation is challenged, and retrospectively seen as a particular case adapted to our standard macroscopic *umwelt;* (ii) the reason for this collapse of coherent representations is understood from an epistemological standpoint; and (iii) despite the lack of any all-encompassing representation, an abstract mathematical structure guides our (technological) activities more efficiently than ever, possibly assisted by a set of clumsy, incomplete, ancillary pictures. In this new situation, the hierarchical ordering of (a) action-related sense-making and (b) elaborate unified representations would be put upside-down once again. Instead of construing representation as an accomplished phase of knowledge beyond mere behavioral adaptation,

one would see it as a more or less optional instrument that is sometimes used in highly advanced forms of enactive fitness. As for mathematical formalisms, they would no longer be taken for a structural image of the actual world, but rather understood as a systematic inventory of our most precise possibilities of action (along with Jean Piaget's genetic psychology or Andrew Pickering's neo-pragmatism). Now, this kind of post-classical conception of knowledge is precisely instanciated by quantum physics. In quantum physics, (i) it has soon been suspected (especially by Niels Bohr) that a fully coherent all-encompassing representation might well be out of reach. At most, one can provide a mathematical scheme that has the mental function of a "representation" without being a representation *of* the world (Schrödinger 1951, p. 40; Bitbol 1996a p. 29); (ii) the reason of this apparent limitation was soon understood to be the *contextuality* of micro-properties; and (iii) one soon realized that this was absolutely no hindrance to the efficiency of the mathematical scheme of the theory. But for nearly one century, there has been continuous struggle against those unexpected and unwanted conclusions. Many scientists felt that lacking a unified and consistent narrative about the world is tantamount to falling into non-sense. And they desperately attempted to overcome what they saw as a failure. Very few researchers tried the opposite strategy that consists in pushing Bohr's approach to its ultimate consequences, thus making sense of the apparent non-sense of the collapse of representations, and looking for a new process of sense-making below (or beyond) the level of representations. Very few of them decided to explore the apparently non-sensical surface of micro-phenomena, and to make sense of their being limited to this surface, rather than trying desperately to tell a tale about the elusive depths hidden behind phenomena. Since taking representations as a paradigm of sense-making might be connected to a bias of our Western culture, I'll confront it with a Zen Buddhist perspective. After all, the highest achievement of the Zen path might easily be understood as a recognition of global meaninglessness while making sense of it.

1-Quantum enigmas and buddhist therapy

If there is any benefit to be found in comparing quantum theory and Buddhism, microscopic physics and the Way of awakening, this benefit certainly does not consist of over-determining thought by favouring a specific thesis concerning the world and its hypothetical depths (Capra [1975] 2010)[2]. It should, on the contrary, make it possible to free

[2]This famous book contains many cases of over-determination and hasty analogies. For example: "Like the mystics, physicists are now approaching the question of non-sensory experience of reality"; "The fundamental

scientific thought from its chains of inherited forms. It should invite us to *unlearn* the habitual aim of seeking to represent some sort of "reality" hidden behind appearances; an aim which might well be illusory, and is the source of most of the quantum "paradoxes" (Bitbol 1996b, 2003, 2010). Besides, as Varela et al. ([1991] 1993) explained, Buddhism can play a considerable role in going beyond enaction as a theoretical scheme, towards a *mode of life* in which its stance about cognition becomes a matter of course. Then, in remarkable conformity with the original spirit of Buddhism, the sole relevance of a comparative approach to quantum theory and connected issues in epistemology is that conferred by its *therapeutic* power. Its task is to lend support to the philosophical endeavour which, following the teaching of Wittgenstein, does *not* aim at explaining; nor at answering questions; nor at seeking facts, putting forward conjectures, or unearthing the foundations of knowledge (Lock 1992). This endeavour aims solely at "pacifying" the compulsive drive to access the "ultimate nature of that which is" ; to treat archetypal questions of this order as so many "pathologies" or "mental cramps"; and finally to let things be "the way they are", after having learned to live (and to talk) with them as they will (Wittgenstein [1953] 1968).

One may of course ask why support of this sort is necessary. Is philosophy (in the Wittgensteinian sense) not quite capable of carrying out by itself its mission of putting to rest the metaphysical flights of imagination which sometimes guide, sometimes mislead scientific thought? Is not Buddhism, and all the more so the Zen version which is so succinct that it appears enigmatic and cryptic, after all a stranger to the constitutive dialogue between Western science and philosophy ever since their inception? This would be to forget that the work of philosophy, whether it aims at systematic construction or the critique of systems, is not solely a question of explicit intelligence. It is (or should be) the work of human persons who are not content to put forward positive assertions, but who adopt an *existential posture,* from which their major intellectual positions are often derived. Large-scale theoretical options, such as empiricism or materialism, can thus be rightly attributed to *attitudes* which are generally essentially tacit, even more so than simple presuppositions (Van Fraassen 2002). Doctrinal pontifications have time and again proven to be fashioned, unbeknown to themselves, by *ways of life*.

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unity of the universe is not only the central characteristic of mystical experience, it is also one of the most important revelations of modern physics"; "The emptiness of Eastern mystics can well be compared to the quantum field"; " (…) Physicists and mystics study different aspects of this single reality", etc.

Certainly, these forms of philosophical life cover a whole range of modes of being-in-the world, ranging from the most embodied and engaged to the most abstract and distant; but the balance between these two poles is strongly biased in favour of the second, because of a background set of distanciating and "naturalizing" values typical of our Western culture (Descola 2008). This explains in large part the obstinate resistance of many thinkers when they are faced with the radical changes in perspective which would be necessary to dissolve questions which are manifestly badly posed, and which have lead the enquiry concerning the foundations of quantum physics into an impasse. Indeed, these changes in perspective would amount precisely to a reinvestment of what is concrete and manifest in the daily practice of laboratory life (and therefore easily accounted for by the enactive paradigm of sensori-motor sense-making), after a long interlude during which the audacious productions of an intelligence bent on world-building held sway. It is this same cultural preference which explains why the critical and therapeutic strategies of a few philosophers have overwhelmingly met with reactions of rejection (or proposals to "supersede" them) from their own community. An illustration of this is provided by the severely negative reactions of Russell and Popper against Wittgenstein's "second philosophy" (Lock 1992). By contrast, a current of thought such as Zen – which is an open invitation to work on the embodiment of gestures and conducts (Herrigel [1948] 1993), which issues from the very practice of sobering up conceptually and of "letting things be", which has no aim other than being an accessory to a radical lightening of the existential load – offers the possibility of a profound change in the subsoil of unconscious taken-for-granted attitudes on which philosophical endeavours are built. The scale of priorities risks being turned upside-down; the critical and therapeutical branch of philosophy may gain a new legitimacy from its synergy with a mode of being which accomplishes it in practice; and the quest to dissolve a certain number of (false) problems in quantum physics may be strengthened by leaning on a programme of philosophical treatment.

2-Some quantum paradoxes: a deflationary approach

It will now suffice to show, by several case-studies, how this new synergy actually works in practice; we will find that the majority of the "weird paradoxes" of quantum physics dissolve away and no longer appear "weird", once we have untied the knot of cultural prejudices which held them excessively tight.

There is a premise which conditions all these case-studies. It concerns the evaluation of the epistemological status of quantum theories. What *are* these theories, what do they

succeed in doing, and what do we have a right to ask of them? Do they offer an *explanation*, or at least a description unequalled in its precision, of subatomic processes? Have they made it possible to elucidate the *intimate mechanisms* of chemical phenomena and nuclear transformations? Have they penetrated further into the fundamental nature of things than classical theories, such as the mechanics of Galileo and Newton, thermodynamics or electromagnetism, have ever managed to do before? The great misunderstanding which runs through the debates on quantum physics stems from the fact that most of the time it is thought that this is the way things *must be:* that the three questions listed above *must* be construed as so many positive assertions. The belief of Western science in a *telos* here claims its due. However, once one accepts that, a whole cascade of disturbing conclusions burst forth. The world which is supposedly "revealed" by quantum mechanics has an appearance as unexpected and ludicrous as Alice's Wonderland recounted by Lewis Carroll. And in this case it would seem that all that can be done is to accept the weirdness.

As is well known, one of the first surprises is the wave-particle duality, this strange association between extension and point localization, between continuity and discontinuity, which is supposed to describe the "nature" of the new entities that are sometimes called "quantons" (Lévy-Leblond & Balibar 1984). Einstein, the first scientist to have imagined entities of this sort (concerning electromagnetic radiation), was unable to hide his perplexity on this subject: "Is it possible to reconcile the quanta of energy on one hand, and the Huygens principle on the other? Appearances go against it, but God seems to have found the trick of it" (Einstein [1911] 1989). It may be added that although our spontaneous intuition cannot digest this amalgam between the discontinuous and the continuous, between quanta and the "Huygens principle" for wave interference, we ourselves seem to have found a "trick" which has the reputation of being able to combine them and thus to "enter into the mind of God". The mathematical formalism of Hilbert does indeed make it possible to establish a connection both with a continuous geometry (by means of the concept of the spatial amplitude of a probability or a "wave function"), and with an algebra of discontinuity (by means of the scheme of quantization). But does this formal derivation really suffice to reconcile the two contradictory concepts, or does it just amount to reject them both (setting them back-to-back) and substitute something quite different in their place?

A second surprising finding is the problem of measurement. A famous way of telling the story so as to bring out its dramatic implications is the paradox of Schrödinger's cat (Schrödinger [1935] 1983). The most succinct account of this paradox plays on the

contradiction between the state of the cat as *described* and as *concretely occurring*. Quantum mechanics (so it is said) describes the cat subjected to Schrödinger's infernal machine[3] as being in a *superposed state* of being both alive *and* dead. However in actual practice it is found that the cat is found to be *either* alive *or* dead. Here, the (supposed) quantum description of the cat does not accord with what one sees of it. Dozens of solutions have been proposed to get around this difficulty. One of them consists of taking the quantum "description" literally, and to suppose that each of the two terms in the superposition represents a separate "possible world": in one of these worlds the cat really is alive (and the inhabitants of this world see the cat alive), and in the other world the cat is dead (and the inhabitants find it dead). However the way out that is currently dominant (called "decoherence") amounts to refusing to confront the problem according to the standard formulation, and to change the formulation in a way that is so subtle that many scientists are unaware of the sleight of hand: instead of a problem of compatibility between conjunction and disjunction, between a plurality of possibilities and the uniqueness of what actually exists, the problem that is resolved is a problem of connection between two forms of the calculation of probabilities (Lyre 1999, Bitbol 2009).

A third disturbing finding was formulated for the first time by Einstein, Podolsky and Rosen ([1935] 1983). Even though the aim of these authors was to demonstrate the "incompleteness" of quantum mechanics (its incapacity to describe all the "elements of reality" attached to physical systems), what posterity has retained from their reflections is quite different (d'Espagnat 1994). The enigma which remains bears on the explanation of the strange "EPR correlations" predicted by the "entangled states" of quantum mechanics. How is one to understand the strict correlation between the values of observables measured on pairs of particles which were initially in contact but which are now situated at arbitrarily large distances from each other? Briefly, the only two explanatory frameworks which are plausible are (a) common causes and (b) reciprocal causal influence. But one and the other of these two explanatory possibilities encounters insurmountable obstacles in quantum physics. Considering that the origin of the correlations lies in common causes amounts to asserting that they are inscribed in the *properties* of the particles, and that these properties were fixed ever since the initial moment when the particles were contiguous. However this option (called

[3] This (imaginary) machine comprises a fragment of radioactive matter having one chance in two of disintegrating over the time of one hour, and a flask of poison which is released when the disintegration occurs. If the poison is released, it kills the cat.

local hidden variables) is excluded by Bell's theorem (Bell 1987)[4]. The other hypothesis, that of reciprocal causal influences with an arbitrarily large speed (including larger than the speed of light) has indeed been modeled and tested experimentally in recent years (Suarez 2000); but it has been refuted and must therefore be rejected in its turn. How is it possible to extricate oneself from this impasse? Two extreme options remain available. On the basis of the presupposition of « scientific realism » (according to which quantum theory describes the properties of things as they really are, including their inseparability), the only way out is to adopt an *ontological holism*. According to this doctrine, space and time are only emergent deployments of an "implicate order" (Bohm 1984) which is pre-spatial and pre-temporal; and the two distant particles are in truth distinct manifestations of one and the same universal entity. Their correlation no longer has to be explained by any sort of *transmission*, from the past to the present or from a present here to a present over there, but simply by a statement of *identity*. At the opposite extreme, according to the most radical of the *anti*-realist options, there is simply no need to "explain" an instantaneous correlation at a distance, for the good and simple reason that the latter has no intrinsic existence. The correlation only ever sees the day *relatively* to mechanical and electro-magnetic devices apt to "provide evidence for it". Now, that can only come about when the information concerning one of the correlated properties has had a sufficient time (at least the time that would be taken by a light signal) to rejoin the region of space where the information concerning the other property is available (Smerlak & Rovelli 2007, Bitbol 1983). No "non-local influence" need be invoked in this case.

The fourth disturbing finding covers in fact a whole network of clues that point towards a conception of physical theory that is non-descriptive and non-representational, but rather purely predictive and informational (Bruckner & Zeilinger 2009). A large number of experiments (some of which have actually been carried out, others which are pure thought-experiments) make it pretty much unthinkable that one could describe processes which are supposed to have happened before the actual act of their detection or observation; and this forces one to trust only the information drawn from such an act by basing oneself on previous knowledge of the configuration of the experimental set-up as a whole. I will mention just two of these experiments: "measurements without interaction", and "delayed-choice experiments" (Skully & Drühl 1982, Elitzur et al. 2003). In the first sort of experiment, information derived

[4] Bell's theorem establishes the incompatibility of quantum mechanics with certain inequalities (the Bell inequalities) which inevitably result from theories with local hidden variables.

from an *absence* of interaction between the object and an intermediate part of the instrument have exactly the same consequences as those that would result from their actual interaction (Elitzur & Vaidman 1993). That is enough to make one think that what counts in a quantum experiment is not the detail of the hypothetical processes which may be supposed to occur between the preparation and the final detection, but rather the informational content that the whole structure of the apparatus confers on the event of detection. Indeed, in some spectacular experiments with "delayed choice", the object interacts with an elementary measuring agent (for example a photon), but its so-called "state" depends on decisions that can be made millions of years later concerning the arrangement of the device which makes it possible to collect the photon. Unless one imagines that certain influences can go backwards in time (as certain physicists have been led to propose (Wheeler 1978)), it must be recognized that what may be carelessly called "the state of an object" expresses nothing other than the information made available by the observational apparatus which gives access to it *after* the moment when all the decisions concerning the apparatus have been taken.

3-Looking for hidden meaning or confronting non-sense?

Each of these paradoxical situations can lead one (and many physicists have not hesitated to take the step) to consider that there is something quite extraordinary in the occult nooks and crannies of the world; something that quantum descriptions give an oblique glimpse of, but that neither our language nor our imagination can properly grasp, and that only mathematics makes it possible to circumscribe. Nevertheless, the very same situations can also be interpreted in a diametrically opposite fashion, as we have hinted at during our presentation of them. Once they are reconsidered in the most intellectually economical fashion, all these supposed "paradoxes" converge towards the possibility that quantum theory is nothing more than an ingenious but purely formal way of anticipating experimental information; that it does not offer an incomplete and cryptic revelation of an invisible and ineffable reality, but only a method for orienting oneself with respect to that which shows itself and is said; that instead of penetrating further into the recondite depths of matter than any previous theories have managed to do, quantum mechanics is rather a systematic inventory of its *surface*. For every one of these "paradoxes", without exception, can be immediately *dissolved* (in the absence of the means and above all of any real motivation for *resolving* them) as soon as one renounces the application to quantum mechanics of the descriptive, representationalist, "realist" conception of physical theories. Accepting the "non-

sense" of the collapse of representations here allows to make better sense of a physical theory. Let us take up again the first two "paradoxes", bringing out the sketch of a dissolution which has already been suggested. The dissolution of the latter two paradoxes has already been sufficiently indicated.

Assigning a double nature, as wave and as particle, to the objects called "quantons" is a biased, over-determined and prejudiced way of expressing a phenomenon which does not *a priori* impose *either* an ontology of waves *or* an ontology of particles. The phenomenon in question is the distribution of a large number of punctual events according to a pattern which is isomorphic to that which *would be produced* by the interference of two waves or the diffraction of a single plane wave passing through a hole. Bohr himself already criticized treating this sort of phenomenon in ontological terms when he replaced the assertion of a wave-particle *duality* by that of a *complementarity of the images* of a wave and a particle. Each image is only relevant, according to Bohr, with respect to a particular experimental context; and the contexts which render these two images appropriate are partially exclusive of each other. But that is not all. It can be shown in a quite general way that any theory capable of accounting for phenomena concerning mutually exclusive contexts, predicts distributions which will have a wave-like *appearance* (Destouches-Février 1951); i.e. distributions where everything happens *as though* we are dealing with waves even though there are no waves at all. In other words, far from manifesting the *absolute* wave-like properties of microscopic entities, the interference behaviour of quantum phenomena could be the eloquent sign of their epistemic *relativity;* far from bearing witness to the deep nature of things, the pseudo-wavelike effects could well represent one of the most salient marks of the *superficial, interfacial* character of the phenomena that quantum mechanics makes it possible to anticipate.

The case of the paradox of Schrödinger's cat can be dealt with in even more summary fashion, if only one accepts once again to follow the lead given by Bohr. The apparent contradiction here derives from the repeated use of the term "state", which actually has two quite different meanings. The superposed quantum "state" of the cat does not fit with the "state" that is manifest and observable. This apparent conflict disappears as soon as we recognize that the quantum "state", far from indicating what the cat actually *is,* only makes it possible to estimate the chances one has of *seeing it* in a certain way; that far from corresponding to a "state" in the full and proper sense of the term, the quantum "state" vector is nothing other than a symbolic instrument making it possible to evaluate the *probability* of

finding the cat in one or other of its two biological states. Indeed, no-one has ever required that a probabilistic evaluation should reveal in advance the actual outcome (in the full and proper sense of the term) of the event in question; in the same way, no-one should hope to reveal or to engender the actual observed state of the cat merely on the basis of the quantum probabilities. The only non-conventional aspect of quantum theory is the peculiar (non-additive and interferential) structure of its calculation of probabilities, which is quite different from the classical calculation, because it is adapted to the contextuality of microscopic phenomena (Bitbol 1998). The only remaining problem thus consists of linking up (at least approximately) this non-classical structure of probabilities with the classical additive structure which is valid for the mutually exclusive events observed in the laboratory. This problem is solved, as we have already indicated, by the theories of decoherence.

4-Relaxing the struggle for sense-making: a strategy to make sense of quantum theory

If we wish to express the lesson of these reflections in a deliberately provocative way, we might remark that quantum mechanics is better understood, and in a way that avoids posing logically insoluble problems, by admitting that it reveals *rigorously nothing* about the alleged intimate nature of its objects. After all, if quantum mechanics is considered as a generalized process of evaluating probabilities, there is no more reason for it to reveal the nature of its objects than the classical theory of probabilities has of revealing the nature of objects to which it is commonly applied such as dice, of roulette tables, of fluctuations in the financial market, or the clients of an insurance company. Just like the theory of probabilities, quantum mechanics is grafted onto the outside layer of events that it aims at anticipating – without penetrating into a hypothetical "interior". Even more than the theory of probabilities, quantum mechanics rests on the surface of things, because what it anticipates are not even actual events that will come about by themselves, but merely *potential* phenomena which require a particular experimental setup in order to occur (Bohr wrote that these phenomena are *defined* by such an experimental setup). And that is not yet all. Not only does quantum theory reveal no intimate nature of things beyond the phenomena, but its success and its fruitfulness are easily explained by the fact that it incorporates in its very structure the *limits* to the exploration of phenomena. Its success and its fruitfulness come from the fact that it does not even allow any *meaning* to the belief that there might be something deeper to understand behind the superficial screen which is its own domain of validity. Heisenberg's

indeterminacy relations can thus be considered as the expression of a limit to any possible knowledge of the dynamic variables of elementary particles. But these relations are at the same time a powerful tool of theoretical exploration which has made it possible to predict, among other things, the bandwidth of rays of electromagnetic emission, the life-time of radioactive nuclei, and a number of striking effects of quantum field theory (such as virtual particles, the Casimir forces, etc.). Here, the limit to knowledge is not a matter of a provisional obstacle, but determines the very form of what is to be known. Relaxing the usual struggle towards representational sense-making turns out to be a good strategy to make sense of the efficiency of quantum mechanics.

Indeed, not only is quantum mechanics the superficial prediction of superficial phenomena, but its redoubling of superficiality is what accounts for its remarkable vocation for *universality*. If quantum theory is above all a general procedure for anticipating on a probabilistic mode the replies to experimental solicitations, or more precisely for anticipating replies which correspond to the type and the *order* of these solicitations, then it ought to be generally applicable to *any domain whatever* that is solicited. Now this does indeed turn out to be the case, which reinforces the initial "deflationist" interpretations. The recent generalization of quantum theory, which is applicable to many domains in the human sciences (Bruza et al. 2009a, Bitbol 2009) running from decision theory to semantics by way of the psychology of perception, is a remarkable illustration of this. It does not matter who or what *responds* (human beings or things), the probabilistic structure of the responses is the same. From this restricted point of view, a set of human beings making choices which depend on the options which are presented to them, and on the order of the decisions to be taken, behave exactly like a set of electrons on which one evaluates several incompatible observables (Zwirn 2009). A set of speakers who have to decide on the meaning of a polysemic word, according to the propositional contexts, thus behaves exactly like a set of microscopic particles which violate the Bell inequalities (Bruza et al. 2009b). There is nothing shocking about the fact that it should be so, and implies strictly nothing about any community at the level of their *profound being* between electrons and humans; there is only a formal isomorphism in their situation and their "surface" reactions to being solicited.

To recapitulate, the conception of quantum mechanics as being doubly "superficial" (both superficially phenomenal and superficially probabilistic) makes it possible to dissolve away what are alleged to be the major paradoxes of this theory; to explain a large part of its effectiveness; and to promote its universality. As if this were not enough, one can add that this

conception also maintains a remarkable degree of notional and mathematical simplicity, which contrast strongly with the ever-increasing sophistication of those ideas which aim at saving a "realist" interpretation of quantum physics. Why, under these conditions, is this conception not more widely accepted? Why does it so often find itself opposed by the indignant reactions of certain physicists who reproach it with "betraying the ideal of science", of "breaking the great dream of knowledge" (Stengers 1997), of being unacceptable or even "scandalous" (Thom 1993)? Why, even when indignation is absent, does the exposition of the minimalist conception of quantum theory give rise to a resigned silence which manifestly expresses a profound disappointment? There is no doubt that it is because, as we have felt it coming since our introduction, we are dealing with a breach of several contracts at the level of a whole civilization. One of these is a fairly recent contract which, from the sixteenth century onwards, has instigated a collusion between the desire for a metaphysical breakthrough upheld by the clerks, and the need for technological perfectionism of the craftsmen (Scheler 1993) . Another is a very ancient contract which has made it an obligation to seek a principle of understanding appearances in the inmost depths of things (Schrödinger 1954). If scientific progress does not help our gaze to penetrate to the very heart of material bodies, and to *definitively guarantee* technological effectiveness by laying bare their secret, what is the point of it? If the progress of knowledge amounts merely to a kaleidoscopic deployment of the phenomenal skin of things, instead of opening up a vision of their very flesh and marrow, does it not seem in vain? It is all very well to recall that all the entities which, in the history of science, were pompously dignified at the time by the title of "realities behind appearances" have turned out to be themselves a matter of : (1) *other* appearances (or phenomena) revealed by a new approach, postponing the revelation of what Goethe called the "Urphänomen" (Seamon & Zajonc 1998) to an indefinitely remote utopia; or (2) mathematical idealities which express some invariants of the phenomena reconstructed by the intelligence. This simple reminder is not enough. The "dream of reason" pursues its course; this same dream that Kant upheld at the beginning of his quest, before discarding it in his critical philosophy: the dream of managing to grasp by thought a "representation of things *as they are*" (Kant [1770] 2004).

The fact that this dream survives in spite of the obstacles, that it seems deaf to everything which can sap its foundations (in particular in the field of quantum physics), confirms the suspicion we have already formulated: we are not dealing here with intellectual convictions based on solid rational argument, but rather with civilisational postures which

have been internalized at a level below common consciousness. Other postures, which would doubtless have been discouraging at the origin of the modern natural sciences, may not only prove to be more fruitful at a later stage of their development, but also, more widely, favour new syntheses between the search for the "good life" and that for knowledge. Such alternative postures would substitute confident receptivity for "tense interest" (which according to Husserl is what intentionality consists of); they would substitute an ethics of knowing how-to-do and how-to-be, for the exclusive value of objective knowledge; they would substitute the willingness to let things deploy themselves, in place of the gestures of grasping and holding fast. They would have as a consequence the acceptance, or indeed the recognition as a saving grace, of the omnipresence of appearance and the cascading deployment of the surface of phenomena.

5-The Zen model: relaxation of sense-making as a way of life

Dôgen, the foremost thinker of Sôtô Zen, offers a particularly pure example of this alternative posture. His writings can be construed as a long hymn to the *process of appearing* and its realization. A fluctuating process of appearing which calls out to be recognized as *what there is*, instead of serving as a mere pretext for going beyond it towards the unity of sense-making and the supposed constancy of ultimate being. A process of appearing which in a certain sense remains unperceived, unexpressed, unfathomed (Dôgen [1231] 2007-2011); and this not because it is inaccessible, but because it is falsely taken as a simple means of access to something else, and because of that it is ignored and ran across in the direction of that "other" which is forever beyond reach. A process of appearing which we often despise as being a simple illusion, but whose neglect only results in what is even more certainly an illusion: that of grasping its foundation by passing through it. "This whole universe, writes Dôgen, has nothing hidden (behind the phenomenon)" (Dôgen [1231] 2007-2011). The immanent phenomena have no transcendent meaning. What actually results in a dissimulation, is the belief that there is something *concealed* and, moved by this belief, an inability to stay in place. For it is by going to look elsewhere, by always-already transporting oneself towards another place than right here, that one unwittingly masks the actual exhibition of things. Whereas it is only in this place, in this "here", that things show themselves for what they are: as a process of appearing; as a "reflection" of nothing other than a reflection; as a picture of a picture; as an "as if" (Orimo 2007a). Taking the process of appearing as a disguise amounts to disguise it and to becoming blind to it. Conversely, accepting phenomena as such, with no

judgment about their being superficial appearances of something else, realizes the essence of Zen as described by e.g. D.T. Suzuki ([1940] 1996).

A contrario, what is to be understood is that it is necessary to undertake a long labour, studded with practitionings and fractures of language and concept, to regain a sensitivity to the process of appearing, to make it again our habitat and our element. Once this labour is accomplished, the very word "appearing" becomes useless, out of place, because it still carries with it the very opposition (being versus appearing) from which one is seeking to free oneself. Instead of that, it is suggested that we employ a more neutral vocabulary: the "just as it is" (*nyoze* in Japanese) (Orimo 2007b), or the "thusness" (*tathatâ* in Sanskrit). Thusness is plainly "thus", in peace and globally meaningless. This vocabulary says nothing, because saying is still meaning something, and meaning something is transporting before and beyond. Instead of pro-jecting, this vocabulary reassembles and gathers in the attention, and then deposits it gently at the point of equilibrium of the presence. This vocabulary knows how to efface itself by means of its own insignificance, in order to allow for the budding of a moment which gathers everything into itself, trembling and unstable as the flame in the breath of time. The phrases can then make light of the dualities which erstwhile seemed eternally solidified: form and content, appearance and reality, the reflection and the thing. "Their aspect *as such* is their nature such as it can be known in the end" (Dôgen [1231] 2007-2011). The form *is* the content, the appearance *is* the reality, the reflection *is* the thing just as the thing *is* reflection. The "so it is" is what there is to be known *in depth* (Dôgen [1231] 2007-2011), before one lets oneself be captivated by the lure of "the depth of things", and thereby rendered a stranger to the presence as it is.

6-Applying the Zen model to appease the quantum demand for representational sense-making

Can one imagine a disposition of mind more favourable to a sober and precise interpretation of quantum mechanics? It is indeed only by freeing oneself from the transgressive representationalist impulsions, i.e. the imperative of scientific realism, that one can at last see this theory for what it is in its daily functioning: a deep knowledge of the surface of things, an optimally coherent systematization of the procedures for anticipating appearances, a grammar of experimental information, a historical success of the Kantian strategy which consists of putting to rest one's metaphysical instincts in order to attain the necessary rules which anticipate the mutual connection of phenomena. It is an optimal

approach for making sense of non-sense, rather than a failed attempt at improving representational sense-making.

The whole atmosphere of Dôgenian awakening gives breathing space to epistemological thought, opens up pathways which seemed inaccessible, makes its lines of resistance crumble away, discreetly suggests possibilities which up until then had been discarded. Once brought home to the country of *thusness*, epistemology is delivered from its inherited rigidities and points of reference, and it discovers lines of reflection which have been not so much unknown as repressed by its history. "This vast sea, writes Dôgen, is neither round nor square (…). It is only there where my eye reaches that it appears round for the moment" (Dôgen [1231] 2007-2011). Through the lens of this remark, it is the whole theme of the relativity of phenomena, of their emergence on the occasion of an encounter with an informed vision or a pre-arranged apparatus, which is delivered from skeptical regret and invested with the value of lucidity which governs the practice of Zen. And it is the whole equilibrium of philosophical positions, those which are marginal as well as those which are dominant, the vanquished and the victors, which is decisively shifted to the benefit of a climate which favours a renewed understanding of this theory which has the reputation of being incomprehensible: quantum mechanics. Indeed, understanding or (with its latin root) *comprehension* consists of taking with, taking with us, recognizing as our own. How can we fully assimilate quantum mechanics into our familiar set of bearings if we have not changed what is familiar to the point of integrating in it the delicate shiftings on the surface of things?

Conversely, some of the most singular quantum concepts seem able not only to shed light, but also to formalize (by means of the generalized quantum theory) the state of mind or the way of being-in-the-world that renders them acceptable. Consider that a state of mind which is fully receptive to *thusness* is "a-categorical"; that it falls short of categories which discriminate and separate, which force an appearance to *mean* something and thereby distract attention towards the future rather than holding it firmly in the bath of presence. In the generalized quantum theory, the a-categorical state can be formalized by the superposition of state-vectors, or by state vectors which have not yet been decomposed according to the vector-base of any observable whatsoever. This way of formalizing a state of mind is not just a simple analogy without any repercussions, but a veritable tool for prediction which has been applied with success to psycho-physiological situations such as perceptual bi-stability (Atmanspacher & Fach 2005).

Conclusion

Thus we can witness the installation of the synergy we announced, the two-way enrichment between a way of being which values a floating in *thusness*, an acceptance of representational non-sense, and a pure physics of the phenomenon; between a way which frees us from the "haunting of meaning (*telos*)" (Orimo 2007a) and a scientific theory which blocks all flights of fancy towards the further reaches of elsewhere. The application of quantum theory to context-dependent human decisions does not require any sort of community in the *nature* of electrons and human beings. In the same way, this synergy between a "Zen-attitude" and quantum epistemology does not suppose the least identity – in terms of historical objectives and domains of validity – between the experience of awakening and laboratory practice. All that it requires is to take due account of what an act of research owes to the value-systems to which the seeker after truth is predisposed, to his cultural restrictions and his acquired openings.

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