Science as if situation mattered[1]

Michel Bitbol
CREA/CNRS, 1, rue Descartes, 75005 Paris FRANCE

Phenomenology and the Cognitive Science, 1, 181-224, 2002

Abstract: When he formulated the program of *Neurophenomenology*, Francisco Varela suggested a balanced methodological *dissolution* of the " hard problem " of the philosophy of mind. I show that his dissolution is a paradigm which imposes itself onto seemingly opposite views, including materialist approaches. I also point out that Varela's revolutionary epistemological ideas are gaining wider acceptance as a side effect of a recent controversy between hermeneutists and eliminativists. Finally, I emphasize a structural parallel between the science of consciousness and the distinctive features of quantum mechanics. This parallel, together with the former convergences, point towards the common origin of the main puzzles of both quantum mechanics and the philosophy of mind: neglect of the constitutive blindspot of objective knowledge.

Introduction

A few years ago, Francisco Varela published a ground-braking paper entitled " A science of consciousness as if experience mattered " (Varela, 1998), which provided a striking abstract of the new disciplin he had called " Neurophenomenology " (Varela, 1996, 1997). There, he advocated an original (dis)solution of the " hard problem " of consciousness which involved a consistently *methodological* approach rather than one more theoretical view.

The basis of his approach was the remark according to which any third person, objective, description, arises as an invariant focus for a community of embodied, situated, subjects endowed with conscious experience in the first place. This remark is usually either overlooked (by those philosophers who think invariance is only our way to *discover* a reality behind the " superficial " situated appearances), or overrated (by those philosophers who use it as a weapon against any claim of knowledge). The two former attitudes yield a systematical bias towards conscious experience.

Overlooking the effective primacy of situatedness, which is a common trend in our culture, leads to downplaying the status of

1 This paper is in memory of Francisco Varela, who first came at the center of my thought, and then at the center of my friendship.

consciousness. If one accepts that conscious experience is but a parochial path (*our* path) towards an intrinsically objective reality of which we partake, then it is likely to be either completely dismissed (strong eliminativism), or reduced to a field of description which is easy to objectify (physicalist reductionism), or treated as an objective entity in its own right (substance or property dualism). Conversely, overrating the fact that third-person accounts are produced by (communities of) sentient subjects located in a network of natural and social links, usually means indulging in skepticism, relativism, or subjective idealism.

But Francisco Varela did not overlook or overrate the primacy of situatedness (embodiment) in some abstract theory of the mind-body relation. He took it as a natural starting point for defining an appropriate *strategy of research.*

His central idea was that in the science of consciousness, one should neither try to absorb the subjective into a previously defined objective domain, nor objectivize somehow the subjective, nor give the subjective any kind of supremacy over the objective. One should rather go back to the experiential realm from which the very dichotomy between subjectivity and objectivity arises, and then establish *within it* a system of *mutual constraints.* In actual fact, mutual constraints are enforced between first person statements of phenomenal *contents,* and third person descriptions of those phenomenal *invariants* that are established by the collectively elaborated neurosciences.

This strategic choice has two important consequences : a practical one and an epistemological one.

The practical consequence is that careful elaboration of first person statements is given exactly the same importance as the elaboration of third person statements. After all, a proper mutual constraint can only be set on a firm basis if both sides are equally mastered. On the first person side, this requires a phenomenological-like disciplined attention which has to be learned like any other skill. As a preliminary, one must become fluent with the process of *phenomenological reduction*. This avoids the usual pitfalls of introspection, by promoting intimacy rather than distance with experience.

The epistemological consequence is that, in order to encompass consciousness, science as a whole is no longer restricted to describing structures that are invariant across a more or less extended range of (spatio-temporal, personal, cultural etc.) situations. Its methodological ground is stretched so as to include: (i) regulated mutual relations between situated accounts, and (ii) relations between situated accounts on the one side and their own invariants on the other side. Intersubjectivity complements

objectivity *stricto sensu* and is systematically related to it.

Now, one may wonder how this (dis)solves the " hard problem " of the philosophy of mind. In a nutshell, the " hard problem " consists in finding a place for conscious experience within nature as it is supposedly described by our best scientific theories. But as D. Chalmers (Chalmers, 1995, 1996, 1997), after many other authors (Nagel, 1986; Jackson, 1997; Searle, 1997), pointed out, scientific theories can only yield derivation of structures from structural axioms. They can do nothing to explain non-structural qualitative features of experience, let alone to justify the mere *existence* of experience. In other terms, they enable us to predict *relations* between phenomena[2], yet have nothing to say about the brute fact of phenomenality, which is more likely to be taken as " absolute " than anything else (Blackburn, 1993).

Varela defuses this dilemma by proposing nothing less than a radical redefinition of science, of nature, and of naturalization. As long as science is restricted to describing trans-situational invariants, as long as nature is construed as a collection of such invariants taken as objects and laws, and as long as naturalizing consciousness means either projecting it onto the plane of these natural objects or inventing for it a new class of objects, the " hard problem " remains stubbornly unfathomable. But if science is extended so as to include a " dance " of mutual definition taking place between first-person and third-person accounts (Varela, 1998, p. 42) ; if nature is made of views and situated experiences as well as of their manifold invariants[3] ; and if, accordingly, *naturalizing consciousness means including its disciplined contents within a strongly interconnected network of objects and experiences,* then any problem has disappeared.

In some sense the " hard problem " is solved by this approach because consciousness has been straightforwardly naturalized ; and in another, more plausible, sense, it is only *dissolved* because its motivation has been shown to be ill-founded from the outset. In agreement with the second interpretation, Varela insisted that in the usual formulation of the problem of consciousness, " (...) what is missing is not the coherent nature of the explanation but its alienation from human life " (Varela, 1998, p. 41). His attempt therefore amounted to a systematic reintegration of human life (namely embodied experience) in the framework of the discussion.

The main difficulty at this point is that, like any other dissolution, this

2 One must be cautious about the term " phenomenon ". It can either be synonymous of " isolated experience of perception ", or point towards the more sophisticated concept of an *experimental* phenomenon. But since experimental phenomena may in turn be construed as low-level invariants of perceptions under well-defined technical conditions, one can skip temporarily the distinction for the sake of this argument.

3 These may include the experiential invariants of phenomenology, and the universal structural invariants which are typical of the natural sciences as well.

one is convincing only to those who accept to be “ converted ” to a proper reformulation of the problem and/or to the associated alternative philosophy of science. Many thinkers nowadays strongly resist this “ conversion ”. They still prefer to reassert a sense of mystery about the emergence of conscious experience from matter (Searle, 1997), or to declare that present science has already an explanation in store, e.g. in some exotic interpretation of quantum mechanics (Penrose 1994; Stapp, 1996), or to express their faith in some future, but unforeseeable, scientific advance that will dispel the riddle.

Facing this deep-lying collective resistance, Varela essentially adopted a scientist’s attitude. He wished to convince his peers by demonstrating that the research program of neurophenomenology is “ progressive ” in Lakatos’ acceptation (Lakatos, 1978) ; namely that it produces new and unexpected results which are empirically testable and which give rise to technical or medical applications. Some of his most recent work on the phenomenology of time perception (Varela, 1999), on epilepsy (Le Van Quyen et al., 1999), on large-scale integration in the brain (Varela et al., 2001), and on the two-way causal relations between conscious experience and bodily features (Varela, 2000; Thompson & Varela, 2001, 2002), was precisely aimed at that.

As a philosopher, my task is rather to provide the readers of this paper with a sense of rational inevitability. Varela’s dissolution is not only *one* possible way out among many others; it is a paradigm which tends to creep into several other (apparently opposite) views in the philosophy of mind, and which is moreover in remarkable agreement with the present state of the debate in general philosophy of science and in philosophy of physics. To display this, I will proceed in three steps. Firstly, I will show that many of the most promising and/or popular conceptions in the philosophy of mind willy-nilly converge towards Varela’s dissolution of the “ hard problem ”. Secondly, I will point out that Varela’s far-reaching epistemological move is gaining wider and wider acceptance, as a side effect of the controversy between eliminativists and hermeneutists on the issue of folk-psychology. Thirdly, I will emphasize the fact that physics, which is usually considered the prototype of an exclusively objective science, actually involves a thoroughgoing dialectic between invariants and situations ; between the objectified structures and a network of situated (actual or potential) subjects. Failure to aknowledge this triggered many of the so-called “ paradoxes ” of quantum mechanics. Conversely, full recognition of this dialectical mode of functioning will result in a comprehensive parallel (though by no means a mere identification) between the problems of quantum physics and the problems of the

philosophy of mind. Such a convergence should enable us to set the basis for a generalized *science in which situation matters*, beyond Varela's *science of consciousness in which experience matters*.

1-A network of first-person expressions and third-person accounts

It was already observed by F. Varela that his neurophenomenology has many features in common with several other recent approaches.

One such similarity concerns the basic idea of non-reductive mutual articulation of first person and third person accounts. In O. Flannagan's method of " triangulation " (Flannagan, 1992), for instance, both the subjective perspective and the objective perspective focus towards a supposedly unique (mental) process, rather than claiming any priority on one another. And in M. Velmans' " reflexive model of perception ", first-person and third-person accounts of located perceptions are mutually related, without any temptation to project phenomenology onto a physical level of description (Velmans, 1998).

A major difference, however, is that unlike these two authors, Varela deliberately tackled the problem of how to raise first person accounts to a level of faithfulness which could sustain comparison with scientific objective accounts. After all, no one would trust scientific experiments performed with unstable instruments (Wallace, 2000; Wilber, 1997). One should not trust detailed first-person accounts either, if they arise from a poorly stabilized mind. In good agreement with such a methodological option, N. Depraz (Depraz, 1999; Depraz et al., 2002)) developed the ambitious project of a disciplined " hyperesthetic phenomenology " in which noticeable neurological events could be ascribed an appropriately refined experiential counterpart, even when they do not cross the threshold of *ordinary* conscious awareness. As for B. A. Wallace (Wallace, 2000, pp. 81-82), he based a (dis)solution of the " hard problem " on this background methodology of stabilized experience. According to him, the concomitance that can be established *systematically* between (suitably refined) first person reports and some third person neurological accounts is tantamount to a causal relation in the weak sense of strict *reciprocal interdependence* ; one should aknowledge this, rather than longing for a stronger causal link construed lopsidedly as a one-way " mechanism " leading from a permanent neural " basis " to some fleeting ordinary conscious appearances. This subtle move suggests that choosing the right *level* of neuro-experiential comparison is the point that makes the real difference. As long as coarsely characterized first-person reports are compared to detailed microscopical third-person neurological analysis, it is natural to

endow the latter with a priviledged status and to claim that experience supervenes on a neurophysiological layer. But if first person reports are sufficiently refined, and if moreover they are compared to appropriate large-scale neural processes, then the matching may become so remarkable that the two types of reports are likely to be put on the same footing within a scheme of reciprocity. In such circumstances, if one is to avoid a flat restatement of the Identity Theory (see discussion below), the neurophenomenological approach is inescapable.

Another convergence with neurophenomenology revolves around the broadened conception of nature that is implied by it. D. Chalmers advocated the idea that the basic furniture of the world (its ontology) should be expanded in order to include experience as a new fundamental " property " (Chalmers, 1995). New laws should accordingly be enabled to rule the relationship between these recently accepted features and the former physical features of the world. Similarly, in a very Meinongian style, D.W. Smith (Smith, 1999) proposed to expand the list of Aristotelian categories. He first divided the domain of categories into formal and material, and then supplemented each domain with mentalistic categories. The original formal categories of substance, quality, relation etc. were thus reinforced by him with intentionality, experience, content etc. *Pace* Ockham, the entities of nature were voluntarily multiplied.

Here again, however, there are important differences between proposals of this kind and Varela's standpoint, even though they share commitment to a *fundamental status of mind* at its most elementary experiential level[4]. The main difference bears on the specific position of experience in the system of knowledge, which is fully aknowledged in Varela's writings, but not in the theories of the two former authors. How can we characterize this position ? In a few metaphorical but suggestive words, conscious experience is not a thing or a feature that one *has*, but what one *lives*. It is not a thing or a feature that one may *know*, but what one *dwells in*. The experiential-mentalistic terminology accordingly does not point towards a definite domain of being, liable to categorization, but towards the definitely distinct domain of embodiment or situatedness. It is the well-documented (yet incompletely assimilated) difference between *to be* and *what it is like to be* ; or, in the frame of Husserl's phenomenology, the difference between *Körper* (the objectified body) and *Leib* (the lived body).

4 B. Montero cogently pointed out that the most acute problem of the philosophy of mind is not the traditional mind-body problem, but rather the question : " Is mentality a fundamental feature of the world ?". My present discussion focuses on authors, from Wittgenstein to Varela and Chalmers, who would mostly agree on a positive answer to that question, but who diverge about the status of this fundamental feature (Montero, 2001).

Wittgenstein and the Wittgensteineans (Rudd, 1998) have been acutely aware of this type of split. Writing about a sensation and more generally about experience, Wittgenstein declared : “ It is not a *something*, but not a *nothing* either! ” (Wittgenstein, 1968a, §304, p. 102). It is not a something ; it is not an object or property *about which* one could develop a discourse or a theory ; it is not any entity that fits within a categorical scheme ; yet one would be equally wrong in denying “ it ” any reality, as some radical eliminativists were tempted to do. Thus, instead of entering into the endless ontological debate about the status of mental *entities*, Wittgenstein enquired into our everyday practice of multi-centered embodiment. He explored the way we use the mentalistic *terminology*, together with behavior, in order to express ourselves to alter-egos. Rather than extending the furniture of nature, he urged one not to ignore the full range of verbal and gestural *procedures* of which the exercise of objective natural science is only a small part.

In that respect, Varela came remarkably close to Wittgenstein’s way of tackling the problem of consciousness. He did not endow his stretching of the concept of nature with any ontological/categorical import. He rather focused on defining a new sphere of methods wherein the methods of objective natural science are embedded as a particular case. A new methodological approach of which experiential contents are a motivation, a background, and a major component, but *not an objectified theme*.

For those who had the opportunity to discuss with Francisco Varela, this comparison with Wittgenstein may be surprising. Varela used to emphasize his preference for husserlian phenomenology, and to criticize the shyness (not to say the dismissiveness) of Wittgensteinean philosophers when the problem of the *description* of experienced contents is at stake. Before I develop other topics, I must then reduce the gap between these two major philosophical programs of the twentieth century. This reconciliation conditions the parallel (which is central in the present paper) between Wittgenstein and neurophenomenology. Actually, as we shall now see, the disagreement is more apparent than real.

The key point of the debate bears on the notion of a phenomenological “ description ”. Husserl characterized phenomenology as a *descriptive* science which involves “ morphological ” concepts, as opposed to the exact sciences which involve “ ideal ” concepts (Husserl, 1928, §74). The primary aim of phenomenology is to *describe* the “ *essence* ” of each “ *erlebnis* ” (lived experience), as it becomes accessible when the phenomenological *reduction* (i.e. the turning away of attention from ordinary objects to the field of conscious states) has been performed. Now, what is an essence, and what does it mean to “ describe ”

it? An “ essence ” is defined by Husserl as an invariant rule of possible phenomenal variations; and conversely the restricted set of possible variations of individual fact-like presentations points towards a certain “ essence ” (Husserl, 1928, §2). As a consequence of this definition, essences may differ according to the modes of presentation, and also according to the type of invariant which is retained. These differences circumscribe *regions* of essences, and, accordingly, each science corresponds to a “ regional eidetics[5] ”. Among the sciences, phenomenology is concerned with one specific “ regional eidetics ”: the region of the essences of the “ transcendentally pure *erlebnis* (lived experience) ”. One of the main differences between the regional eidetics of phenomenology and the regional eidetics on which the natural sciences depend concerns the role of *space*. It belongs to the essence of the natural entities (the bodies) that they are only given partially, through spatial perspectives or “ adumbrations ” *(abschattungen)*. This defines their *transcendence*. By contrast, the typical essences of the phenomenological region do not imply this mode of presentation through perspectives (Föllesdal, 1984). As Husserl pointed out, *“ an* erlebnis *is not given by adumbrations ”* (Husserl, 1928, §42). This establishes the *immanence* of the lived experience and, accordingly, its incontrovertibility. But there is also a basic similarity between the various regions: in every case, an essence is an *object* for some kind of intuition, in the same way as the familiar empirical entities are objects for perceptive intuition. There is an *eidetic* intuition according to Husserl, just as much as there is an *empirical* intuition. And the eidetic intuition is construed literally as a variety of *vision* (Husserl, 1928, §3). This being granted, describing a phenomenological essence is tantamount to describing an object of (quasi-visual) intuition. Here, the common-sense connotations of the word “ description ” seem to have been entirely retained. Everything *looks as if* phenomenology were based on a crypto-dualist (subject-object) scheme. Actually, things are much more intricate: Husserl himself fighted repeatedly against possible dualistic misunderstandings of his descriptive phenomenology.

But before we document Husserl’s striving towards clarification, let us sketch Wittgenstein’s position on *describing* one’s own mental contents. Wittgenstein is very eager to dispel from the outset the dualistic methaphor of the seer and the seen in mental context. In order to strenghen his anti-dualist position he first considers the limiting case of primitive vocal and bodily expressions of pain (or other simple feelings): “ Moaning is *not the description* of an observation ” (Wittgenstein, 1968b). There is *no*

5 “ Eidos ” can be translated by “ essence ”.

separation whatsoever between the primitive expression and what it expresses, and this is enough to differentiate it from a “ description ”. The expression cannot be justified by the experience which is expressed by it (as a description would be justified by what it describes), for there is full *continuity* between this expression and the corresponding experience. By no means can one establish logical independence between the primitive expression and the expressed.

Then, the former analysis is extended by Wittgenstein to genuine statements such as “ I have toothache ”. According to him, these statements are basically expressive, just as crying and moaning are; here again, they cannot be said to *describe* any internal state, because in principle there is *no real separation* between the putative description and the state which is allegedly described.

Taken together, these remarks call for a strict cut between non-dualist *expressions* and dualist *descriptions*. However, here as ever, Wittgenstein is quite flexible on the vocabulary. He is aware that employing the word “ description ” becomes more and more tempting when one goes from mere interjections to complex expressive sentences. Even the idea of *describing* one’s pain is not formally rejected by Wittgenstein, although he remains slightly ironical about it (Wittgenstein, 1967, §482). Thus, instead of being completely dismissive of the claim to be able to *describe* a mental content, he urges one to distinguish the language game of ordinary descriptions and the language game of mentalistic descriptions (Wittgenstein, 1968a, § 290). In the language game of ordinary descriptions, there are truth conditions because it is possible in this case to *compare* somehow the descriptive statement with the state of affairs it describes. But in the language game of mentalistic description, some statements are at the same time *criteria* of what they are supposed to describe (Bouveresse, 1987, p. 510). The incontrovertibility of first-person reports becomes *normative,* instead of being factual or intuitive as in Husserl. This is enough to define the specific domain of what we might call (with a sense of paradox) “ non-dualistic descriptions ”. Provided the many *uses* of the word “ description ” are not overshadowed by its phonetic uniqueness, no real harm is therefore done by employing it.

Now, let us come back to Husserl. As I suggested before, Husserl was very careful to avoid some of the misunderstandings which could arise from the word “ description ” as it is used in phenomenology. He was especially worried about possible confusions with introspective psychology, which involves “ self-observation ” of *reflected* lived experience. He thus sketched a compromise between the dualistic undertones of the word “ description ” and the thoroughly immanentist

spirit of phenomenology: (i) unlike introspective psychology, phenomenology aims at describing *unreflected* lived experiences; but (ii) the description of such unreflected *erlebnis* is based on second-order " *reflexive* intuition of essences " (Husserl, 1928, §79). This determines specific rules of use of the word " description " in phenomenology.

To sum up, Wittgenstein's insistance on distinguishing mentalistic " expressions " from ordinary " descriptions " is not absolutely incompatible with the phenomenological concept of " description ", provided some precautions are taken, and fine-tuned distinctions are made. Both Wittgenstein and Husserl were struggling towards what we may call " a language of immanence ". Even from that respect, it is not absurd to compare Varela's neurophenomenological investigations with Wittgenstein's study of forms of life. I could then use both vocabularies, but for the sake of (non-dualist) clarity, I shall henceforth stick to Wittgenstein's dichotomy between expression and description.

Until now, the convergences I have documented only applied to Varela's views and neighboring positions (including Wittgenstein's). The sense of inevitability I wish to develop would be much strengthened if effective or potential convergences with diametrically opposite ideas could be displayed. But such convergences with alien views exist, and they are quite significant. To begin with an elementary remark, even hard-line behaviorists and identity theorists implicitly accepted as a matter of *fact* that in order for a description of publicly observable behavior and neural events to be accepted as an account of *mind* at all, or even to be credible as a *substitute* for mental categories, it has to be compared at some point with first-person reports making use of such categories. Behaviorists and identity theorists tacitly relied on a shared understanding of experience, in their very attempt at purifying science from any remnant of it; they promoted a *negative* use of this shared understanding. True, behaviorists or identity theorists usually minimized this point, or hid it altogether ; and they consistently denied that it is to be accepted as a matter of *principle*. But their *praxis* was basically similar to the *praxis* of those authors who advocate the setting up of mutual constraints between first person and third person accounts rather than mere reduction of one to another ; this *praxis* was only underdeveloped on the first person side.

Actually, the similarity is so striking that, in the past, advocates of the mutual constraint strategy have repeatedly been mistaken for behaviorists or identity theorists.

The most interesting example of this confusion bears on Wittgenstein. He has often been accused of a variety of behaviorism (Mungle, 1966), and

this continues today[6], despite his own defense, and despite a number of excellent commentaries (Bouveresse, 1986; Hacker, 1993) which have exonerated him from this charge. At the beginning of paragraph 304 of the *Philosophical investigations*, his imaginary prosecutor blames him for making no difference between pain and pain-behavior. Wittgenstein denies that, but the prosecutor goes on : " And yet you again and again reach the conclusion that the sensation itself is a *nothing* ". Wittgenstein's subsequent answer is tantamount to a reiterated denial, but at the same time it sets the stage for subsequent misunderstandings. " The conclusion, he writes, was only that a nothing would serve just as well as a something about which nothing could be said ". This remark that " *a nothing serves as well* " triggers the feeling that there is no room in Wittgenstein's philosophy for conscious experience, just like in behaviorism. And the allegation that nothing can be said *about* the contents of conscious experience may promote the belief that Wittgenstein discarded the folk-psychological terminology (and, even more so, the phenomenological terminology), just like in eliminativism. But both tenets are misjudged, as we shall see.

The best commentators characterized Wittgenstein's approach as follows. Wittgenstein shared with behavorism : (i) denial of an inner realm of sensations and thoughts which could be inspected by some homuncular subject and then reported about; (ii) the idea that the meaning of the mentalistic terminology depends crucially on expressive behaviors (it is this latter point that urged some commentators (Mungle, 1966) to misleadingly characterize Wittgenstein as a " logical, or linguistic, behaviorist "). But on the other hand, Wittgenstein repudiated the extreme behaviorist claim that pain (or any content of experience) so to speak *identifies* with some behavior. After all, he pointed out, saying that toothache *is* such and such behavior, utterly contradicts the normal use of the term (Wittgenstein, 1968b, p. 296). To sum up, according to him, a verbal report of pain does not just *mean* pain-behavior ; nor does it play the role of one more external symptom (besides behavior) of an alleged inner event.

So, what type of relation did Wittgenstein institute between experience, behaviour, and expressive sentences ? The relation he considered is one of *mutual feedback* during the process of *learning* psychological vocabulary. His leit-motiv in the late 1930's was that pain-behavior operates as a *criterion* of experienced pain. This is not tantamount to say that there is any rigid link of entailment between pain-behaviour and pain ; only that one effectively acts and speaks *as if* there were such kind of

6 See the article " Behaviorism " in (Audi, 1999). Discussion in (Suter, 1989).

rigid link in the context of *learning* the linguistic expressions of pain and also, by and large (with a few exceptions which *must* stay *exceptions),* in their context of *use*. A stabilized " grammar " of mentalist vocabulary and sentences could only arise, according to Wittgenstein, from a *norm of interconvertibility* of the first person, second person, and third person conditions of their use. The use of " I am in pain ", " you are in pain ", and " he is in pain " *must* be interconvertible according to this norm. And this means implementing *mutual constraints* between expressions of experience, expressions of empathy, and descriptions of behavior, as part of a complex *praxis* called a *form of life*.

The similarity with Varela's position becomes conspicuous at this point.

Varela has often been mistaken, in some philosophical circles[7], for an identity theorist. The reason for this conflation can be indicated in a few sentences. (i) Both Varela and identity theorists deny any duality between an inner domain of mental objects and an introspective subject able to observe them and report about them ; both of them resist any form of dualism (including Chalmers' property dualism) and discard accordingly the picture of the " cartesian theater ". (ii) Both Varela (Thompson & Varela, 2001, 2002) and identity theorists believe that the relations between mental and neural events are stronger and more reciprocal than in anomalous monism. Moreover, from a semantic standpoint, Varela and his collaborators were not far from considering that, in the future, fixing the meaning of certain delicate and discriminating phenomenological " descriptions "[8] can depend in a crucial way on their disciplined correlation with neural events. Yet, Varela overtly rejected the idea that experiences *are* just brain events. True, he was well aware that one might ask him : " Is this not just a fleshed-up version of the well-known identity theory ? " (Varela, 1998). But he answered the question by pointing out that in his approach, theoretical matters are systematically deflected onto a methodological plane. His neurophenomenology is not an identity *theory* of some factually given neuro-experiential correlation ; it is a *procedure* of systematic *institution* of such relationship, and of correlative refinement of the phenomenological terminology.

Varela here implicitly expanded Wittgenstein's " grammatical " analysis of expression. Wittgenstein restricted his investigation to the way

7 M. Lockwood told me that, in conferences, he had the constant feeling that F. Varela was essentially an identity theorist. A clear statement of M. Lockwood's position on these matters can be found in (Lockwood, 1993).

8 Here again, the use of the word " description " can be misleading. One should at least pay attention to the fact the " grammar " of the term " description " is not the same in a phenomenological non-dualist context and in everyday use.

the standard norm of interconvertibility between (first or second-person) expressions and (third-person) reports of external behavior institutes an intersubjectively acceptable folk-psychological vocabulary. But Varela amplified his field of interest to a norm of mutual constraint between (first or second-person) phenomenological " descriptions " of stabilized contents of experience and (third-person) neuroscientific reports. While in Wittgenstein's work, the form of life in which the use of expressive sentences makes sense basically reduces to our everyday activity, in Varela's work, the relevant form of life is broadened so as to include disciplined practice of phenomenological reduction and neuroscientific experimenting and/or theorizing as well.

To conclude this comparison, we now see that in no way can Wittgenstein's and Varela's positions be respectively assimilated to a blend of behaviorism or identity theory. But conversely, behaviorism and identity theory can be characterized as two reifying and dissymmetric accounts of the ongoing dialectic of embodied experience and objective reports that Wittgenstein displayed in ordinary life and that Varela extrapolated to a refined combination of experiential and scientific form of life. They are reifying because they usually take for granted that objective reports (of behavior or neural events) disclose *things as they are*. And they are dissymmetric because, even though they rely more or less tacitly on a background of first-person experience, they emphasize the ontological or epistemological primacy of third-person descriptions of behavior or neural events. Their proposed " solution " of the mind-body problem is tantamount to a curtailed and unbalanced variety of Wittgenstein's and Varela's dissolution.

In an even more compelling way, materialist and eliminativist thinkers themselves tend more and more often to construe their own propositions as providing a dissolution rather than a solution of the " hard problem ". According to them, objective science has proved so fruitful that one should accept : (i) its urge to revise the very definition of an explanation (even if it means renouncing traditional explanatory requirements), and (ii) its criteria of interruption of the chain of explanations. V.G. Hardcastle used both arguments in a subtle defense of materialism against Nagel's, Jackson's, and Chalmers' challenge (Hardcastle, 1996). Relying on point (i), Hardcastle asserted that displaying the neuronal necessary conditions for a report of conscious experience *should* be accepted as providing an explanation of consciousness. If some modern skeptic persistently replies that this does not explain anything, one can only try to modify his/her attitude until he/she finally *sees* the displayed neuro-experiential correlation *as* an explanation. But this sounds

more like *conversion* than *conviction* ; precisely the type of conversion which would be necessary to accept (as in Wittgenstein's and Varela's dissolution) that the problem does not even arise. Here again, however, the main difference bears on symmetry : instead of saying that mutually constrained relationship between the neurological and the experiential is all what is needed, V.G. Hardcastle maintains that a strong correlation should count as a one-way explanation *of* the experiential *by* the neurological. At this stage, Hardcastle's dissolution thus looks like one more biased and restricted version of Varela's.

The reason for the bias is likely to be the popular confusion between objective entities (namely inter-situational structural invariants) and things in themselves, which was dispelled by Kant long ago[9] : since neurobiological entities are objective, and since this (allegedly) means intrinsic existence, it becomes likely that the direction of explanation goes from them to the ghostly contents of subjective experience and not the other way around. But if the equivalence between objectivity and absolute reality is not granted, as e.g. in the kind of non-representationalist theory of cognition advocated by Varela (Varela, 1979; Bitbol, 2001), the lopsidedness of the explanatory chain strikes one as unjustified.

Then, turning to point (ii), V.G. Hardcastle also argues that since science has not the slightest clue about how to tackle the " hard problem ", one should proceed with problems that are in principle accessible to a scientific approach (e.g. the neural correlates of sleep, anesthesia, coma, reflexive self-awareness, etc.)[10], and put the central problem of the ultimate origin of primary consciousness aside. Several crucial *features* of conscious experience can be elucidated this way. Most importantly, the cumulative large-scale integration of experience, its relative stability, the fact that its contents can be reidentified as such by latter experiential acts, and even its reflexivity, can probably be accounted for by global iterative properties of neural networks such as Edelman's " reentrant loops " (Edelman, 1994, p. 120). But the basic *material* of this process of integration and stabilization (possibly a series of fleeting " instantaneous appearances ") is both presupposed by the former neurological account and left beyond the boundaries of its explanatory power.

At any rate, this strategy of concentrating on " easy " problems

9 For those readers who are not impressed by the authority of Kant, let me add an argument of elementary logic. Whereas the discovery of some feature of a putative intrinsic reality would certainly manifest itself by invariance with respect to the manifold of epistemic presentations, the converse is by no means incontrovertible. Invariance is a necessary but not sufficient condition for faithfulness to reality. This is the reason why the debate between realist and anti-realist philosophers of science is still alive nowadays, and is likely to go on forever.

10 Another accessible issue is that of the correspondence between neuro-chemical relations and qualitative structural relations such as Helmholtz's triangle of colors.

(whose compatibility with the strategy of *seeing* correlations *as* explanations is dubious[11]) was developed by several authors. Some of them (O'Hara & Scutt, 1997) hoped that solving a large number of easier problems could bring us to a point where the harder problem becomes tractable. Other authors (Mills, 1997) took even more seriously the idea that science is entitled to define what counts as a problem to be solved by it, and what is definitely outside its domain of legitimate explanation. One celebrated example is Newtonian mechanics, which developed on the basis of a decision *not* to explain gravitational attraction at a distance. In the same way (though even more radically so), current neuroscientific advances should be allowed to proceed on the basis of a decision *not* to explain the very existence of primary consciousness.

The latter proposal is to be taken seriously. The development of objective science must not (and cannot *de facto)* be impaired by unreasonable requests. But sticking to this sound remark may restrict unduly the field of inquiry. To begin with, since objective science still acts as a dominant *value* in our societies, asserting that something (i.e. conscious experience) is not a proper topic for science amounts to suggesting that this something is no issue at all. Here, epistemological retreat is likely to be followed soon by ontological denial. Furthermore, the circumstance that the methods of objective science cannot tackle the brute fact of the existence of conscious experience, does not mean that there is no other methodology which would be able to do so.

Now, as we know, what Varela did was precisely to promote and implement such an alternative methodology. His methodology is not a regression with respect to that of objective science : it rather takes the latter for granted and then complements it. Varela's methodology complements the method of extracting invariants of purely structural features of experience with a method of disciplined cultivation of experiential contents and interpersonal coordination of those contents. It closely parallels (and extends) Wittgenstein's strategy in his second philosophy : embedding the old debate about the correspondence between words and world, between representation and reality, between first person and third person accounts, within a lived practice of interpersonal exchange and mutual control. In Wittgenstein's wake, the philosophy of language had to rediscover for itself that language does not reduce to substantives denoting objects and predicates indicating properties ; that it also includes performative expressions, pronouns with indexical function, and many other tools of

11 Either one thinks that the neuro-psychological correlation is an explanation by itself, or one asserts that science does not retain elementary conscious experience as something which has to be explained. Either the explanation is already there, or the demand for explanation is declined in the name of objective science. This is clearly a disjunction, and one cannot argue on both lines at once.

intersubjective interplay. Similarly, in Varela's (and a few other authors') wake, the philosophy of science has to rediscover for itself that science does not and *cannot* reduce to a static correspondence between its theoretical structures or entities and the putative laws and objects of the world ; that it crucially involves experimental and experiential procedures, as well as a systematic network of constraints between the first type and the second type of approach (i.e. between disengaged accounts and engaged practices).

To recapitulate, once it is pushed to its ultimate consequences, the materialist view of primary consciousness faces a dilemma : either it relies on future and unforeseeable developments of objective science, or it pushes the problem of the origin of experience to the boundaries of objective science *stricto sensu*. If the second option is taken, the materialist view is bound to come surprisingly close to the Wittgenstein-Varela dissolution, though with an irrepressible one-sided inclination. Materialists disregard what the method (of objective science) does not circumscribe. On the contrary, Varela expanded the method (to a dialectic of objectivity and intersubjectivity) in order to circumscribe what it is in the power of nobody to disregard. Materialists may renounce any explanation of primary consciousness because it is marginal in their conception of an intrinsically objective nature. But Varela advised us not to seek any elusive mechanistic explanation of primary consciousness for the opposite reason : because it is so fundamental in his situated view of nature that it should be taken for granted, and then articulated with structural invariants in a generalized epistemic procedure.

2-What is a *theory* ? A forced consensus on science

In the former section, I documented an elementary convergence that takes place *nolens volens* between Wittgensteinean-Varelian and materialist thinkers, on the option of dissolving rather than solving the " hard problem " of consciousness. In this section, my aim is to develop another, more comprehensive, convergence which bears on the conception of scientific theories. Here again, tacit agreement arises irrespective of one's wishes. It results from a fierce debate that pushes authors towards unassailable positions which are likely to be closer to one another than they would have fancied.

The debate revolves around the status of folk-psychology. Is folk-psychology a primitive empirical theory, providing human beings with prediction or explanation of other persons' behavior, and liable to be falsified ? Or is it something else, not to be compared with scientific

theories at all ? Then, if it is something else, what is it exactly ?

The first thesis, according to which folk-psychology has the same status and purpose as a scientific theory, was developed as a strong argument in favor of eliminativism. If folk-psychology is merely a *primitive* theory of human behavior, then modern science should not even bother to account for experiential reports expressed within its framework. It does not have to explain these reports, or to reduce them to neural processes either ; it should rather ascribe itself the task of *superseding* folk-psychology by a better (presumably neurophysiological) theory (Churchland, 1986).

Of course, whether replacement of folk-psychology by a neurophysiological theory of mind is equivalent or not to dismissal of primary consciousness as such, remains an open issue. It is by no means obvious that theoretical eliminativism amounts to radical eliminativism. After all, theoretical eliminativism *stricto sensu* only entails substitution of a network of categories and relations based on thorough neuroscientific research, for another which was already in use before the era of neurosciences. It could then involve mere recategorization of experiential contents in the light of neurophysiology, rather than expulsion of the very fact of conscious experience. Only within a very narrow epistemological perspective, or if consciousness is construed as a folk-psychological category in its own right, does theoretical eliminativism generate radical eliminativism[12]. This distinction being granted, a supporter of Varela's Neurophenomenology may find some points of agreement with a purely theoretical eliminativist. But before discussing these points, let me turn to the alternative status of folk-psychology, and to the subsequent debate between the champions of the two conceptions.

According to the alternative view (Gordon, 1986; Gordon, 1992; Goldman, 1992; Greenwood, 1999; Perner et al., 1999; Pust, 1999; Warren, 1999)[13], folk-psychology is not a theory at all. It is a system of landmarks and normative rules for *simulating* others' mental states. Whereas a theory enables prediction and explanation by means of chains of third-person accounts, here folk-psychology is construed *(at the very least)* as an instrument of prediction of others' behavior by inserting one's own first person experience into their mental situation. " Inserting " does not only mean " putting oneself in the other's place " in a superficial projective way, but also adjusting one's own state in order to accommodate manifest differences with this other person.

12 The closest position to radical eliminativism (though with many qualifications) is probably Dennett's (Dennett, 1992).

13A criticism of the simulation conception can be found in (Stich, 1996).

At this stage, three important issues must be raised about the meaning of the " simulation conception " of folk-psychology : (i) when folk-psychology is so construed, can it give proper *explanations* of behavior or is it restricted to prediction ? (ii) does the simulation conception of our knowledge of other minds complement or exclude the theory conception[14] ? (iii) is the simulation conception bound to be incompatible with theoretical eliminativism or (surprisingly) not ?

About the first point, one must notice that whereas it is natural for a neuroscientist to seek *explanation* of behavior, it is by no means clear that this is or can be the primary task of someone who uses the simulation strategy permitted by folk-psychology. Yet, it is also undeniable that people engaged in folk-psychological simulation do not restrict themselves to prediction of behavior. What do they do then, if they do more than predicting but less (or something else) than explaining ? Here, the old concept of " understanding ", borrowed from Dilthey's paradigm of the *Geisteswissenschaften* (and from hermeneutics), is manifestly appropriate. " Understanding " somebody does not mean displaying a causal chain from anything including past behavior, past mental states, or past neural states, to present behavior ; it means providing a first-person rationale about his present conduct by being able to embody (or simulate) his intentions and his (conscious or unconscious) *reasons* to act. That " understanding " has truly nothing to do with scientific explanations has been strongly emphasized by K-O. Apel (Apel, 1976, 1980; Von Wright, 1971). Explaining something requires *objectification*. Each link in a causal explanatory chain must be treated as an object of third-person description. But the case of " understanding " is utterly different. It involves a " subject-cosubject relation " (Apel, 1976), instead of the " subject-object relation " of explanation. It belongs to the language game of pure " intersubjective communication ", not to the game of objective knowledge. It arises from another specific " interest " in life: an interest which requires engagement within the situation of the one to be understood, rather than distanciation with respect to him. The gap is wide open indeed ; and Apel goes as far as saying that objective science and hermeneutic understanding *exclude* each other. But is this the last word ?

The latter question raises my second point of comparison between the simulation conception and the theory conception of folk-psychology. According to Apel, objective science and hermeneutic understanding are not merely exclusive. They are *complementary* in Bohr's sense ; i.e. they are also jointly indispensable to exhaust the possibilities of knowledge. But

14 The " theory conception " of folk-psychology is a conception according to which folk-psychology is a theory. It is also called " the theory theory ".

when Apel develops the reason why he thinks they *complement* each other, he manifests a hermeneutical bias which is the exact mirror-image of the materialist bias. Objective science and hermeneutic understanding, he says, are jointly indispensible because objective science *presupposes* hermeneutic (or pre-hermeneutic) understanding between fellow-scientists. More specifically, simulation is likely to act as a precondition for elaborating a proper theory of mental processes and behavior (Goldman, 1989).

Ascribing intersubjective understanding or simulation the role of a prerequisite for objective science is perfectly acceptable, as it has been documented, e.g., in a fierce debate which took place between Schrödinger and Carnap in 1935 (Carnap, 1936; Bitbol, 1999, 2000). However, *this is only half of the story*. Hermeneutic understanding can use scientific theories to promote its aims as well. Scientific explanations of behavior can be used for their own sake, but they can also be operated as useful intermediate devices for simulating each others' situations. An objective model can even turn out to be an exceptionally efficient and flexible instrument for hermeneutic " understanding ", since it promotes simulation of *every possible* situation within an accepted framework. This reversal (explanation as a tool for understanding, rather than understanding as a mere precondition for scientific explanation) may sound strange as long as " pure " detached knowledge is the ultimate value ; but it goes without saying if insertion in one's social and natural environment creeps in as the alternative dominant value.

We now see that, even though there is no prospect of *reduction* of understanding to explanation (of simulation to theorization), or *vice versa*, there exist strong two-way interrelations between them. But this reciprocity is precisely the basis of Varela's Neurophenomenology.

At first sight, Varela's insistance on disclaiming *both* lopsidednesses, the lopsidedness of objectivistic materialism *and* the lopsidedness of hermeneutics, may appear baffling. He reminded the materialists of the unavoidable priority of embodiment, or the necessity of disalienating knowledge from human life ; and he reproached the hermeneutists for their systematic rejection of naturalizing procedures. But this twofold criticism is perfectly justified as soon as one realizes that the apparently antinomic attitudes of materialism and hermeneutics are in reality two sides of the same coin. Both arise from the same truncated (purely objectifying) conception of science and nature. Materialism tends to force every aspect of " what is the case " into this incomplete science ; and Hermeneutics tries to shelter, in an exceedingly airtight manner, one aspect of life from the *same* incomplete science. However, if the conception of nature and of

science is expanded as Neurophenomenology demands it, neither forcing nor sheltering are advisable. Cross-fertilization of objective science by its situated background, and of intersubjective understanding by scientific explanations, becomes conceivable. The efficiency of this cross-fertilization may furthermore be dramatically improved by the neurophenomenological method of imposing " mutual constraints " between the two sides.

This brings us to the third question (Is the simulation conception compatible with theoretical eliminativism ?), with a good prospect of giving it a *positive* answer. This prospect may be surprising at first sight, but the surprise (or disbelief) is likely to fade if the positive answer is qualified : the compatibility of the simulation conception with theoretical eliminativism is not given for free ; it has to be secured, here again, by a process of mutual fine tuning which is the subject of the next paragraphs.

Let us start with a remark about the interconvertibility of the vocabularies of " understanding " and " explanation ". Categories such as feeling, desire, project, action, motive, etc., which normally operate as signposts and normative focal points for intersubjective understanding, may also be utilized as intermediate elements of objective-like explanations. Teleological explanations and practical inferences, as described by Von Wright[15], exactly fit this description. In this case, intentions and reasons *de facto* intervene as additional objective entities in the furniture of nature, and they moreover partake in a causal or quasi-causal pattern. Apel rightly pointed out that the fact that intentional categories are often used in what *looks like* an explanation, should not hide their primary hermeneutic purpose. But conversely, their primary hermeneutic status should not prompt one to dismiss dogmatically the common practice which consists in sprinkling explanations of behavior with intentional-teleological terms. Some semantic flexibility is needed at this point. One must recognize, in a Wittgensteinean style, that a word does not have an intrinsic *nature*, but only a *function* and *use*. Thus, if it is used in a dialogue, an intentional term normally *works as* a tool for reciprocal simulation. But if it is used in the context of a practical inference it can perfectly (and it does commonly) play the *role* of an intermediate step in some causal-like explanation of behavior.

The problem is that as soon as this latter, explanatory, *role* is promoted, the intentional categories compete with other (sometimes more appropriate) categories derived from the natural sciences. The temptation

15 An example of teleological explanation based on practical inference is : " A *intends* to bring about p ; A *considers* that he cannot bring about p, unless he first sets himself to learn to do a ; therefore A sets himself to learn to do a " (Von Wright, 1971, p. 101)

rises to reduce them to their scientific counterpart, or to replace them altogether with more refined explanatory concepts. Reductionism and eliminativism thus appear as inescapable by-products of a widespread cultural prejudice in favor of explanation. But our reaction, in this case, should not be to replace a prejudice with the opposite one (as an hermeneutist would be inclined to do). It should rather be to show what can be done by relaxing any such prejudice.

Let us then consider, to that effect, the best possible explanation of behavior using a theoretical eliminativist's (presumably neurophysiological) categories. There, the terms play the *role* of intermediate links in a causal explanatory chain made of objective elements. However, nothing prevents one from ascribing them the *role* of new, different, and possibly more discriminating, signposts for intersubjective *understanding*. Only the way they are *used* may determine their status. But does any such intersubjective *use* of originally objective concepts ever arise ? There are many signs in current ordinary language that hermeneutic conversion of the *prima facie* objectifying vocabulary of neurosciences is occurring to some extent. It is not unusual today to hear somebody saying, e.g.: " My brain is processing the information " instead of " I am thinking hard ", or " My circuits are overloaded " instead of " I am unable to figure out what to do in these complex circumstances ", or " Your neurons are working overtime " instead of " You are mentally exhausted", etc. Despite a superficial impression, this way of speaking does not mean that simulation and intersubjective understanding have just been *replaced* by eliminativist-like explanations ; it rather suggests that the eliminativist's third-person words are available for being *used as* first and second-person expressive terms. For after all, *in the context of dialogue*, the purpose of such terms or sentences cannot be (only) to *describe* a certain neurophysiological state; it is to *express* what it is like to be in that state, and to *suggest* what it could be like for the co-subjects to be in the same state. The only obstacle which hinders this hermeneutic conversion (leading one to the wrong conclusion that explanation has overruled old-fashioned " understanding " even in its stronghold of everyday speech) is that one lacks a proper experiential counterpart to most of the neurophysiological concepts used by theoretical eliminativists. But finding, and fixing normatively, such a counterpart is precisely one of the most important aspects of Varela's neurophenomenological research program.

We now see why theoretical eliminativism is not in essence incompatible with the simulation conception of folk-psychology : its own categories involve potentialities for intersubjective simulation *use* ; and these potentialities are likely to be actualized by neurophenomenological

investigations.

P.M. and P.S. Churchland, the two most emblematic defenders of eliminativism, are not very far from appreciating this unexpected convergence (Churchland & Churchland, 1998). Moreover, the way they come close to a reconciliation of their eliminativism with the simulation conception is especially interesting to us, since it involves a definite option about the status of scientific theories in general. The Churchlands first accept that there is something right in the contention that folk-psychology is basically used as a tool for the " intricate social *practice* " (Churchland & Churchland, 1998, p. 10). of which we partake, and that its quasi-laws are normative rather than descriptive. Then, they defend their theory conception of folk-psychology by noticing that it does not contradict the simulation conception on that point, provided a Kuhnian view of scientific theories is adopted. According to that view, they say, learning a scientific theory " (...) is not solely or even primarily a matter of learning a set of laws or principles : it is a matter of learning a complex social *practice* (...) " (Churchland & Churchland, 1998, p. 11, 33). A theory thus involves components of practical commitment and insertion within a network of intersubjective communication. These components, which are constitutive of the status of folk-psychology according to the supporters of the simulation conception, are not denied, but rather refined and brought up to date by theoretical eliminativism as the Churchlands define it. This move is very radical indeed, and it fits well with Kuhn's neo-Wittgensteinean inclination. But I wonder whether it is not tantamount to surrender to the opposite side ; or at least whether it does not undermine the key motive of the debate.

After all, the central claim of the opposite side is not about the choice of more or less discriminating normative categories of simulation. It is about the fact that first person experience and intersubjective practices of " understanding " (namely simulated substitution of each other's situation) *cannot* be merely stamped out and replaced by third person descriptions or disengaged explanations. Now, if the *epitome* of third person descriptions and disengaged explanations, namely the corpus of scientific theories itself, is said to involve the same type of dialectic between embodiment and distanciation, or between ongoing practice and static inspection, as the mutual " understanding " of cosubjects, then the whole debate becomes pointless because everybody agrees on the all-pervasive presence of situated knowledge. In order to win the issue, theoretical eliminativists ought to have objectified both subjective expression and hermeneutic understanding. But they have been pushed to react the other way around, namely by " hermeneutizing " their conception of scientific theories.

The problem is that this momentous turn in the eliminativists' thought is at odds with their predominantly objectivist research program, and with the narrowly objectivist undertone of the major part of their writings. Coherence could only obtain within a research program involving a systematic mutual feed-back effect between first person reports and third person descriptions, together with a full-scale participatory epistemology. But these stipulations exactly depict Varela's position, since, in it, neurophenomenological " mutual constraints " are associated with an " enactive theory " of cognition.

3-Quantum mechanics as a prototype of participatory science

Several authors (Velmans, 1998, 1999; Wallace, 2000) recently pointed out that insertion of consciousness in the overall framework of science would be made much easier if science was not construed restrictively as a static opposition of subject and object. Indeed, experiential contents could readily be accommodated within a generalized framework of intersubjective agreement, wherein active situated cognition is given logical priority over shared invariants. But is this view in line with the present state of science ?

It is quite easy to convince oneself that it is at least *consistent* with any branch of scientific investigation, including the whole of classical physics, chemistry and biology. Kant for instance proposed a remarkable reading of Newtonian physics in these terms, both in the *Critique of Pure Reason* and in the *Metaphysical Foundations of Natural Science*. But, according to a significant part of its available interpretations, the case of quantum mechanics is even more compelling. As stated by these interpretations, quantum mechanics is not only *compatible* with an intersubjectivist and participatory view of science ; it displays its participatory status in its very structure, and so to speak *forces* us to change our current epistemology. The founding fathers of this family of interpretations were Bohr[16] and Heisenberg[17].

True, no argument *internal to physics* has been able to give this conception any decisive superiority over rival interpretations. Alternative views of quantum physics involving remnants of epistemic dualism and/or formal atomism (such as the Bohmian mechanics of 1952), are still arguable nowadays provided the frame of discussion is narrow enough.

16 " (...) the new situation in physics has so forcibly reminded us of the old truth that we are both onlookers and actors in the great drama of existence " (Bohr, 1987, p. 119).

17 " Natural science does not simply describe and explain nature; it is part of the interplay between nature and ourselves; it describes nature as exposed to our method of questioning " (Heisenberg, 1990, p. 69).

Although one of the basic features of the Bohr-Heisenberg interpretation (namely *holism)* has an equivalent in every alternative interpretation, maintaining an analytic view of the world and of cognitive processes is still feasible, either by compensating it with non-local interactions, or by superimposing clumsy fragments of the traditional analytic terminology on a deeper layer of integrated formalism. But as soon as the frame of discussion is broadened to include the problem of how science in general can deal with situatedness, the Bohr-Heisenberg interpretation (or a modern version of it) is likely to be preferred. Indeed, this interpretation provides one with an excellent example of how we can take our anthropological situation into account without retreating in the least from the ideal of universally valid knowledge. An interpretation of a particular scientific theory (here quantum physics) may have to be favored because of its ability to clarify a recurring quandary of science as a whole.

In order to get a better grasp on the problem of how lived experience fits within the overall framework of science, it is then useful to scrutinize it against the background of a conception of physics (such as quantum mechanics interpreted by Bohr and Heisenberg) where objectivation is not taken for granted. The analogy is striking. On the one side, one comes up against a manifestation of situated embodiment, with no real possibility of distantiating oneself from it and taking it as an *object* or *property*. On the other side, one deals with statements of situated insertion within the world at a certain step of the scale of lengths (i.e. reports of experimental phenomena), with no real possibility of distantiating oneself from it and acquiring a *God's eye view*. My aim in this section (Bitbol, 2000) will thus be to draw a systematic comparison between the epistemological configuration of a science of consciousness and the epistemological configuration of quantum mechanics[18].

Bohr himself attempted such a comparison in the early 1930's (Bohr, 1987). So, even though his approach is not devoid of loopholes, I will start with it, and then follow with my qualifications.

Bohr's basic remark is that in any experiment of microphysics, the processes are " disturbed " by the very act of measurement ; or rather, in a deeper and more acceptable way, that phenomena are indissolubly *co-defined* by the experiments which are used to make them manifest. The material " subject " of experimental microphysics (namely the

18 Even those who are not keen on purely epistemological developments should consider seriously the need of a parallel study of quantum mechanics and the science of mind without any physicalist bias. As M. Lockwood cogently noticed, " (The) prejudice in favour of the material seems to me devoid of any sound scientific foundation. Quantum mechanics has robbed matter of its conceptual quite as much as its literal solidity. Mind and matter are alike in being profoundly mysterious, philosophically speaking. And what the mind-body problem calls for, almost certainly, is a *mutual* accomodation: one which involves conceptual adjustment on both sides of the mind-body divide. " (Lockwood, 1989, p. X).

measurement apparatus) then cannot properly be detached from its own field of investigation. In other terms, the material " subject " *belongs to* its field of investigation. But if one tries to circumscribe a microphysical *object* (this is a basic epistemological requirement according to Bohr), despite this lack of detachment, a difficulty arises. Each time some *particular* divide between the object and the material subject is conventionnally imposed, a fragment of what is to be known happens to be cut off. So, one can reach full characterization of the putative micro-object only by means of *several* " complementary " (i.e. mutually exclusive and jointly exhaustive) experimental approaches.

In the same way, says Bohr, during the process of *introspection*, the experiential contents are altered by the very attention a subject is focusing on them. More correctly, the experiental contents are *co-defined* by this act of attention. The introspective subject then belongs to its own field of investigation. Setting up a conventional subject-object divide in spite of this, namely trying to cut off artificially the introspective subject from its field of investigation, then means that knowledge gained by this process can only be *partial*. Here again, the putative " object " of introspection needs several " complementary " approaches to be characterized.

Along with this analogy, the compliance of the notion of " complementarity " appears even greater than what K-O. Apel suggested. Apel projected features of Bohr's wave-corpuscle complementarity onto the relations between explanation and understanding. However, reverting the flux of information may be just as revealing. Let us remember that Apel's version of complementarity means mutual exclusivity and joint exhaustivity of (i) law-like descriptions of objectified processes (behavior or neural events) and (ii) simulation of co-subjects. It is complementarity between distantiation and shared situatedness. But if carefully scrutinized, Bohr's wave-corpuscle complementarity can be read exactly this way, provided one does not put too much weight on the corresponding pair of classical *pictures*. Instead, one should emphasize their status and function in the practice of microphysics. To begin with, (3n-dimensional) waves are used to calculate probabilities of any possible measurement following some experimental preparation. They are *invariant predictors,* in so far as they operate irrespective of the experimental situation for which prediction is needed. By contrast, " corpuscles " are there just to afford a classical metaphor for a series of discrete events occurring whenever *certain measurements are effectively performed.* Waves (namely continuous invariant predictors) are the byproduct of an effort to *distanciate* a theoretical structure with respect to special measurement situations. But the notion of a corpuscle is meant to express (loosely) those discontinuous

phenomena that appear *in given experimental situations*. The terms of the wave/corpuscle pair may therefore be called " complementary " in the same sense, and for the same reason, as those of the explanation/understanding pair.

Although the basic motivation (namely contextuality) of Bohr's comparison between microphysics and a science of consciousness is perfectly sound, the way he developed it remains open to criticism. His requirement that a *cut* between an object and the variety of (material or introspective) subjects be imposed somewhere is a widespread epistemological norm; but it can be dispensed with in the frame of a non-representationalist view of cognition. A major advantage of dispensing with this cut is that one is no longer forced to adopt the subtle yet ill-defined Bohrian concept of complementarity. For two distinct pieces of information have to be considered complementary only if they are *about the same object*.

Losing the concept of complementarity is not to be deplored. After all, each component of this concept is debatable.

Mutual exclusiveness, to begin with, is an excessive statement, both in physics and in hermeneutics. The wave aspect is exclusive of the " corpuscular " (i.e. *discrete)* aspect of microphysical phenomena only in ideal circumstances. Usually, both aspects are present at once, although not to their full extent. On the one hand, what is distributed according to wave-like interference patterns is a set of discrete corpuscle-like impacts; and on the other hand, the distribution of *approximately* aligned events which defines a corpuscle-like *trajectory* is determined by wave-like diffraction effects (Held, 1994)[19]. In a similar way, mutual exclusiveness between hermeneutic " understanding " and scientific " explanation " refers to an ideal state of affairs ; understanding of co-subjects usually benefits from being embedded in a framework of objective explanation, and conversely objective accounts arise as generalized coordinations of possible embodied experiences.

As for *joint exhaustivity*, it is even more disputable. Saying that the wave-like predictor only depicts one aspect of some *deeper object*, is tantamout to denying that the universally valid component of microphysics has been entirely captured by this invariant predictor. It means accepting that quantum mechanics is somehow " incomplete ", which, from Bohr's standpoint, suggests surrender to Einstein's arguments. Similarly, asserting that scientific explanations have to be complemented with co-subject understanding in order to reach exhaustivity *about something* is tantamount

19Unsharp measurements are another, more formal, way of seeing that the two so-called " exclusive " aspects are both present to some extent in any case.

to imagining that there is some third term that no approach (neither objective nor intersubjective) can entirely encompass. But evoking such a third term (e.g. Spinozist substance) means that hermeneutics has lapsed into metaphysics, which was certainly not part of its project.

We must then go back to the basic limitation shared by microphysics and the science of mind, and stick to it throughout. Microphysical phenomena adhere to the contraptions that are supposed to " reveal " them; and conscious experience adheres to conscious beings. Detachment is impossible or artificial in both cases. So, what is to be done in such circumstances, if one does not try to impose a dualistic cut by *fiat?* Heisenberg suggested the following solution: " (...) even when a given state of affairs cannot be objectified, (...) this very fact can be objectified in turn and studied in connexion with other facts" (Heisenberg, 1998, p. 268). In other terms, whenever *primary* objectification of a certain set of phenomena is unattainable or contrived, *secondary* objectification can still be worked out. But what exactly is secondary objectification? How should we understand Heisenberg's urge to objectify the very fact that (primary) objectification is out of reach? I suggest the following interpretation of this strategy. Secondary objectification amounts to:

(i) Objective description of the *conditions* under which phenomena occur that are not themselves liable to objectification;

(ii) Elaboration of universally valid rules for *predicting* this kind of phenomena;

(iii) Statement of universally efficient prescriptions for mastering *directly* the *technological* implementations of the predictive rules.

In the popular picture of science, the aim is to formulate a distantiated model of reality " out there " (be it based on " complementarity "), and then to derive predictions and technological applications from this model. But in the alternative picture of science which is emerging, this traditional hierarchy no longer holds. Technology has two-way non-hierarchical relations with local or secondary objectifications. Along with the first way, technology is guided by these objectifications. But conversely, it supports them by its successes; and it also provides them with a *constitutive* frame (i.e. the elementary structure of the rational procedures used in technology is stamped on the secondarily objectified predictive rules). This being granted, the last remnants of a conception of theories as " *theoria* ", as pure contemplation from without, have disappeared. Theories seen from within are mere structural expressions of the largest range of possible practices and possible outcomes at a certain steady state of the advancement of science.

Microphysics and the science of consciousness both fit with this

characterization.

(a) *Microphysics*

Firstly, microscopic phenomena cannot be parsed. One cannot discriminate the contribution of the apparatus and the contribution of a putative object. The phenomena are not dissociable from the context of their appearance. Yet, the (macroscopic) *experimental conditions* under which these phenomena occur can be objectified by way of a classical or semi-classical mode of description. Secondly, microscopic phenomena can be predicted directly by using the universally valid formalism of quantum mechanics. Thirdly, quantum technology is no mere ancillary byproduct of a theoretical description of some detached domain of objects. Rather, it sets up two-way relations with the formalism of quantum mechanics. Along with the first way, technological prescriptions are guided by fragmentary models derived from the quantum theory. They are also determined by the quantum formalism. But conversely, the technological procedures also have an overall *constitutive* role for the secondarily objectified rules and invariants of this formalism. Indeed, as I showed in previous work (Bitbol, 1996a, 1998), the basic formalism of quantum mechanics can effortlessly be construed as a structural presupposition of any activity of production and unified anticipation of mutually incompatible contextual phenomena.

(b) *The science of consciousness*

Firstly, conscious experience cannot be dissociated from the overall lived context of its occurrence. Yet, the neurophysiological, bodily, and environmental *conditions* under which various *types* of experiences occur can (at least in principle) be objectified according to the standards of classical science. Secondly, nothing prevents one in principle from using this (secondary) objectification of conditions for predictive sake. Thirdly, neuro-pharmacological and neuro-functional technologies for modifying conscious states do not derive from some utopical knowledge of the interactions between a pseudo-object " consciousness " and the object " brain ". They are based on an ever increasing set of predictive rules, and conversely they contribute to the elaboration of these rules.

To recapitulate, the science of consciousness is not a science in the narrower sense of 'distantiated knowledge of a domain of objects'; rather, it is a *technology of embodiment,* or a science in Varela's broader sense of a 'dialectical relation between subjective views and intersubjective invariants'. Similarly, considering quantum mechanics as a general *technology of mesoscopic action and experimentation*, or as a dialectical relation between situated phenomena and predictive invariants, easily makes sense of its basic formalism and automatically defuses major paradoxes (Bitbol, 1996a).

The mark of this alternative conception of science in both areas is replacement of dualism with *pragmatic parallelism* (Bitbol, 1996b) rather than with monistic eliminativism or with reductionism. For eliminativism is incurably biased, and every version of reductionism (from the identity theory to functionalism) conveys a materialist version of dualism: brain-world dualism for the identity theory, and software-hardware dualism for functionalism. Let us then define pragmatic parallelism in a few words, before we show how it applies both to the mind-body problem and to the usual quantum enigmas.

To begin with, adopting parallelism is tantamount to accepting that one may give two distinct *self-sufficient* parallel accounts whenever one is immersed in some participatory process. Adding that this parallelism is only " pragmatic " means that one discards metaphysical versions of parallelism from the outset. Here, the two parallel accounts do not indicate two sets of properties or aspects *of* a single substance. As I mentioned previously, quoting K-O. Apel, they merely stand for:

-two different " interests " (sharing a situation and freeing oneself from situatedness);

-two distinct pragmatical attitudes (engagement and distance);

-two different focuses in research (participation and striving towards invariance);

-two different functions of discourse (expressive and descriptive).

Their unity is not due to their pointing towards a common transcendent object, but rather to their stemming (in two different directions) from a common immanent background that one may call *" Lebenswelt "* with due reference to Husserl. As for the circumstance that *two* of them are required nevertheless, it does *not* reveal a duality of aspects of some putative transcendent object; it rather points towards the limits of objectivity, namely towards the negative fact that standing back and striving for invariance cannot exhaust *all* the aspects of life within an immanent stream.

Seen from that perspective, the riddles of dualism appear to arise from: (i) the common habit of mixing up the two types of accounts in a single series, and (ii) the temptation to reify each one of them. Alternating the accounts does no harm by itself, and may have sound practical justifications. But as soon as substances or properties replace stances or functions within the mixed account, one is at pain to set up causal relations between the two fake entities. The question one feels bound to raise is: " When, where, and how do the two entities interact? ". But no answer to *that* question is available.

The most striking instance of this kind of conundrum is the mind-body

problem. Let us analyze it along this line. As it has now become widely accepted, given a series of events involving an " agent ", one can develop both a *thoroughly intentional* account and a *thoroughly causal* account of it (Anscombe, 1957, §23). The intentional account starts from the agent's *decision,* proceeds with *action,* and then goes on throughout an indefinite sequence of *intended outcomes.* The causal account would presumably start from certain firings of neurons in the brain of the agent (although the causal series can start arbitrarily earlier), it would proceed with muscle contractions, and it would then go on throughout an indefinite sequence of effects in the world. However, actual accounts are mixed. One commonly uses the intentional idiom at first (in the immediate surroundings of the agent), and then the causal idiom (for remote effects). The boundary between the two types of account is a matter of practical convenience. Depending on whether one is a physician or a lawyer, this boundary can be shifted closer to or farther from the agent's brain.

The problem is that the intentional idiom is soon reified and turned into a description of what occurs in somebody's mind (or, according to the materialist version of dualism, in somebody's brain). As for the causal idiom, it is also reified and turned into a description of what occurs *an sich* in the external world. From that point on, the questions " when, where, and how does the bridging between mind and body (or between mind and the world) take place? " seem both inescapable and unanswerable.

These questions are unanswerable indeed:

-Because the question " how? " is completely misplaced. If, as H. Putnam pointed out, mind is definitely *not* to be conceived as a thing or property; if, instead, " talk of minds is *talk of world-involving capabilities that we have and activities that we engage in* " (where the use of the verb *to engage* is to be stressed), then the question as to how the two " things (or properties) " interact does not even arise (Putnam, 1999, p. 170).

-Because the answers to the questions " when and where? " are just as much a matter of practical convenience as the use of the intentional and causal idioms is. The locus of interaction between mind and body (or world) then remains intrinsically undecided. Even *materialist* dualism is unable to define exact borders between the two ontologically homogeneous entities it posits: the question " where does the information processor stop (in the brain, at the boundaries of the body and the world, or somewhere in the environment)? " [20] has no clear-cut answer.

But the questions " when, where, and how (do mind and body

20 The idea that the problem-solving capacities usually ascribed to the mind are actually *distributed* between the (human or animal) body and the world is currently gaining ground. (Clark, 1997, p. 160-166; Thompson & Varela, 2001)

interact)? ” are by no means inescapable, provided one goes back to their very (hermeneutic) source, as we have just tried to do.

Our second instance of dualistic conversion of parallelism is borrowed from microphysics. Let us consider the case of alpha-ray tracks in Wilson’s cloud chamber, as analysed by N.F. Mott (Mott, 1929; Bitbol, 2002). One can develop two extreme accounts of this process. One account is clearly situated, in so far as it is relative to what one may witness in looking at some particular cloud chamber: it describes the process as successive ionizations of hydrogen atoms and subsequent condensation of approximately lined up water droplets. The other account only describes the evolution of a multi-dimensional *wave-function* (the entangled wave-function of the system [alpha-particle+molecules of water]). It involves secondary distantiation, since the wave-function can be interpreted as an *invariant predictor* (i.e. invariant with respect to the wide range of irreversible and individually irreproducible courses of events that may develop across microscopic experiments). However, the most popular accounts of the tracks are mixed: they mix continuous wave-like processes and discontinuous occurrences, (secondarily) objective predictors and situated reports. Physicists usually describe the evolution of a 3-dimensional wave-function for the alpha-particle, then “ reduce ” this wave function whenever an ionization occurs (Heisenberg, 1930), then propagate again the reduced wave etc. The boundary between the wave-like account and the “ reduction ” process is to a large extent a matter of practical convenience. It depends on the required precision for subsequent predictions.

The problem, here again, is that both accounts (secondarily objectified and situated) are somehow reified. The wave-like universal predictor has often been reified and turned into a description of real wave processes. Accordingly, the (interest-relative) wave function reduction has been considered as a faithful description of some (strangely instantaneous and ubiquitous) collapse of a real wave process. If this twofold reification is accepted, the questions “ when, where, and how does the sudden transition between the continuous wave propagation and the discontinuous reduction take place? ” seem both inescapable and unanswerable. True, these questions motivate a flourishing program of research nowadays[21]. But the desired answer remain stubbornly elusive. A more promising way out, then, is to realize that the question about the “ where, when and how ” of reduction might well be *meaningless*. For, *prima facie*, reduction is no

21 See e.g. Penrose’s “ Objective Reduction ” program, in connection with quantum gravitation (Penrose, 1994). The idea of objective spontaneous reduction was first developed by G.C. Ghirardi, A. Rimini, & T. Weber in 1986 and it was supported by J.S. Bell.

“ thing ”, event, or process; it comes up as a calculation trick used whenever one needs to *redefine* the invariant predictor by taking into account a former situated experimental outcome[22]. Moreover, as a calculation trick, it is not even indispensible (Van Fraassen, 1991, p. 257). One can perfectly revert to Mott’s strategy which consists in describing the evolution of an increasingly entangled wave function in *parallel* with the sequence of events about which it affords probabilistic predictions.

It is interesting to notice, in this respect, that two of the most advanced “ solutions ” to the measurement problem of quantum mechanics, namely Everett’s interpretation and decoherence theories, do not even attempt to answer questions about state reduction. Everett’s interpretation only deals with *appearance* of reduction (for a situated experimenter), whereas it develops indefinitely the parallel between the continuous (unitary) evolution of a global wave-function and the discontinuous series of observations. As for decoherence theories, they describe the transition from quantum probabilities (with interference effects) to quasi-classical probabilities (with negligible interference terms); they have *nothing* to say about state reduction *stricto sensu*, i.e. about some putative sudden jump from a superposed state to *one* of the eigenstates of the measured observable (Lyre, 1999).

To summarize this point, we now see that the questions “ when, where, and how? ” raised about the so-called reduction of the state are not inescapable either, provided one goes back to the very *function* of the concept of reduction below the level of reified entities, and sticks to it throughout.

What was at stake until now was only the *negative* side of the dissolution strategy. The “ hard problem ” of consciousness was deconstructed along the same line as the measurement problem of quantum mechanics. But one can push this thorough analogy one step further, so as to obtain convergent *positive* teachings on both puzzles.

A first positive teaching bears on the convergent *origin* of both puzzles. As we noticed previously, the origin of the “ hard problem ” of consciousness as described by D. Chalmers is that, from standard objective scientific theories, one can only get more structures and relations, but nothing about the non-structural features of phenomena, let alone about the absolute fact of phenomenality. Objective scientific theories *assume* the very fact of experience, and they extract a structural invariant out of it; one should not expect from them a convincing *derivation* of what is their most basic condition of possibility. In the same way, from the standard quantum

22 This idea was first suggested by Schrödinger (Schrödinger, 1935). It was then developed in (Van Fraassen, 1991; Omnès, 1994).

mechanics, one can only get more (secondarily objectified) predictive structures and correlations, but nothing about the nature of each single phenomenon in given experimental circumstances, let alone about the brute fact that there *are* well-defined phenomena. Quantum mechanics *assumes* that there are experimental phenomena manifesting themselves at a macroscopic scale (its predictions are *about* them); one should not expect from it a full-scale derivation of its own background of elementary assumptions.

Several neo-bohrian authors insisted on that point. Among them, M. Mugur-Schächter (Mugur-Schächter, 1997) and U. Mohrhoff found some striking expressions. According to the latter author, little reflection is needed to realize that " Quantum mechanics always presupposes, and therefore never allows us to infer the existence of a fact (...) " (Morhoff, 2000). The symbols of this theory are secondarily objectified generators of *possibilities* and probabilities. They arise as the by-product of a systematic attempt at detaching a formal element from the flux of situated *actual* phenomena. It is then plainly absurd to think that something of the eliminated actuality can be recovered from the abstract possibility-structures: " Quantum mechanics only takes us from the real world to the realm of possible worlds, and there it leaves us ".

Another supporter of this idea is R. Omnès. " Facts exist ", he writes. " Nobody can explain that as a consequence of something more basic " (Omnès, 1994, p. 350). This may sound strange, especially from such a prominent specialist of decoherence theories. But is that so surprising? After all, as I already pointed out, decoherence theories alone are unable to pick a particular actual phenomenon out of the manifold of possible phenomena in a given experimental situation. They only show how the probabilistic structure which is typical of a *disjunction* of phenomena can emerge from a more entangled probabilistic structure. Moreover, even to reach such a restricted result, decoherence theorists could not avoid making anthropocentric hypotheses. W. H. Zurek for instance assumed that the measurement chain consists of three elements : the micro-object, the apparatus, and the environment. But, admittedly (Zurek, 1982), this division only holds at the emergent level of the macroscopic manifestations and is thus crypto-anthropocentric. Another anthropocentric assumption was used by M. Gell-Mann, who posited a *coarse-graining* of the consistent histories, and justified this coarse-graining by the macroscopic scale of a population of anthropomorphic "Information Gathering and Utilizing Systems" (IGUS). The decoherence theories thus do not prove that a classical world of disjunctive events and properties *necessarily* emerges from a quantum micro-level; they *do not derive* this classical

world from a quantum world. They only show how the two levels of theorization, namely the classical and quantum levels, can be made *mutually compatible* under certain assumptions. But of course, this compatibility is not just optional: it is methodologically *compulsory*. For the consequences of the theory (here, quantum mechanics) *must* be made compatible with its elementary epistemological presuppositions (here, the classical level of properties and events *about* which quantum mechanics affords predictions). If this compatibility were not ensured, a thorough-going kind of inconsistency would undermine the quantum paradigm. This being granted, the additional (anthropocentric) hypotheses of the decoherence theorists are no longer to be despised. They are conditions for the mutual compatibility between quantum mechanics and its elementary presuppositions. They are operators for imposing *mutual constraints* between the physical theory and its epistemological presupposed background.

We are thus led to our second positive teaching on both the mental puzzle and the quantum puzzle. As we now realize, the act of dispelling the referred to puzzles does *not* amount to *deriving* the actuality (conscious or experimental) from some objective description[23]. It simply means enforcing mutual constraints between (i) the actuality which is necessarily *presupposed* by the description, and (ii) certain elements which *belong* to this description. It requires nothing more and nothing less than a detailed statement of *self-consistence* of the overall epistemic system which encompasses objective reports and their pragmatic or experiential background. Let us make these statements more specific, by adapting them successively to the mental puzzle and to the quantum puzzle.

A-In the mental case, mutual constraints are enforced between stabilized contents of experience and certain neurophysiological processes, according to Varela's neurophenomenology. Such mutual constraints operate at two levels.

(1) The first level is structural. It would be naive to think that " psycho-physical correlation " is pre-given out there, ready to be witnessed. The neuroscientific and phenomenological *categories* have to be mutually adjusted in order to become fully comparable with one another. This requires formulation of appropriate neurological concepts (such as long-range cortical correlations, or temporal binding of neural activity) on the one hand, and *engagement* in reliable methods of phenomenological stabilization and report on the other hand.

(2) The second level is individual. Once a set of relevant categories

23 The primarily objective neurophysiological description in one case, and the secondarily objective quantum formalism in the other case.

has been selected, discontinuous series of phenomenological reports are to be put in one-one correspondence with discontinuous series of neural events.

B-In the quantum case, mutual constraints are enforced between experimental phenomena and certain aspects of the formalism. This type of mutual constraints here again operate at two levels.

(1) The first level is structural as well. The experimental and quantum theoretical categories were progressively adapted in order to become fully consistent to one another. The earlier aspect of this adaptation was usually unselfconscious (although Bohr's principle of correspondence served as a guide). It consisted in (i) selecting appropriate formal elements (called " observables ") which could be associated with microphysical experiments, and, conversely, (ii) defining experimental situations (such as Heisenberg's microscope) which may make sense of the algebraic relations of quantum observables. As for the most recent aspect of the structural adjustment of experiments and quantum mechanics, it was the demonstration, provided by *decoherence theories*, that the structure of quantum theoretical probabilities is *compatible* at the mesoscopic scale with a basic precondition of any experiment: the uniqueness and definiteness of its outcomes.

(2) The second level is individual. Once the mutual accomodation of the theoretical and experimental *formats* has been completed, discontinuous experimental events can be forced into the theory, either by means of the reduction postulate, or by changing the contents of Everett's " memory bracket ".

To summarize, there exists a very detailed parallel between the mind-body problem and the measurement problem of quantum mechanics. I take this parallel to be highly significant, because it reveals the common limits of scientific knowledge classically conceived, and because it calls accordingly for a general redefinition of science. Both problems arose from an unavoidable blindspot in objective description. Both problems motivated a (fruitless) struggle aiming at encompassing the blindspot of actuality within the very objective structure that results from systematic elimination of situated actualities in favor of inter-situational invariants. Both problems can then find a general (dis)solution along the following line. One should neither deny the blindspot (radical eliminativism), nor try to force it within the visual field of objective science (reductionism), nor reify this blindspot and take it as some " thing " distinct from the visual field (dualism(s)). One should rather:

(i) Identify those structural or dynamical features in the visual field of objective science, which *indirectly* point towards the persistance of a

blindspot. This careful analysis of recurring quandaries is the step of diagnosis, which is too often overlooked.

(ii) Stretch the method of science in order to enforce a strong reciprocal relation between its objective contents on the one hand, and what the very act of objectification forced one to leave out on the other hand. This is the therapeutic step, according to Varela's prescription.

True, the remarkable isomorphism we have just documented has also triggered a sense of vague analogy, if not identity, between the two problems. Many attempts at *merging* the mind-body problem and the measurement problem of quantum mechanics were made in the past, in the name of this isomorphism. A first group of authors, from C.G. Darwin (Darwin, 1929) to E. Wigner (Wigner, 1979), relied on a dualist view of the mind-body problem to provide the measurement problem with a dubious " solution ": the collapse of the wave-function by an act of conscious awareness. A second group of authors, especially H. Stapp (Stapp, 1993) and R. Penrose (Penrose, 1994), conversely looked in quantum mechanics for a reductionistic " solution " of the mind-body problem. Stapp's thesis is especially fascinating in this respect, for it relies on mere *conflation* of the actuality of experimental microphenomena (and its formal counterpart, namely *state reduction),* with the actuality of conscious experience. According to Stapp, a conscious act *is* the " feel " of the reduction of a brain's global quantum state (Stapp, 1993, pp. 43, 149, 153)[24].

But in view of our analysis, *all* these approaches result from a twofold mistake and a twofold confusion: (i) confusion of the blindspot of objective knowledge with a missing (material or mental) *entity,* and (ii) confused attempt at locating this fake " entity " somewhere within a domain of knowledge whose very existence presupposes the institution and preservation of the corresponding blindspot.

Conclusion

In this paper, we have explored two sideway " solutions " of the hard problem of consciousness. These two " solutions " were deeply intermingled, but they can be stated separately as follows. The first one boils down to relaxing tensions and letting oneself be penetrated by the sense of mystery which arises from just " being there ", in this special

24 Not to mention the lack of ontological credibility of the " state reduction ", one could easily notice, in Chalmers style, that there is absolutely no *reason* why these supposedly objective processes called " reduction " should be associated with a " feel ".

human and individual situation. The second one consists in engaging oneself in an ever-developing program of research about the neural correlates (or necessary conditions) of experiential contents, without bothering to look for an *explanation of* conscious experience *by* neural processes. As I tried to show, far from being incompatible with one another, the two way outs are likely to be complementary (in the usual, non-bohrian sense). For, notwithstanding materialist blind faith in the all-encompassing power of science, the second way out is *permanently* bound to take the first one as its tacit yet creative presupposition. But in order to get a clearer view of this complementarity, a few more precise statements of the two orientations of thought are required.

To begin with, it is interesting to notice that the " ataraxic " stance with respect to the problem of consciousness was adopted not only after but also before the advent of cognitive neuroscience. Thus, following E. Mach's " neutral monism ", or W. James' and B. Russell's " radical empiricism ", R. Carnap took " (...) that which is *epistemologically primary*, that is to say (...) experiences themselves in their totality and undivided unity " (Carnap, 1967, §67) as the " basis " of his early constructivist endeavour. According to the young Carnap, making any other choice, e.g. trying to explain everything (including conscious experience) on a physicalist basis, would be misguided, because it would mean reverting the " epistemic order " that goes *de facto* from the background experience to the constructed entities. This being granted, explaining experience *as such* is by definition out of reach of objective science. For scientific explanations can only use constructed concepts, and they are therefore in principle unable to justify the material of their constructions. Similarly, Carnap pointed out that a *scientific explanation* of " psychophysical parallelism " is by definition unattainable. Metaphysics tries to provide speculative explanations, by postulating some third substantial entity of which the two series are mere *aspects*. By contrast, objective science can do no more than ascertain that " (...) parallel sequences of this sort can be *constructionally produced* ". In other terms, it cannot go beyond showing that mutual correspondence *can* be *enforced* between the psychological series and several physical series (including the neurophysiological one). However " (...) this does not mean that there is a gap in science: *a question which goes further cannot even be formulated within science* " (Carnap, 1967, §169). Here, the constitutive *blindspot* of science is fully recognized. But at the same time it is sharply set apart from any manifest *gap.*

To some extent, Carnap was on the right track. His views are especially efficient for defusing the recurring conflict between the Nagel-

Jackson-Chalmers statement of incompleteness of natural science and the eliminativist or reductionist claim of completeness. Indeed, Carnap's position can be characterized as a balanced middle way: Yes, there is a blindspot; no there is no gap. Or, in more precise wording: Yes, there is a *constitutive* incompleteness; no, there is no *epistemic* incompleteness.

(a) *Constitutive incompleteness.*

Objective science cannot encompass the truism that *you* are *you;* a human being, not a bat. Furthermore, as a mode of *knowledge,* objective science is completely foreign to the circumstance that you *could* nethertheless *be* a bat. Indeed, in that case, no item of *knowledge* would be gained by changing your identity and species. *Being* a bat, you would not even *know* " what-it-is-like-to-be " a bat; you would just be *immersed* in it. (Objective) knowledge requires *distance,* whereas " what-it-is-like-to-be " presupposes *engagement* in being-there.

(b) *Epistemic completeness.*

It is clear that objective science does not lose any *fact-like* datum, any element of *knowledge,* as a consequence of the elusive kind of incompleteness mentioned in point (a). For objective science potentially encompasses every *structural feature* of experience, and structure is all there is to be *known about* " what-it-is-like-to-be ". The remainder is mere *participation.*

To recapitulate: Yes the Nagel-Jackson-Chalmers argument is perfectly sound; no the eliminativist or reductionist defense of objective science is not wrong. This is a crucial lesson to learn from Carnap's early constructivist system.

Yet, many objections can be raised against this constructivist system. They have been formulated by several authors, including the later Carnap. One fundamental objection concerns the so-called *elements* of the construction. Although Carnap criticized Mach for having called " elements " a set of abstract entities (i.e. the sense data), his undivided " elementary experiences " fare no better. For after all, as it has repeatedly been pointed out after Wittgenstein, *discourse* on experiences cannot be primitive. It is one of the most elaborate kinds of discourse, because it is based on a background acceptance of ordinary language and reference to public objects. Experience may well be *factually* primary, it remains *discursively* secondary. Taking it as the basic constituant in a discursive theory is therefore highly questionable. This may explain why conceptions that take experience as their unconditioned departure point have never been very popular despite their being *intuitively* attractive. Another objection is that Carnap, like so many other philosophers, has nothing to say about *how* mutual correspondence can be implemented between the psychological and

physical series. The program of experiential discipline, which is so central in Varela's neurophenomenology, is just skipped by Carnap.

So, let us now turn to more recent varieties of " ataraxic " attitudes that are free from these defects. Departing from the radical empiricist tradition, H. Putnam is very careful in criticizing the philosophically popular notions of sense data and private show. He systematically rehabilitates common expressions such as " it appears to A that object X is white ", instead of the philosophical idiom " there are 'white' sense-data within A's mind/brain ". Unlike Carnap, Putnam then ascribes no fundamental theoretical status to experiences; he rather advocates a " natural realist " position close to common sense and ordinary language. Yet, when he finally accepts to tackle the " mystery of mentality ", Putnam discards any prospect of explanation, by derivation or by " emergence " from a physicalist basis. He rather equates this mystery to the mystery of the existence of " the physical universe itself " (Putnam, 1999, p. 174), about which we have nothing to say because it is the condition of everything else. This idenfication can be taken as an oblique but unambiguous recognition that experience is (at least) as much primitive as the physical universe itself. According to Putnam, just as one would deny the question " why is there a physical universe rather than none? " any scientific status (and/or meaning), one should deny the question " why is there *experience* rather than none? " any scientific status (and/or meaning). One reason for this common rejection is likely to be that the two questions are closely related. After all, the type of (unscientific and/or meaningless) question that captures best the puzzle of the " given " is: " why is there experience-of-a-physical-universe rather than none? " or even " why is there (this indiscriminate) something rather than nothing at all? ". Any split between " experience " and " physical universe " in this context is bound to be a (disputable) dualist byproduct of philosophical analysis. If any question about the " why? " of the existence of the experienced *physical universe* is scientifically meaningless, then so is, automatically, any question about the " why? " of the existence of the *experience of* a physical universe.

To sum up, Putnam's position combines (i) explicit denial of the basic theoretical status of experiential entities in a Wittgensteinean style, and (ii) implicit presupposition of experience as the all-pervading unquestioned background of any theoretical or discursive development.

Point (ii) of Putnam's approach now guides us towards the second way out: *just practice; just develop the scientific inquiry*. True, excessive focus on scientific practice may generate illusions and lopsidedness, in so far as it encourages one to deny what is not (and cannot be) the *object* of an

investigation any reality. But little reflective effort is needed to realize that those verbal or experimental practices which have little or nothing to say *about* situated experience, are nevertheless inextricably embedded *within* this situated experience. Practices are thus likely to *express* (or to *show* indirectly something of) their experiential background, and conversely to *shape* it. Practices can be studied in this spirit, and they can also be complemented in order to improve their disclosing/shaping aptitude.

Wittgenstein was the first consistent exponent of this crypto-phenomenological research program. He was aware that he could easily be accused of neglecting " (...) what goes without saying ", namely " the experience or whatever you might call it (...) almost *the world* behind the mere words " (Wittgenstein, 1968b). But he also insisted that, precisely because *this* goes without saying (because *this* is just universally presupposed), he could not do otherwise[25]. How could he describe what is the tacit presupposition of any description without breaking the constitutive rules of language? The accusation of neglect was thus seen to be irrelevant: " Isn't what you reproach me of as though you said: 'In your language, you are only speaking!' " (Wittgenstein, 1968b). Accordingly (see section 1), Wittgenstein concentrated on how a complex form of life involving first-person experience, intersubjective communication, and objective characterization of behavior, can fix the rules of use of an expressive terminology. This terminology discloses and shapes all at once a set of experiential clusters.

As I mentioned previously, Varela also focused on practices, rather than on illusory theoretical explanations of conscious experience. His specific suggestion consisted in complementing the set of standard practices of science with disciplined attention, and connecting the first-person outcome of this attention with neurobiological invariants. Such sophisticated practices clearly have a disclosing aptitude (through their phenomenological " descriptive " component), but they also focus on *shaping* experience (i) by the phenomenological " reduction " they rely on, and (ii) by the neuro-phenomenological feed-back loop they institute. Far from generating objectivist short-sightedness, the motto " just develop the scientific inquiry " here partakes of a larger project in which subjectivity is recognized both as an ubiquitous background and a dialectical partner.

To conclude, we must realize that by adopting such an attitude, Varela promoted an epistemological leap which can only be compared with Darwinism.

Before Darwin, natural science was methodologically restricted to

25 " 'I have consciousness'- that is a statement about which no doubt is possible'. Why should that not say the same as: 'I have consciousness' is not a proposition? " (Wittgenstein, 1967, §401).

reproducible state of affairs and lawlike necessity. Whenever contingency came in, it was imported from a non-scientific realm (e.g. from theology *cum* finalism). But Darwin encompassed contingency within the scientific domain by extending the methods of science to a natural history of random (genotypic and phenotypic) variations plus " selection of the fittest ". This method proved so powerful that some authors recently offered a Darwinian explanation of an all-pervasive type of contingency: that of the laws of nature themselves (Smolin, 1999).

Similarly, until now, natural science (in the sense of the German *Naturwissenschaften)* was inherently dismissive of subjectivity, or more generally situatedness, and of the procedure of intersubjective or intersituational " simulation " as well. It was constitutively (and for excellent epistemological reasons) foreign to what we may call the *ultimate contingency:* that you *are* you, with this birth, this biography, this genotype, these projects, this standpoint, this way of seeing things, these feelings ... this situation. Not the dry (third-person) fact that there *is* such an entity in the common world, but the awe-generating (first- or second-person) platitude that *you* coincide with *this* unique center of perspective, that you are the coordinate origin of your local world. This structurally excluded aspect of natural science was traditionally taken care of (somehow) by the *Geisteswissenschaften,* in their most specific German sense. But one presently witnesses a multifarious trend towards cross-fertilization of the two formerly incompatible *Wissenschaften.* After history and ordinary contingency, hermeneutic " understanding ", with its capacity for tackling what I have called the " ultimate contingency ", is creeping in at several levels of science (notwithstanding Sokal's caricature). The reason for this is that the program of " naturalization " imperatively requires an unprecedented breaking (and widening) of the procedural framework of natural science in order to overcome the momentous failure of the various reductionisms. In the field of the science of mind, implicit hermeneutization of objective science by P. Churchland (inspired by Kuhn), represents a half-recognition of this need. But Varela's program of establishing mutual constraints between first-person and third-person descriptions appears to be the first *direct* and *self-conscious* statement of the tendency to expand the area of both *Wissenschaften* by unifying their formerly separated branches at a higher methodological level. Varela clearly posited the *design* and the *principles* of the epistemological leap.

As I have shown in section 3, his ideas were only anticipated (although cryptically, in the *modus operandi* of the formalism and in one of its interpretations) by quantum mechanics. For, in the framework of quantum mechanics, the methodological turn which consists in

encompassing both the situated accounts and the invariant entities in a non-reductive process of fine tuning has *already* been taken in practice. A few more decades (and some more foundational work) may be needed to realize this wholeheartedly. Here as in the science of mind, there are still resistances. But the falling apart of the resistances that arise in both disciplins is likely to be dramatically promoted by a full appraisal of their common root.

Bibliography

Anscombe, G.E.M. 1957. *Intention*, Oxford: Basil Blackwell.

Apel, K-O. 1976. Causal explanation, motivational explanation, and hermeneutic understanding. In G. Ryle (ed.), *Contemporary aspects of philosophy*. London: Oriel Press, 1976

Apel, K-O. *Towards a transformation of philosophy.* London: Routledge & Kegan Paul, 1980

Audi, R. (ed.) 1999. *Cambridge Dictionary of Philosophy*. Cambridge: Cambridge University Press.

Bitbol, M. 1996a. *Mécanique quantique, une introduction philosophique.* Paris: Flammarion.

Bitbol, M. 1996b. *Schrödinger's philosophy of quantum mechanics,* Dortrecht: Kluwer.

Bitbol, M. 1998. Some steps towards a transcendental deduction of quantum mechanics. *Philosophia Naturalis,* 35: 253-280.

Bitbol, M. 1999. L'alter-ego et les sciences de la nature, Autour d'un débat entre Schrödinger et Carnap. *Philosophia Scientiae,* 3, 203-213.

Bitbol, M. 2000. *Physique et philosophie de l'esprit.* Paris: Flammarion.

Bitbol, M. 2001. Non-representationalist theories of cognition and quantum mechanics. *SATS (Nordic journal of philosophy),* 2: 37-61.

Bitbol, M. 2002. Radioactivity without particles? Mott's account of alpha-ray tracks in cloud chambers. In C. Blondel, J. Hughes, P. Radvanyi, & R.H. Stuewer (eds.), *History of radioactivity*, (To be published).

Blackburn, S. 1993. *Essays in quasi-realism.* Oxford: Oxford University Press.

Bohr, N. 1987. *Atomic theory and the description of nature.* Woodbridge: Ox Bow Press.

Bouveresse, J. 1987. *Le mythe de l'intériorité.* Paris: Editions de Minuit.

Carnap, R. 1936. Existe-t-il des prémisses de la science qui soient incontrôlables? *Scientia*, LX: 129-135.

Carnap, R. 1967. *The logical construction of the world*, London: Routledge & Kegan Paul.

Chalmers, D.J. 1995. Facing up to the problem of consciousness. *Journal of Consciousness studies*, 2: 200-219.

Chalmers, D.J. 1996. *The conscious mind : in search of a fundamental theory.* Oxford: Oxford University Press

Chalmers, D.J. 1997. Moving forward on the problem of consciousness. *Journal of Consciousness studies*, 4: 3-46.

Churchland, P.S. 1986. *Neurophilosophy: Toward a Unified Science of the Mind-Brain.* Cambridge, MA: MIT Press.

Churchland, P.M. & Churchland, P.S. 1998. *On the contrary.* Cambridge, MA: MIT Press.

Clark, A. 1997. *Being there*, Cambridge, MA: MIT Press.

Darwin, C.G. 1929. A collision problem in the wave mechanics. *Proceedings of the Royal society. London*, A124: 375-394.

Dennett, D. 1992. *Consciousness explained.* New-York: Little, Brown & Co.

Depraz, N. 1999. When transcendental genesis encounters the naturalization project. In J. Petitot, F.J. Varela, B. Pachoud, & J-M. Roy, *Naturalizing phenomenology.* Stanford, CA: Stanford University Press.

Depraz, N., Varela F. J., & Vermersch P. 2002. *On becoming aware: An experiential Pragmatics.* Amsterdam: Benjamins Press.

Engel, P. 1996. *Philosophie et psychologie.* Paris: Gallimard.

Edelman, G. 1994. *Bright air, brilliant fire.* London: Penguin, 1994.

Flannagan, O. 1992. *Consciousness reconsidered.* Cambridge: Cambridge University Press.

Föllesdal, D. 1984. Husserl's theory of perception. In H.L. Dreyfus, *Husserl, intentionality and cognitive science.* Cambridge, MA: MIT Press.

Goldman, A.I. 1989. Interpretation psychologized. *Mind and language,* 4: 161-185.

Goldman, A.I. 1992. In defense of the simulation theory. *Mind and Language,* 7, 104-119, 1992

Gordon, R.M. 1986. Folk-psychology as simulation. *Mind and Language,* 1: 158-171.

Gordon, R.M. 1992. The simulation theory : objections and misconceptions. *Mind and Language,* 7: 11-33.

Greenwood, J.D. 1999. Simulation, theory-theory and cognitive penetration : no 'instance of the fingerpost', *Mind and Language,* 14: 32-56.

Hacker, P.M.S. 1993. *Wittgenstein, meaning and mind (Part I : essays),* Volume 3 of *An analytical commentary of the Philosophical investigations.* Oxford: Basil Blackwell.

Hardcastle, V.G. 1996. The why of consciousness : a non-issue for materialists. *Journal of Consciousness Studies,* 3: 7-13.

Heisenberg, W. 1930. *The Physical Principles of the Quantum Theory.* Chicago: University of Chicago Press.

Heisenberg, W. 1990. *Physics and philosophy,* London: Penguin.

Heisenberg, W. 1998. *Philosophie, le manuscrit de 1942.* Paris: Seuil.

Held, C. 1994. The meaning of complementarity. *Studies in history and philosophy of science,* 25: 871-893.

Husserl, E. 1928. *Ideen zur Einer Reinen Phaenomenologie und*

phaenomenologischen Philosophie. Halle: Max Niemeyer.

Jackson, F. 1997. What Mary did not know. in : N. Block, O. Flanagan, & G. Güzeldere, *The nature of consciousness*, Cambridge, MA: MIT Press.

Lakatos, I. 1978. *The methodology of scientific research programmes, Philosophical papers volume 1.* Cambridge: Cambridge University Press.

Le van Quyen, M., Martinerie, J., & Varela, F.J. 1999. Spatio-temporal dynamics of epileptogenic networks. *In:* P. Grassberger and K. Lehnertz (eds.), *Chaos in the Brain?* Singapore: World Scientific.

Lockwood, M. 1989. *Mind, brain, and the quantum.* Oxford: Basil Blackwell.

Lockwood, M. 1993. Dennett's mind. *Inquiry*, 36: 59-72.

Lockwood, M. 1996. 'Many minds' interpretations of quantum mechanics. *British Journal for the Philosophy of Science,* 47: 159-188.

Lyre, H. 1999. Against Measurement? - On the Concept of Information. In P. Blanchard and A. Jadczyk (eds.), *Quantum future: From Volta and Como to Present and Beyond. Proceedings of Xth Max Born Symposium.* Berlin: Springer Verlag, 1999

Mills, E.O. 1997. Giving up on the hard problem of consciousness. In J. Shear (ed.), *Explaining consciousness, the hard problem,* Cambridge, MA: MIT Press.

Mohrhoff, U. 2000. What quantum mechanics is trying to tell us. *American Journal of Physics,* 68, 728-745.

Montero, B. 2001. Post-Physicalism. *Journal of Consciousness Studies,* 8: 61-80.

Mott, N.F. 1929. The wave mechanics of alpha-ray tracks. *Proceedings of the Royal Society, London,* A126: 79-84.

Mugur-Schächter, M. 1997. Mécanique quantique, réel, et sens. In M. Bitbol & S. Laugier, (eds.). *Physique et réalité,* Paris: Editions Frontières-Diderot.

Mungle, C.W.K. 1966. ‘Private language’ and Wittgenstein’s kind of behaviourism. *Philosophical Quarterly*, 16: 35-46.

Nagel, T. 1986. *The view from nowhere.* Oxford: Oxford University Press.

O’Hara, K. & Scutt, T. 1997. There is no hard problem of consciousness. In J. Shear (ed.), *Explaining consciousness, the hard problem*, Cambridge, MA: MIT Press.

Omnès, R. 1994. *The interpretation of quantum mechanics.* Princeton, NJ: Princeton University Press.

Penrose, R. 1994. *Shadows of the mind*, Oxford: Oxford University Press.

Perner, J., Gschaider, A., Kühnberger A., & Schrofner S., 1999. Predicting others through simulation or theory ? a method to decide, *Mind and Language*, 14: 57-79.

Petitot, J., Varela, F.J., Pachoud, B., & Roy, J-M. 1999. *Naturalizing phenomenology.* Stanford, CA: Stanford University Press.

Pust, J. 1999. External accounts of folk psychology, eliminativism, and the simulation theory. *Mind and Language,* 14: 113-130.

Putnam, H. 1999. *The threefold cord: mind, body and world,* New-York: Columbia University Press.

Rudd, A. 1998. What it is like and what’s really wrong with physicalism : a Wittgenstanean perspective. *Journal of Consciousness Studies*, 5: 454-463.

Schrödinger, E. 1935. Die gegenwärtige Situation in der Quantenmechanik. *Naturwissenschaften,* 23: 807-812, 823-828, 844-849; English translation in: J. A Wheeler and W.K. Zurek, 1983. *Quantum mechanics and measurement,* Princeton, NJ: Princeton University Press.

Searle, J. 1997. *The mystery of consciousness.* London: Granta Books.

Smith, D.W. 1999. Intentionality Naturalized. In J. Petitot, F.J. Varela, B. Pachoud, & J-M. Roy, *Naturalizing phenomenology.* Stanford, CA: Stanford University Press.

Smolin, L. 1999. *The life of the cosmos.* Oxford: Oxford University Press.

Stapp, H. 1993. *Mind, matter, and quantum mechanics.* Berlin: Springer Verlag.

Stapp, H. 1996. The hard problem, a quantum approach, *Journal of Consciousness Studies,* 3: 194-210.

Stich, S. 1996. *Deconstructing the mind,* Oxford: Oxford University Press.

Suter, R. 1989. *Interpreting Wittgenstein: A Cloud of Philosophy, a Drop of Grammar. Philadelphia:* Temple University Press.

Thompson, E. & Varela, F.J. 2001. Radical embodiment: neural dynamics and consciousness. *TRENDS in cognitive science,* 5: 418-425.

Thompson, E. & Varela, F.J. 2002. *Lived Body: Why the Mind is not in the Head.* Harvard: Harvard University Press.

Van Fraassen, B.C. 1991. *Quantum mechanics, an empiricist view.* Oxford: Oxford University Press.

Varela, F.J. 1979. *Principles of Biological Autonomy,* Amsterdam: Elsevier/North-Holland.

Varela, F.J. 1996. Neurophenomenology. *Journal of Consciousness Studies,* 3: 330-349.

Varela, F.J. 1997. The Naturalization of Phenomenology as the Transcendence of Nature: Searching for generative mutual constraints. *Alter: Revue de Phénoménologie* 5: 355-385.

Varela, F.J. 1998. A science of consciousness as if experience mattered. In S. Hameroff, A.W. Kaszniak, & A.C. Scott, *Towards a science of consciousness II : The second Tucson discussions and debates,* Cambridge, MA: MIT Press, 1998

Varela, F.J. 1999. Present-time consciousness. *Journal of Consciousness Studies* 6: 111-140.

Varela, F.J. 2000. Upwards and downwards causation in the brain: Case studies on the emergence and efficacy of consciousness. In K.Yasue and M.Jibu (eds.), *Towards a Science of Consciousness, Tokyo '99* , San Francisco, CA: Benjamin Publishers.

Varela, F.J., Lachaux, J-P., Rodriguez, E., Martinerie, J. 2001. The Brainweb : phase synchronization and large-scale integration. *Nature Reviews Neuroscience* 2: 229 – 239.

Velmans, M. 1998. Goodbye to reductionism. In S. Hameroff, A.W. Kaszniak, & A.C. Scott, *Towards a science of consciousness II : The second Tucson discussions and debates,* Cambridge, MA: MIT Press.

Velmans, M. 1999. Intersubjective science. In F. Varela & J. Shear, *The view from within, first person approaches to consciousness,* Thorverton: Imprint Academic.

Von Wright, G.H. 1971. *Explanation and understanding,* London: Routledge& Kegan Paul.

Wallace, B.A. 2000. *The taboo of subjectivity, toward a new science of consciousness.* Oxford: Oxford University Press.

Warren, D.D. 1999. Externalism and causality : simulation and the prospects for a reconciliation. *Mind and Language,* 14: 154-176.

Wilber, K. 1997. An integral theory of consciousness. *Journal of Consciousness Studies,* 4: 71-92.

Wigner, E. 1979. Remarks on the mind-body question. In E. Wigner, *Symmetries and reflections,* Woodbridge, CT: Ox Bow Press.

Wittgenstein, L. 1967. *Zettel.* Oxford: Basil Blackwell.

Wittgenstein, L. 1968a. *Philosophical investigations.* Oxford: Basil Blackwell.

Wittgenstein, L. 1968b. *Notes for lectures on 'private experience' and 'sense data'. Philosophical Review,* 77: 271-320.

Zurek, W.H. 1982. Environment-induced superselection rules. *Physical*

Review, D26: 1862-1880.