FORM AND ACTUALITY[1]

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> "(...) Think about form, but
> do not construct theories about form"
> Nâgârjuna, *Mûlamadhyamakakârikâ,* IV, 5.
> (trans. J. Garfield)

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1-Introduction

According to Hegel, the now is just *what is not any longer when it is* [2].

By contrast with this expression of extreme instability, physics has inherited from Parmenides a very strong tendency towards the formulation of formal invariants, independent from any personal, spatial and temporal point of view. The very notion of state, which is so fundamental for physics, concentrates in it an ambition to convey the primacy of Being over the process of Change[3]. This quest of immutability culminated with Minkowski's geometry of space-time, and with Einstein's Parmenidean characterization of the flow of time as an illusion[4]. Thus, at first sight, "now" is exactly the kind of term which is to be banished from the language of physics. One should not be surprised that "physics is missing any concept of the now"[5].

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[1] A few paragraphs of this paper were borrowed from my short preface to: M. Bitbol & E. Ruhnau (eds.), *Now, Time and Quantum Mechanics,* Editions Frontières, 1994

[2]See G.W. F. Hegel, *The phenomenology of mind,* Trad. J.B. Baillie, Library of philosophy, 1931, Part A, chapter I.

[3]E. Ruhnau, "The now, the missing link between matter and mind", in: M. Bitbol & E. Ruhnau (eds.), *Now, Time and Quantum Mechanics,* Editions Frontières, 1994

[4]K. Popper, *The postscript to the Logic of scientific discovery, II The open universe,* Hutchinson, 1982, §26

[5] About the thema of the "missing now" see also: "The starting point of our enquiry is the 'missing now' in physics" J. Schneider, "The now, relativity theory and quantum mechanics"; S. Saunders, "Time and quantum mechanics in: M. Bitbol & E. Ruhnau (eds.), *Now, Time and Quantum Mechanics,* op. cit. According to S. Saunders, for instance, "In both cases (quantum mechanics without state reduction and space-time theory without 'time flow'), it seems that something fundamental is missing in the physics"; M. Bitbol, "The missing now", Contextos (University of Leon, Spain), VI/11, 17-31, 1988 (new version published on Academia.edu : "IS

In fact, the lack of any concept of the now is only one instance of a momentous choice which underlies physics as a whole. This choice consists of banishing actual situations and indexical elements of speech from theoretical descriptions, in order to reach a universal formal construct relative to which actualities and indexical terms can be considered as reflecting mere particular standpoints. Physics could be defined, *inter alia,* as a systematic attempt at pushing *actuality* aside and bringing *form* to the fore. True, the formal descriptions which are the theoretical end-products of physics have to connect somewhere with actuality. But one should notice that even this connection is dealt with in such a way that any direct reference to actuality is avoided. Indeed, in physics, applying a general law to a particular case, namely connecting the theoretical description to the practice of the experimentalists, involves two steps which both carefully avoid strict adherence to actuality. First, one refers to mesoscopic individual objects, namely to preparative devices and measurement apparatuses that can be handled within the laboratory. Second, by ordering the individuatable events which may arise from experimental configurations, and by defining a metric on this ordered set, one generates a set of numbers taken to be the measured values of the variables which enter into a certain law. Now, mesoscopic individual objects and individuatable events are related to actuality, but only *sketchily,* by means of one of their aspects or profiles, at a certain time and in a certain perceptual context. As for the measured values, they retreat even farther from actuality; for they tend to substitute abstract locations on a numeric scale for actual events, just as stating a property P means substituting an abstract location on the logical binary scale [P, not-P] for an actual perception.

To sum up, even though a physical formalism has to connect repeatedly with actuality, it usually does so through the mediation of the halfway concepts of object and event. Invariant structures are defined in such a way that they are not *directly* instanciated by actual perceptions, but rather by individual objects and particular processes involving changes in properties or in measured values. Physical laws connect only *indirectly* with actuality, usually by providing a mapping

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NOW A MOMENT IN TIME ? A discussion of McTaggart's argument against the reality of time from a transcendental idealist standpoint")

of a set of individual *objects* and measured *values* onto another set made of the same individuals and modified values[6].

The previous remarks can be understood as follows: physics articulates a *second-level* objectivation (the level of laws and structures); and at the same time, it presupposes a *first-level* objectivation which underlies language, everyday activity, and ordered experimental activity as well. The first-level objectivation amounts to defining tacitly (by acting and by using language) mesoscopic permanent objects (or 'things'), enduring properties, and causal processes, of which singular actual percepts are supposed to be mere special appearances. This first-level is definitely out of the scope of physics, for the contents of physics could not even be stated without taking it for granted. We shall say that physical laws are related to actuality through the intermediary of pre-objectivized *delegates* of actuality (namely the individual 'things' and measured values).

Such a shift from actuality to its delegates has recently been documented by Hintikka. According to Hintikka[7], Kant's theory of knowledge can only apply to modern science if one replaces *passive* sensorial reception with *activities* of seeking and finding, and also if one replaces the intuitive mode of selection of particulars, which was advocated by Kant[8], with logical instantiation. But there is an important difference between intuition and logical instanciation, which bears on their respective relation to actuality. Kant's intuition is directly connected to sensorial actuality. By contrast, logical instantiations are once again *halfway* between forms (or concepts) and actuality. Indeed, on the one hand, logical instanciations are 'particular representations of concepts' according to Hintikka; and on the other hand we have seen that they are able to operate as *delegates of actuality*.

We can understand this momentous difference of focus between Kant and modern advocates of transcendental philosophy as follows. Kant's reference to *intuition,* and to conceptual organization of the material afforded by intuition, is typical of a situation where science is

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[6] See Brian Cantwell Smith, *On the origin of objects,* The MIT press, 1996

[7] J. Hintikka & I. Kulas, *The game of language,* Reidel, 1983, p. 33; J. Hintikka, *Knowledge and the Known,* Reidel, 1974

[8] I. Kant, *Critique of pure reason,* (new edition, by V. Politis), Everyman's library, 1993, A32-B47

so young that it needs some kind of (transcendental) foundation of the preliminary (first-level) objectivation of individuals, properties, and events, which it presupposes. By contrast, Hintikka's focus on *logic* is typical of a situation where science is sufficiently mature; so much so that one may consider that the pre-objectivation of individuals and properties has been given enough *intra-scientific* justifications by its successful use in the past, especially in *classical* physics, to be in no need of further extra-scientific (metaphysical or transcendental) foundations. No wonder that Bohr relied on *classical physics* as a necessary ground of the elaboration of quantum physics.

Now, this flight farther and farther from actuality, towards more and more universal hierarchies of forms, raises some problems. It is of course legitimate in so far as it is aimed at extending ever increasingly the scope of our inter-subjective discourse and our common mastery of every aspect of our environment. But exclusive fascination for the supposed target of the flight, to the detriment of the original actuality, may also have some serious drawbacks. I shall list some of them in this paper. To begin with, in paragraphs 2 and 3, I'll discuss those drawbacks which concern physics itself. Then, in paragraphs 4 and 5, I shall give a hint about some other drawbacks which concern our civilization as a whole in so far as it takes physics as a cultural paradigm, and objectivation as a quasi-exclusive value. Finally, in a short conclusion, I shall draw the teachings of this rehabilitation of actuality for the general project of a *formal epistemology*.

2-From the laws of physics to actuality I: Statistical mechanics

The hypothetico-deductive method, which is so widespread in physics, has had a great impact on the philosophical conceptions of the physicists. It is essential to this method that precise predictions bearing on phenomena can generally be derived from both the formalism and the initial conditions, but not the other way around. As a consequence, it is very common among physicists to reify the formal skeleton of the model; namely to behave as if the model were a faithful (though possibly approximate) representation of some absolute reality, and as if the phenomena themselves were only partial and relative appearances involving both the represented "absolute" reality and our special mode of experimental investigation. The most

traditional way of expressing such a hierarchy between the model and the phenomena is the Descartes-Locke distinction between primary qualities (which belong to a geometrical representation) and secondary qualities (whose significance is relative to the receptive structures of our senses). Such a distinction is still popular today among physicists, provided one accepts to shift the focus of primary structures from the ordinary space to extended abstract spaces, and to replace the senses with experimental devices.

Unfortunately, this conception is not devoid of difficulties. To begin with, one may wonder, in terms borrowed from Schrödinger[9], whether the (hypothetico-deductive) method is based on the good reasons one has to think that a stable, unified and universal model will eventually be able to represent reality as such, or whether, conversely, this realist belief is based on the (provisional) success of the method. Another difficulty is that the more a formalism becomes autonomous, the more it incorporates symmetries which enable it to deal with a great variety of (experimental) situations, and the less it is able to deal with the essentially asymmetric features of particular situations without *ad hoc* assumptions. Two (possibly interrelated) instances[10] of this loss of relevance to immediate experience are:

(i) Statistical mechanics and its difficult connection with irreversibility,

(ii) Quantum mechanics and its purely probabilistic connection between the continuous unitary evolution of state vectors and the discontinuity of experimental outcomes.

Let us begin which statistical mechanics (quantum mechanics will be dealt with in §3). It has been accepted, since the debate between Boltzmann and Loschmidt, that any purely mechanical description of a system made of a great number of molecules is bound to be time-symmetric and reversible. Gibbs' method has made this point even clearer[11]. Therefore, in order to account for the second law of thermodynamics in mechanical terms, it appears to be necessary to impose some extrinsic rules, or approximations, which have the effect of breaking the formal time-symmetry. But such rules or

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[9] E. Schrödinger, "The present situation of quantum mechanics" §1, in: J.A. Wheeler & W.H. Zurek, *Quantum theory and measurement,* Princeton University Press, 1983

[10] Another celebrated instance is the difficult connection between the Einstein-Minkowski four-dimensional block-universe, the concept of 'now', and the past-future asymmetry.

[11] See e.g. E.T. Jaynes, "Gibbs versus Boltzmann entropies", in: E.T. Jaynes, *Papers on probability, statistics, and statistical physics,* (R.D. Rosenkrantz, ed.), Reidel, 1983

approximations (for instance Gibbs' coarse graining, Boltzmann's assumption of molecular chaos in a probabilistic framework, Jaynes' minimal information, or the comparison between the time of observation and the Poincaré's cycle), clearly refer to the spatial or temporal scale of the experimenters. This latter point has either been taken as a proof that the second law has some irreducible "subjective" aspects in it, or as an incentive to go beyond the Boltzmann-Gibbs version of statistical mechanics in order to look for a purely "objective" account of the second law. In both cases one considers that, for a law to be "objective", it should arise directly from the model, namely from the second-level of objectivation which is typical of physics, and not from our interest-relative way of dealing with our environment. The requirement is that the model must be capable of generating its own symmetry-breaking processes.

Many attempts at reaching the "objectivity" of the second law of thermodynamics *in this sense* have been carried out. But when carefully studied, such attempts all exhibit the features they aimed at disparaging, though under highly elaborated aspects. One recent example is Prigogine's theoretical description of how time-symmetry breaking occurs by means of what he himself calls the "laws of chaos"[12]. At first sight, the introduction of the high sensitivity to changes in initial conditions, which is typical of chaotic regimes, is all that was needed in order to show that the time-symmetry breaking of the dynamics of molecular systems is "intrinsic" (namely self-generated by the formalism). However, as I. Stengers rightly pointed out[13], Prigogine's result does not so much demonstrate the possibility of deriving the second law of thermodynamics from a proper consideration of the traditional object(s) of statistical mechanics, as the necessity of considering a completely new kind of object. In the so-called *baker's transformation,* for instance, fibers must be substituted for material points; for it is precisely this substitution which allows one to avoid any reference to coarse graining. Thus, in order for the model to generate its own symmetry-breaking process, one must modify the very mode of objectivation which yields it.

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[12] I. Prigogine, *From being to becoming,* Freeman, 1980; I. Antoniou & I. Prigogine, "Intrinsic irreversibility and integrality of dynamics", Physica, 192A p. 443, 1992; I. Prigogine, *Les lois du chaos,* Flammarion, 1994

[13] I. Stengers, *Cosmopolitiques 5. Au nom de la flèche du temps: le défi de Prigogine,* Editions La Découverte, 1997

Whereas the old mode of theoretical objectivation (which extrapolates the spontaneous mode of objectivation of our everyday speech and activity one step farther, namely from 'things' to 'material bodies' or 'material points') had the consequence that some aspects of the phenomena were to be ascribed to the relation between the object and the experimenters, the new mode of objectivation *incorporates* the relational aspect[14], and thus exempts the physicist from explicitly mentioning it. Accordingly, the leading question of the physicists no longer bears on the properties of an autonomous pre-given object of nature, but on how it is possible to frame a new type of object in such a way that it can be treated *as if* it were autonomous, and yet able to encompass the typical asymmetry of the situations with respect to which it has been provided this "as if" autonomy.

This circumstance has been taken by I. Stengers as a proof that, nowadays, physicists are still able to fulfil their good old dream of a series of models construed as increasingly faithful representations of reality, in spite of the fact that they have inadvertently made clear the interest-relative components of their models by the very attempt of hiding them. However, from a critical viewpoint, the same circumstance can be seen in a very different light. In this perspective, Prigogine's move shows how a great specialist of statistical thermodynamics is eventually forced to recognize, by his having recourse to a new kind of (purposedly constructed) hybrid objects, that he uses *constitutive procedures* (in Kant's sense) during the initial phase of his work. True, the modern statistical physicist has rehearsed successfully the fascinating game of *projection* of the normative rules of experimental practices onto a model and a set of objects. But the new version of this projection is so thoroughly modified that it misses almost completely its original target. For the projected object now manifestly encompasses the "descriptional relativity"[15] which was to be eliminated from the model. It has become obvious, from the very process of construction of the new object of statistical physics, that it cannot pretend to represent a reality construed *in the absolute,* irrespective of any relation with the particular experimental situations in which it manifests itself.

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[14] ibid. p. 150

[15] See M. Mugur-Schächter, "From quantum mechanics to universal structures of conceptualization and feedback on quantum mechanics", Foundations of physics, 23, 37-122, 1993

No wonder that another lineage of physicists and philosophers of physics[16] have tried to reverse completely the problem. I. Stengers herself accepts, at least in principle, the appropriateness of this kind of reversal, which gives priority to the asymmetric presuppositions of the experimental practices over the internal symmetries of the model. As she notices, "(...) the well-known physical laws which assert the equivalence between 'before' and 'after' have been made possible by measurement operations; (but) the least measurement apparatus *denies* this equivalence"[17]. However, as a philosopher of science, she does not wish to hold on to that simple remark. According to her, this would make difficult any communication between philosophers and physicists, since the latter are traditionally more fascinated by their intentionally aimed at objects and models, than by their own practices. I personally think that, on this point, her attitude is exceedingly ambiguous. Being respectful of the internal aims and historical choices of the community of physicists should not prevent a philosopher from throwing strong light on the background which underlies their experimental activity, and from insisting that this background *cannot* be completely wiped out from the theoretical end-product of their investigation without major inconvenients. After all, some physicists are not unable to understand what is at stake in the critical approach of their science, and this may provide their practice with additional self-consciousness. One should not forget that even though the usefulness of philosophical lucidity is admittedly doubtful during the periods of 'normal science', it has proved crucial during the past major scientific revolutions.

So, let us turn to the arguments of those thinkers who advocated an equivalent of Kant's "Copernican revolution" in the domain of statistical physics. To begin with, according to Bohr, the concept of observation already implies a fundamental irreversibility. In thermodynamics, the reason for this is quite obvious: "(...) the very concept of temperature stands in an exclusive relation to a detailed description of the behaviour of the atoms in the bodies concerned"[18].

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[16] N. Bohr, "Chemistry and the theory of atomic constitution", Journal of the chemical society, 349-384, 1932, in: N. Bohr, *Collected Work,* vol. 6, J. Kalckar (ed.), North-Holland, 1985; Th. Görnitz, E. Ruhnau, and C.F. v. Weizsäcker, "Temporal asymmetry as precondition of experience", Int. J. Theor. Phys., 31, 37-46, 1992; M. Bitbol, "Prélude à l'irréversibilité", Sciences et avenir (Numéro spécial *Les énigmes du temps),* Mars 1994.

[17] I. Stengers, *Cosmopolitiques 1. La guerre des sciences,* Editions La Découverte, 1996, p. 107

[18] N. Bohr, *Collected Work,* vol. 6, op. cit. p. 400

In other terms, the operational definition of the temperature variable and the mechanical description of microscopic behaviour are "complementary". It is this extrinsic (though fundamental) methodological point, rather than any intrinsic feature of the mechanical model which, says Bohr, "(...) allows us to solve the apparent contradiction between the law of increase of entropy and the general reversibility of the individual mechanical processes"[19]. In the same way, Görnitz, Ruhnau and Von Weizsäcker[20] recently emphasized that temporal asymmetry is already at work in a very basic presupposition of experimental science construed as a process of information gathering: namely the pre-requisite of a difference between possibility and fact. Their problem is thus to explain the time-symmetry of the fundamental laws of physics given the time-asymmetry which is the precondition of experience, and *not* to explain the time asymmetry of the most familiar processes by taking the time-symmetry of the laws for granted. According to them, one possible answer is that this artificial time-symmetry is due to an abstraction leading one to transform semi-groups into groups whenever (i) clock-time is represented by a real-valued continuum and (ii) laws of motion are formulated by means of differential equations.

Of course, one may then wonder why symmetric laws such as that of mechanics are not flatly falsified by experiments which are supposed to involve an all-pervasive asymmetry. I think that the reason of this absence of straightforward falsification is that no experiment is ever compared *directly* to symmetric laws. Actually, experiments are compared to *altered* symmetric laws, namely to symmetric laws implicitly modified by an additional *ad hoc* asymmetric assumption. They are compared to the laws of mechanics modified by the hypothesis that motion takes place from earlier times to later times, or to the laws of electromagnetism modified by the selection of retarded solutions, or to the laws of relativity modified by an extrinsic distinction between the future cone of light and the past cone, and so on and so forth. It is in this way that, in the everyday work of physicists since the seventeenth century, the urge for universality and symmetry has been made compatible for all practical purposes with the fundamental asymmetry of experience.

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[19] ibid.

[20] Th. Görnitz, E. Ruhnau, and C.F. v. Weizsäcker, "Temporal asymmetry as precondition of experience", loc. cit.

Let me add at this point a little qualification of what I have written in the previous paragraphs. By advocating the logical priority of the actuality over the formalism, of the asymmetric presuppositions of the experimental work over the symmetric form of the laws, I do not wish to deny the value of the work of those physicists, such as Prigogine and many others[21], who attempted to show how symmetry-breaking can be generated by the model itself provided some additional assumptions are made or some new choice of objects is performed. But I take this value to be quite different from what was usually indicated by the physicists themselves. Demonstrating the possibility for a model to generate its own symmetry-breaking does not mean that one has eventually disclosed the way an essentially symmetric reality manifests itself by asymmetrical appearances. It only means that physics is mature enough to be able to provide in its own terms a proof of self-consistency of the overall list of basic assumptions on which it relies. The axioms of the theory, which tend to reach maximal objectivity by means of generalized symmetry, and the asymmetric presuppositions of experimental practices, are thus shown to be mutually compatible. To paraphrase Quine[22], the crucial point is that the physicist is not confronting a challenge from some external reality whose basic symmetry is to be connected with the obvious asymmetry of experience. He is confronting a challenge that arises from *within* his science. This challenge runs as follows: *if* the models of theoretical physics were to be taken *litterally,* how could we make sense of the practice of experimentation? The problem of the physicist is that of finding ways, in keeping with his models, whereby human beings (and especially experimenters) can live in an asymmetric environment. To summarize, it is a problem of logical closure of science, not of ontology.

2-From the laws of physics to actuality II: Quantum mechanics

In quantum mechanics, the issue of a connection between the formalism and actuality is even more stringent than in statistical mechanics. For, in this case, what is apparently missing in the model

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[21] H. D. Zeh, *The physical basis of the direction of time,* Springer-Verlag, 1989; R.D. Sachs, *The physics of time-reversal,* The University of Chicago Press, 1987

[22] W.V. Quine, *The roots of reference,* Open court, 1974, p. 2

is not only an isolated feature of actuality, such as the asymmetry between fact and expectation, but it is a proper equivalent of *actuality itself in its univocity*. Accordingly, the most pervasive problem of the interpretation of quantum mechanics is that of "actualization" (or "transition to actuality"): namely that of the compatibility between (i) the continuous evolution of a state vector construed as a description of the manifold *potentialities* of some experimental situation involving a putative microscopic object, and (ii) the very circumstance that a single outcome is *actually* obtained at the end of the experiment. The first move in order to cope with this problem of compatibility has been to project the uniqueness of the outcome onto the formalism by a *fiat*, that is by means of Von Neumann's projection postulate. But many questions then remain to be answered: the questions about *where, when and how* the so-called "reduction of the wave packet" occurs.

In fact, things are even more intricate (and more interesting) than what this short presentation of the problem tends to show. Indeed, one additional distinctive feature of quantum mechanics is that its formalism puts the concept of pre-objectivized *delegates* of actuality, such as individual objects endowed with properties, or objective events, under strong pressure. Individuality lacks criteria within the quantum paradigm, and it must be bracketed in quantum (Bose-Einstein or Fermi-Dirac) statistics; furthermore, intrinsic properties are generally[23] replaced by contextual observables. As a consequence, the very notion of mutually exclusive past objective events, which is grounded on the idea that previous properties of objects have been permanently modified in a well-defined way, does *not* possess any formal equivalent within the framework of the quantum theories (if we put aside the artificial projection postulate). In B. d'Espagnat's terms, "within standard quantum mechanics, (there are) no 'really existing' facts"[24].

Not surprisingly, in view of this two-step analysis, the proposed solutions to the so-called measurement problem of quantum mechanics essentially fall under two categories[25]. There are solutions

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[23] The case of superselective observables must be taken apart.

[24] B. d'Espagnat, "Towards an empirical separable reality?", Foundations of physics, 20, 1147-1172

[25] I shall not discuss here the Hidden variable theories. Indeed, they do not offer any solution to the well circumscribed problem of the connection between the quantum formalism as it stands and actuality: they rather substitute a new formalism for the quantum formalism.

which tend to cross directly the gap between the quantum formalism and each *unique* actual event. And there are other solutions which only aim at showing how the *notion* of pre-objectivized delegates of actuality (the 'properties' and the 'objective events') can be recovered at the macroscopic scale.

The first kind of solution consists in modifying pure unitary quantum mechanics in such a way that it acquires its own mechanism of transition, from a state vector to one eigenstate of the relevant observable. This approach, which consists in adding to the Schrödinger equation a small term of random discontinuous jump which adds up when macroscopic bodies are involved, has been initially developped by Ghirardi, Rimini, and Weber[26], and it has then been advocated by John Bell[27]. It perfectly fits the general requirement that a model should be able to generate its own processes of symmetry-breaking, since the symmetry of a state vector written in terms of a linear superposition of eigenstates is broken so that only one eigenstate remains. But it also has many defects. One defect is that the term added to the usual Schrödinger equation is completely *ad hoc,* and that several physicists are now at great pains to provide it with convincing justifications. A second defect[28] is that one does not see how it is possible to account in this framework for the case of macroscopic superpositions (instantiated by superfluidity or superconductivity). A third defect is that one may wonder why and how a certain basis of eigenstates should be priviledged for the spontaneous collapse. This is the well-known "preferred basis problem" which is common to all the interpretations of quantum mechanics which tend to provide the Hilbert-space model with a sufficient autonomy[29]. Solving that problem by just mentioning that the choice of a basis may depend on some extrinsic criterion (such as the correspondence principle) would be tantamount to giving up the project of identifying a completely *intrinsic* mechanism of symmetry-breaking in the quantum-mechanical model.

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[26] G.C. Ghirardi, A. Rimini, & T. Weber, "Unified dynamics for microscopic and macroscopic systems", Physical review, D34, 470-491, 1986

[27] J.S. Bell, *Speakable and unspeakable in quantum mechanics,* Cambridge University Press, 1987, p. 202

[28] P. Mittelstaedt, *The interpretation of quantum mechanics and the measurement process,* Cambridge University Press, 1997

[29] M. Dickson, "What is preferred about the preferred basis?", Foundations of Physics 25, 423-440, 1995

But this is not all. A much more fundamental criticism which can be directed against the spontaneous collapse interpretation is that it is flatly irrelevant; that it aims at solving within the framework of physics a problem which is in principle out of the scope of physics (and of science in general), namely the problem of the uniqueness of actuality. As R. Omnès wrote, "(...) the actuality of facts is something that needs not be explained by a theory"[30]. Accordingly, the aim of a good theory of quantum measurements is not to account in each case for a transition from a state vector representing potentialities to *one* particular eigenstate representing the actual actuality; it is only to show how the quantum model may be made compatible with the very idea that a measurement process leads to one *or* another well-defined outcome, embodied in permanent properties of pointers and recorders. In other terms, the project here is to show how one may recover the general notion of pre-objectivized delegates of actuality within the quantum paradigm. The most efficient strategy which has been followed in order to do so can be described in two steps. The first step consists in encompassing not only the measurement apparatus, but also an environment with a great (possibly infinite) number of degrees of freedom, within the account of the measurement process by pure unitary quantum mechanics. The second step is to show that the interference terms of the corresponding density matrix tend to decay very fastly, so that one witnesses a transition from a pure state to an approximate statistical mixture of mutually exclusive alternatives. In other terms, one shows that there is a transition from the 'and' of a superposition to the 'or' of a mixture. This is the essential claim of the *decoherence theories*. Another, more recent, claim of the decoherence theories is that they can *also* account somehow for the choice of a basis of eigenstates[31].

The main difference between spontaneous collapse and decoherence can now be seen very clearly. One cannot say that they both perform the same job, though in two different ways. They rather arise from two radically different conceptions of the job to be performed. In the spontaneous collapse strategy, a mechanism of symmetry breaking is offered. But in the decoherence strategy, what is asked to the model is not to break its internal symmetries by its own

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[30] R. Omnès, *The interpretation of quantum mechanics,* Princeton University Press, 1994, p. 354

[31] J.P. Paz & W.H. Zurek, "Environment-induced decoherence, classicality, and consistency of quantum histories", Physical Review, D48, 2728-2737, 1993

means, but only to have the capacity of transforming those symmetries in such a way that they offer a natural point of contact with an asymmetric well-defined actuality. This natural point of contact is the notion of mutually exclusive *events*. The necessity of reaching such an intermediate step between the probabilistic model and actuality is *typical of quantum mechanics;* it has no equivalent in classical physics. Indeed, the said intermediate step is straightaway available in classical stochastic theories, but not in quantum mechanics.

All the problems are not solved at this stage, however. Decoherence theories, which claim to be able to make the Hilbert-space model generate a transition from 'and' (superpositions) to 'or' (mixtures) by their own means, are *also* pervaded by interest-relative (or anthropomorphic) postulates[32]. They all involve some statements or assumptions which presuppose that the processes described by the model must eventually result in an acceptable macroscopic world for anthropoid creatures to speak about and to live in. The most important among these statements is Zurek's basic hypothesis that the overall state vector can be analyzed into three parts: one part for the object, one for the apparatus, and one for the environment. But admittedly, this partitioning only makes sense relative to a cognitive and experimental process involving mesoscopic instruments. In the same way, Gell-mann's theory of decoherent histories involves a superimposed coarse graining of the set of consistent histories[33]; and this coarse-graining is clearly relative to the characteristics of the so-called IGUSes ("Information Gathering and Utilizing Systems"), whose anthropomorphic flavour is unmistakable. This being granted, it is clear that, except in the remote perspective of a completely convincing strategy of "closing the epistemological circle"[34] of object and subject within the framework of the Hilbert-space model, the decoherence theories cannot pretend to have made this model able to generate a disjunctive structure by its own means. They has not

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[32] S. Saunders, "Decoherence, relative states, and evolutionary adaptation", Foundations of physics, 23, 1553-1585, 1993; S. Saunders, "Time and quantum mechanics", in: M. Bitbol & E. Ruhnau, *Now, time and quantum mechanics,* Editions Frontièreres, 1994; B. d'Espagnat, "Towards an empirical separable reality?", loc. cit.

[33] Gell-Mann & J.B. Hartle, "Classical equations for quantum systems", *Physical Review,* D47, 3345-3382, 1993

[34] A. Shimony, *Search for a naturalistic world view,* vol. I, Cambridge University Press, 1993; see also Gell-Mann's IGUS concept, in: M. Gell-Mann & J.B. Hartle (1993), "Classical equations for quantum systems", *Physical Review,* **D47**, 3345-3382

succeeded to show convincingly how a classical world may emerge *by itself* out of a *completely self-sufficient* Hilbert-space world.

In view of this partial failure of the attempts at making the model able to self-generate structures which are isomorphic enough with actuality, one may be tempted by a renewed gesture of reversal of the problem. After all, if one transposes I. Stengers previous remarks from statistical mechanics to quantum mechanics, one lends into the following statement: *the (unitary quantum-mechanical) model which yields statements such as the cat's paradox has been made possible by measurements; but the least single outcome of a measurement process flatly denies that the measurement chain is not in a well-defined state*.

Giving a logical priority to phenomena over the Hilbert-space model was the attitude Bohr recommended in the interpretation of quantum mechanics: "Strictly speaking, the mathematical formalism of quantum mechanics and electrodynamics merely offers rules of calculation for the deduction of expectations about observations obtained under well-defined experimental conditions specified by classical concepts"[35]. According to Bohr, the measurement problem thus arises from two essential mistakes. The first one bears on the status of the Hilbert-space model which is usually taken at face-value by physicists as describing "states" of "systems", whereas it only represents a purely mathematical tool for calculating "expectations" (namely probabilities) in an overall experimental situation. The second one is that, in the quantum theory of measurement, we improperly "(...) treat the instrument as an object"[36] to which a quantum "state" is ascribed. But one should not forget that, according to Bohr, instruments *must* be left in the (classical) background, rather than treated as (quantum) objects; for the instrument *must* fall under classical concepts in order that unambiguous communication between experimenters be possible at all. This is a kind of transcendental condition for experimental knowledge, and it cannot thus be ignored. Such a position is well-known, but it was soon discarded by physicists who hoped that the quantum theory of measurement would be able to self-generate its own classical level. When decoherence theories were formulated, Bohr's position appeared all the more superseded since

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[35] N. Bohr, *Essays 1958-1962 on atomic physics and human knowledge,* Ox Bow Press, 1987, p. 60

[36] D. Murdoch, *Niels Bohr's philosophy of physics,* Oxford University Press, 1987, p. 113

the hoped-for result seemed close at hand. However, the conceptual loopholes of the decoherence theories (or rather the discrepancies between their ambitious aims and their methods) led to a recent renewal of Bohr-like arguments.

One very striking example is M. Mugur-Schächter[37], who both emphasizes that "In a probabilistic interpretation of quantum mechanics, there is *no* measurement problem", and that "the quantum mode of description *presupposes* the instrument *as a primary non-represented given"*.

Another interesting example is S. Saunders, who started with an examination of Everett's interpretation, who then put this interpretation in the light of the decoherence theories, and who finally recognized his affinities with a very sober statement of Bohr's views. Let us try to understand these three successive moves, in the framework of the present study.

(1) In the decoherence strategies, one tries to make the model compatible with the idea that some event has occurred *an sich,* but that we do not know which one; then one considers that the "actual actuality" just reveals *which* objective process, leading to a certain event, was taking place. In other terms, the decoherence theory aims at displaying a formal equivalent of a list of alternative pre-objectivized delegates of actuality (the 'events').

(2) But is such an attempt at showing how the intermediate-level concept of delegate of actuality may be made compatible with the Hilbert-space model, really indispensible? After all, one can perfectly dispense with this concept of *delegate* of actuality, provided one accepts to deal directly with the connection between the formalism and *actuality*. This is exactly what Everett attempted to do by means of his "relative state" interpretation of quantum mechanics (which has to be carefully distinguished from later many-worlds interpretations). In the "relative state" interpretation, the connection between *actuality* and the various possible experimental outcomes exhibited by the formalism is direct and purely *indexical,* in the same way as the connection between *now* and a set of tensed proposition. As S. Saunders writes, "Whilst 'Event E is past; Event E is future' are *prima facie* contradictory, introducing new events T, T* we obtain: 'E

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[37] M. Mugur-Schächter, "Mécanique quantique, réel, et sens", in: M. Bitbol & S. Laugier, (eds.), *Physique et réalité, un débat avec Bernard d'Espagnat,* 1997, Frontières-Diderot, p. 138 and 150. An english version of this paper is to be published by *Foundations of physics*.

is past relative to T; E is future relative to T*' and there is no longer a difficulty. Likewise: 'Observable X has value r; Observable X has value r*' are inconsistent. But introducing a new observable Y we may say instead: 'X has r relative to u of Y; X has r* relative to v of Y' and there is no longer a contradiction"[38]. Thus, if one does not try to reconstitute the distance between actuality and objectified (absolutized) processes or events too rapidly, one may have the chance to realize that quantum mechanics has the structure of *two-level relativized description*. The first level is well-known: each set of observable values is relative to some given type of apparatus. The second-level is typical of the indexical reading of Everett's interpretation: each single value ascription for an observable is relative to a value ascription of another (apparatus) observable. In this scheme where no actual object or event is defined in the absolute, actuality can only arises relatively, for somebody who *partakes of* the chain of relations. But, this being accepted, shouldn't we adopt directly *our own* standpoint, namely the standpoint of someone who is caught into the network of relations supposedly constitutive of the world? Does it make sense for us to assert (from a position in "cosmic exile", so to speak) that our standpoint within the network of relation is "only" a *local* standpoint?

(3) S. Saunders, as some other philosophers, takes the latter remarks very seriously into account. So seriously that, at the end of his highly non-bohrian itinerary of thought, he fully recognizes the value of Bohr's (strictly anthropocentric and local) approach of the measurement problem: "What is the solution of the measurement problem? I say it is this: on measurement of X with eigenstates ϕ_1 outcome x_1 is observed with probability $|\langle\psi|\phi_1\rangle|^2$, where ψ is the initial state. This is what we return to, so it will do for a beginning as well"[39]. At this point, the "copernican revolution" of our appraisal of the measurement problem has been completed: the unicity of each experimental result comes first, and the probabilistic formalism of quantum mechanics is subordinated to it.

Of course, here as in the case of statistical mecanics, we must add an important qualification to what has just been said. Advocating the

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[38]S. Saunders, "Time and quantum mechanics", in: M. Bitbol & E. Ruhnau, *Now, time and quantum mechanics*, op. cit.

[39] S. Saunders, "Time and quantum mechanics", in: M. Bitbol & E. Ruhnau, *Now, time and quantum mechanics,* op. cit.

logical priority of actuality over formalism, of the fundamental presuppositions of any cognitive process over the form of the model, does not mean denying the value of the work of the specialists (of decoherence) who attempted to show how the model may generate by itself the structure of objectivized delegates of actuality which any experimental work takes for granted. But this value is quite at variance from what is usually indicated by the physicists. Demonstrating the possibility for the Hilbert-space model to generate its own structure of mutually exclusive events does not mean that one has eventually disclosed how an essentially wave-like interferring reality may have emergent classical features. It only means that quantum mechanics is mature enough to be able to provide *in its own terms* a proof of consistency of the overall list of basic assumptions on which both its formalism and the experimental procedures used to test it, are based[40]. Here, as in the case of statistical mechanics, we are confronted with a problem of logical closure, not of ontology. The *ontological* problem would only arise if the Hilbert-space model were taken at face value, the state vectors being either considered as the basic constituants of the world or as expressing intrinsic determinations of the basic constituants of the world. By contrast, the problem of *logical* closure arises even if we consider the Hilbert-space formalism together with, say, the Born rule, as a mere instrument of generalized probability assessment.

Indeed, the problem of this instrument of probability assessment is that on the one hand it claims to be able to afford probabilistic valuations for any univocally defined experimental phenomenon, and that on the other hand, whenever it is extended to second-order experiments (measurements bearing on the first-order measuring instruments) it becomes *prima facie* incompatible with the simple statement that the first-order instrument has recorded a univocally defined phenomenon that we may happen to ignore. In other terms, if applied universally, this generalized probability theory *appears* to leave no room for the elementary notion of pre-objectivized delegate of actuality (the 'event' or the 'property of a pointer') which it itself presupposes. Decoherence shows that, actually, the Hilbert-space-Born's-rule mode of estimating probabilities can be made

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[40] M. Bitbol, *Mécanique quantique, une introduction philosophique,* Flammarion, 1996; M. Bitbol, *Schrödinger's philosophy of quantum mechanics,* Boston Studies in the Philosophy of Science, Kluwer, 1996

approximately compatible with the presuppositions of experimentation. Provided decoherence theories are given this very restricted significance, the interest-relative assumptions which are indispensible to them in order to be worked out are no longer embarassing. For in this case, one *only* needs to show that the interest-relative assumptions which are injected at one end are not *necessarily* inconsistent, given the model, with the interest-relative presuppositions which are to be respected at the other end. In more precise terms, one only needs to demonstrate (and one has indeed demonstrated by means of the decoherence theories) that when applied to a preliminary anthropocentered division of the world into objects, apparatuses, IGUSes, and environment, the quantum probability theory is not unable to give us back the mutually exclusive event-structure which human experimenters need to posit as a basic methodological assumption.

4-Beyond physics: Form and actuality in life and philosophy

What is at stake in this problem of the relations between form and actuality goes well beyond the respective status of the postulates of theoretical physics and the presuppositions of experimental practice. It is also a basic issue for the Western culture, and especially for its ability at circumventing the blind spot which was generated by its characteristic tendency to emphasize the exclusive value of objectivity.

The priority given to the formal model over actuality had both a minor consequence and a major consequence in the basic attitudes of the West. The minor consequence is what I shall call the Golem complex. Namely the mixture of hope and fear that, in the end, the creature of man will exceed the power of its creator. A purely intellectual variety of the Golem complex is the tacit conviction that theoreticians somehow *think in order to avoid thinking any longer* [41]. Indeed, among other things, the use of mathematics is aimed at replacing the adventurous manipulation of fluctuating concepts by fixed definitions and mechanized derivations. This being granted, the hope and fear is that the mathematics 'knows more than the

[41] M. Richir, *La crise du sens et la phénoménologie*, Jérôme Millon, 1990

theoretician', and that it thus acquires a kind of autonomy with respect to the intellectual power of the scientist. Of course, at the present stage of science this situation is met only within the restricted domain of validity of some theories of physics. It is still necessary to think and to mould concepts near the margins of this domain, when the issue of the relation of one theory with another one (or with its successor) is at stake. But the very urge towards unification, the very dream of a 'theory of everything' which be the 'final theory' at the same time, shows that many of us consider that this is a provisional situation, which should ideally be replaced by one in which the theory is absolutely universal, self-sufficient, and thus able to dispense anyone from the obligation of further thinking. It is interesting to notice that this software variety of the Golem complex is strongly coupled with a hardware version, that we may call 'the Deep Blue complex'. Here, it is the autonomy of a material embodyment of our cognitive operations which is both hoped-for and feared. The sought result of this process consists in reaching a mastery of the mental aspects of 'all that is the case'[42] in the same terms as the physical aspects, and thus, finally, obtaining a complete 'closure of the epistemic circle' *(including actual appearances),* within the methodological framework of the physical sciences. If, moreover, computers that work out some sort of 'theory of everything' by themselves could be conceived, the merging of the software and hardware variety of the Golem complex would be close at hand.

Of course, this ambitious program could well prove to be an utopia, as a matter of principle. Let us then discuss this possibility. Many thinkers, the most prominent of whom are Gödel[43], Lucas[44] and Penrose[45], have provided some reasonings tending to show that complete closure of the epistemic circle by means of a mechanistic model (or, more generally, within the framework of a *computable physics)* is impossible. All these arguments rely heavily on self-reference and related incompleness theorems. According to R.

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[42] L. Wittgenstein, *Tractatus Logico-Philosophicus,* Routledge, 1974, §1: "The world is all that is the case".

[43] See H. Wang, *From mathematics to philosophy,* Routledge & Kegan Paul, 1974,

[44] J.R. Lucas, "Minds, machines, and Gödel", in: A.R. Anderson (ed.), Minds and machines, Prentice-Hall, 1964

[45] R. Penrose, *Shadows of the mind,* Oxford University Press, 1994; R. Penrose, "Why new physics is needed to understand the mind", in: M.P. Murphy & L.A.J. O'Neill, *What is life?, the next fifty years,* Cambridge University Press, 1997

Penrose, for instance, "Gödel's theorem has the clear implication that mathematical understanding [and other kinds of human understanding as well] cannot be reduced to a set of known and fully believed computational rules"[46]. As for Lucas' classical argument, it runs thus: "We (...) construct a Gödelian formula (such as 'this formula is unprovable in the system') in [a given] formal system. This formula cannot be proved-in-the-system. Therefore, the machine cannot produce the corresponding formula as being true. But *we* can see that the Gödelian formula is true: any rational being could follow Gödel's argument and convince himself that the Gödelian formula, although unprovable in the given-system, was nonetheless - in fact for this very reason - true."[47]. Let us examine carefully the implications of these sentences. What the "mind" is supposed to do in order to *see* that the Gödelian sentence of the machine is true, is to formulate a meta-description of the relationship between the machine and its Gödelian sentence. But, after all, one may notice that this can be done by a second-order machine as well. Lucas therefore demonstrates that introducing higher-order machines does not help solving the difficulty in a purely mechanistical way, since this only leads to an infinite regress (the second order machine generates a Godelian formula referring to its own formal system, etc...). Why is it then that the mind is not confronted with the same difficulty as any higher order machine? Lucas' answer is the following: "We are trying to produce a model of mind which is mechanical - which is essentially 'dead'. - But the mind, being in fact 'alive' can always go one step better than any formal, ossified, dead system can". Leaving aside the purely biological aspects of "life", one can reformulate this remark as Gödel himself did in his own argument against a mechanical model of mind: "(...)mind, in its use, is not static, but constantly developing"[48]. Mind is no well-defined higher order procedure; it is the *ability* to produce an arbitrarily high order reasoning, ever adapted to the stage reached by the problem at stake. In more general terms, avoiding a too narrow focus on minds and machines, one might say that what Gödel and Lucas are trying to convey in their reasonings, is that *actuality* gets always ahead of any attempt at encompassing its features within a

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[46] R. Penrose, "Why new physics is needed to understand the mind", loc. cit.

[47]J.R. Lucas, "Minds, machines and Gödel", Philosophy 1961, reprinted in: A.R. Anderson (ed.), *Minds and machines*, New Jersey, Prentice-Hall, 1964, p. 47

[48]Quoted in: H. Wang, *From mathematics to philosophy,* op. cit. 1974, p. 325

formal model. Their reasoning thus challenges the software variety of the 'Golem complex', just as much as the hardware variety.

Now, what are we to think of this family of arguments? At first sight, they are quite convincing. But many sound counter-arguments have also been provided, for instance by P. Benacerraf[49] and J.C. Webb[50]. One of these counter-arguments is especially striking, because it uses the very existence of the argument against it. Let us quote J.C. Webb: "Such is the basic dilemma confronting anti-mechanism: just when the constructions used in its arguments become effective enough to be sure of, (...) a machine can simulate them. In particular, it implies that our very behavior of applying Gödel's argument to arbitrary machines - in order to conclude that we cannot be modelled by a machine - *can indeed be modelled by a machine*. Hence any such conclusion must fail, or else we will have to conclude that certain *machines* cannot be modelled by any machine! In short, anti-mechanist arguments must either be ineffective, or else unable to show that their executor is not a machine"[51]. This is perfectly right, but what does it show exactly? If taken at face value, it shows that *any effective argument,* be it an argument trying to appropriate 'life' or 'constant development', can be simulated by a machine. More generally, arguments which attempt to involve directly or indirectly actuality, at one step or another of their development, are somehow self-defeating. This is so because they pathetically tend to capture "what makes itself manifest" within the field of "logic" in the sense of Wittgenstein's *Tractatus*.

The consequence of these remarks is that the Gödel-Lucas family of arguments are invalid. Their invalidity however does not entail that they are useless. It only shows that they must be restricted to the status of a Tractarian "ladder" which *has* to be thrown away after one has climbed on it. Admittedly, part of the present article has itself this kind of status. But this should not be taken as a symptom of failure either. Only as a sign that whenever one tries to display the flaws of mechanistic or formalist positions by accepting the rules of the mechanist-formalist language-game, the well-foundedness of the whole move is undermined. Moreover, this kind of defect is not strictly specific of the criticism of mechanism and formalism. To be

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[49] P. Benacerraf, "God, the devil, and Gödel", Monist, 60, 9-33, 1967

[50] J.C. Webb, *Mechanism, mentalism and metamathematics,* Reidel, 1980

[51] J.C. Webb, *Mechanism, mentalism and metamathematics,* op. cit. p. 232

fair, one should also notice that those mechanist-formalist reasonings which go against the choice of giving actuality a priority over formal models are undermined for converse reasons. Indeed, they do not content themselves with an internally consistent chain of derivations; they try to promote their position against their opponents by relying on the *actual understanding* of their interlocutors, thus taking the explicitly denied primacy of actuality as an implicit basic premise.

To summarize, actuality should not intervene in the discourse of either its supporters or its opponents, lest they accept to be caught into inextricable performative contradictions. Its opponents should content themselves with pursuing their regulative ideal of ever-increasingly comprehensive models tending to close the epistemic circle. And its supporters should content themselves with displaying the lacunae which are left in one's description of the world by the successive realizations of the regulative ideal of the opponents (paragraphs 2 and 3 of this article illustrate this latter attitude). Talking of actuality can nevertheless become indispensible, as an auxiliary trick, whenever the upholders of the mechanist-formalist trend of thought become so fascinated by the faster and faster run in the direction indicated by their regulative ideal that they become deaf to the remarks of those who display the recurring lacunae. This is why I decided to give "actuality" such a prominent role in this article, though I was not unaware of the insuperable (and well-known) difficulties this would raise.

As I said formerly, giving priority to the formal model over actuality does not have only the "Golem complex" among its consequences; it also has another consequence that I described as *major*. This consequence is that it promotes and keeps very efficiently alive what Kant called "the transcendental illusion". But what is exactly the transcendental illusion? It consists in reifying the ideally completed aim of a rational investigation, so that one views it as an adequate representation of some absolute reality. For theoretical enquirers, it consists in taking at ontological face value every formal element which provides them with a precise orientation in the attainment of knowledge. In other words, the transcendental illusion is a natural tendency to *forget* that the reason why one is committed to formal regulative ideals of research is essentially *practical,* and accordingly to interpret the corresponding forms as retaining something of the nature of the independently real. Along with such a

perspective, it appears that even though modern science has grown out of a radical criticism of scholastic and aristotelician ontology (especially the ontology of natural place)[52], *in fine* it has promoted this kind of forgetfulness more powerfully than ever. This is the case because of the very success of the scientific method. Indeed, in its highest achievements, it manages to incorporate all the normative aspects of a class of efficient experimental practices within a formal model. So much so that the model itself tends to be hypostasized, to the detriment of a lucid recognition of the practical component in it. No wonder that the discourse of so many scientists of our time is flatly pre-critical in Kant's sense: as Kant himself before the *Critique of pure reason,* they take for granted that actual perceptions or experimental outcomes represent things *as they appear,* whereas the theories and formalized models elaborated by our intelligence tend asymptotically to represent things *as they are*[53].

A very serious question must be raised at this point. Kant explained at length that, according to him, even if it is disclosed, the transcendental illusion is persistent and unavoidable[54]. This assertion is best justified by the commitment of any practice to its internally presupposed target. A transcendental illusion is likely to arise imperatively from within the practice whose interests are embodied by it. The man-in-the-street is committed to the targets of his action and discourse, and this commitment gives rise to what A. Fine named the *Natural Ontological Attitude*. As for the scientist, he/she is committed to the targets of his/her experimental practice, as well as to the heuristic guides of this practice. Extrapolating the Natural Ontological Attitude to the objects and models of science is then the normal expression of the *seriousness* with which the scientist undertakes the research at stake[55]. As a consequence, many philosophers of science consider that, as Putnam[56] would have it, "science taken at face value implies realism", or that "realism is so to speak science's philosophy of science".

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[52] J. Petitot, "Objectivité faible et philosophie transcendantale", in: M. Bitbol & S. Laugier, (eds.), *Physique et réalité, un débat avec Bernard d'Espagnat,* op. cit.

[53] See I. Kant, *Inaugural dissertation (1770),* §4, AK II 392

[54] I. Kant, *Critique of pure reason,* op. cit. A298-B354

[55] For a parallel between Realism and morals, see R. Harré, Varieties of realism, Basil Blackwell, 1986; and M. Bitbol, *Schrödinger's philosophy of quantum mechanics,* Boston Studies in the Philosophy of Science, Kluwer, 1996

[56] H. Putnam, *Meaning and the moral science,* Routledge & Kegan Paul, 1978

But then, by taking the exact counterpart of this internal committment of scientists, namely by adopting an external view on science, we can also imagine a very different situation. Provided one *stands back* from the practices which generate a favourite intentionally aimed at picture of the world, one may have an opportunity to see the loopholes of this picture (and thus to be freed of the transcendental illusion associated with it). In order to submit Kant's view that the transcendental illusion is unavoidable to a moderate criticism, I shall therefore proceed in two steps. To begin with, I shall briefly evoke the loopholes of the current pictures of the world from a viewpoint poorly defined as 'that of somebody who has decided to step back from the practices associated to the pictures of the man-in-the-street and of the scientist'. Later on, in paragraph 5, I shall give some precisions about the various ways of stepping back, and about the various depths of the move.

Typically, the loophole left in the above-mentioned pictures of the world can be described as follows: exclusive interest for what Thomas Nagel calls 'The view from nowhere', and complete inability to account for any 'view from somewhere' aspect of 'all that is the case'. An old example of this, in the moral science, is the inability of scientists to find an agreement between the so-called "freedom of the will" and a deterministic picture of the world, and also their tendency to think (incorrectly[57]) that the solution of this riddle is to be found in some indeterministic features of the natural processes. Such a disarray is not surprising if, as L.W. Beck[58] points out, the scientific description comes about within a disengaged *view from nowhere*, whereas freedom is the necessary presupposition of any actor *engaged somewhere*. The major mistake here amounts to trying desperately to fit what pertains to the standpoint of the actually engaged actor into a disengaged and timeless picture.

Another example is the extreme reluctance of specialists, especially during the first half of the 20th century, to recognize *contextual* aspects in semantics or in the physical science. Nowadays, contextuality has virtually pervaded every field of knowledge, but there are also enduring symptoms that some consequences of it have

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[57] See E. Cassirer, *Determinism and indeterminism in modern physics,* Yale University Press, 1956, for a cogent criticism of this position first suggested by P. Jordan.

[58] L.W. Beck, *A commentary on Kant's critique of practical reason,* The University of Chicago Press, 1960

not been fully accepted. Indeed, the predominant tendency is to look for a way of encompassing the low-order contexts within the field of a higher-order non-contextual discourse or description. But such a regress from a lower level of contextual description to an meta-level of non-contextual characterization of the contexts must have an end. Part of the contexts must be left in the background (see the case of quantum mechanics). Absence of recognition of this necessity has had unfortunate consequences in philosophy.

One of these consequences is the poor analysis provided by philosophers of language about the *indexical* components of everyday speech. According to the current view, indexical terms such as *here, now, I, this, etc.,* are all to be considered as token-reflexive devices. 'Here' is supposed to be used to refer to the *place* from which it is uttered; 'now' to the *time* of utterance; 'I' to the *person* who utters it, and 'this' to the *item* pointed towards by the person who utters it. But this simple token-reflexive analysis leaves aside a very important aspect of the use of indexical terms. That this is so is especially obvious for 'now' and for 'I'. One of the most striking components of the meaning of 'Now' is what we could call its self-elusiveness: namely the fact (already pointed out by Hegel in the introductory sentence of this paper) that as soon as Now is taken as an object of awareness, it is no longer *now*. Similarly, it was recently emphasized[59] that, in performative sentences, 'I' does much more than merely referring to the person who utters it. It conveys personal *commitment*. In other words, it is clear that 'I' has not only the function a *pronoun;* for replacing it by a *noun,* say in a promise, often fail to convey the same meaning.

It is not so difficult to overcome these difficulties provided one makes a clear distinction between the presuppositive and the denotative function of an indexical. The denotative function of indexicals enable them to partake of the expression of a formalizable 'view from nowhere'; but their presuppositive function is definitely irreducible to this view, and it indirectly points towards the too obvious and hence forgotten *actuality*. In the case of 'now', one should for instance establish a pragmatic distinction between the presupposed presence and the denoted instants. In the case of 'I', the model for a distinction between the presupposed and the denoted is

[59] P. Müllhausler and R. Harré, *Pronouns and people,* Basil Blackwell, 1990

already available in G.H. Mead's work about the difference between 'I' and 'me', and in recent commentaries on G.H. Mead by J. Habermas[60]. True, Mead[61] starts his analysis by endorsing the traditional opposition between the transcendental and the empirical, when he writes: "The 'I' is the transcendental self of Kant. The self-conscious, actual self in social intercourse is the objective 'me' (...)". But he then clearly promotes the pragmatic way of thinking when he points out that, during a conversation, *"(...) 'I' is a presupposition, but never a presentation of conscious experience",* whereas the objective 'me' can be presented.

It is interesting to notice at this point that there is an obvious twofold parallel:

(i) between 'I' and the actual now, and

(ii) between 'me' and the referred to instant of vocal utterance of the sound 'now'.

Making full use of this parallel would lead to the following paraphrase of Mead's statement about 'I': *The real Now is a presupposition of speech, even though it cannot be spoken about. The token-reflexive 'now' can be spoken about, but it does not deserve to be called "Now".*

That this is more than a mere analogy can be guessed from the detailed *temporal* analysis of 'I' and 'me' as given by Mead and Habermas. According to these authors, 'I' can but be given to me by means of memory; 'I' is always a historical figure, if it is to be a figure at all; the 'I' is either what you were *one second ago,* or it completely eludes thematization. Similarly, 'now' either receives *ex post facto* characterization or it eludes any characterization. Such an overlapping irresistibly suggests the idea of a common origin of the plurality of particular indexical terms such as 'now' and 'I'. It makes likely that they have all been derived, in some remote (and possibly mythical) prehistory of language, from a single general indexical term "Aha!", that may be said to stem from "absolute actuality" (in phenomenological terms) or from "act force"[62] (in pragmatic terms). Whereas each particular indexical (I, here, now, this) presupposes

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[60] J. Habermas, *Nachmetaphysisches Denken,* Suhrkamp Verlag, 1988.

[61] G.H. Mead, "The mechanism of social consciousness", The journal of philosophy, psychology and scientific methods, IX, 1912, 401-406; G.H. Mead, "The social self", The journal of philosophy, psychology and scientific methods, X, 1913, 374-380; both in: G.H. Mead, *Selected writings,* Bobbs-Merrill, 1964.

[62] P. Müllhausler and R. Harré, *Pronouns and people,* op. cit. p. 35

only a particular aspect of the context of speech, the general indexical "Aha!" would presuppose the whole actual context.

This primeval all-encompassing indexical would have some affinities with the "inarticulate sound" with which, says Wittgenstein[63], some philosophers would like to start their investigation. Wittgenstein is perfectly right to emphasize that this *inarticulate sound* cannot really be taken as the explicit departure point of philosophy, because "(...) one cannot begin before the beginning". But I also think that the all-pervasive implicit role of what is expressed by this sound should underpin each single word of the work of a philosopher, if he is to avoid improprieties and dissonances with respect to *what it is like to be a sentient being*.

5-Three remedies against the transcendental illusion

Freeing oneself from the transcendental illusion would mean being able to broaden one's awareness so as to encompass the whole of actuality (including the immanently operating regulative ideals), rather than letting oneself be carried away by exclusive fascination for the interest-relative objects of thought construed as transcendent. As I mentioned previously, the preliminary condition for this liberation consists in *stepping back* from the practice whose orientations are embodied by a set of objects of thought. But of course, such a move is not easy to perform. The more one gets close to the basic practices of life, and the more it becomes difficult. In view of this difficulty, I shall adopt a progressive approach. I shall discuss successively three strategies aiming at freeing oneself from deeper and deeper layers of the transcendental illusion. The first strategy pertains to (Kant's) critical philosophy; the second stragegy to Wittgensteinian 'therapy'; and the third strategy to Indian (Hinduist and Buddhist) soteriology[64].

The standpoint of critical philosophy has been adopted repeatedly in this paper; and the very concept of a transcendental illusion has been borrowed from it. That it consists in stepping back from the main scientific practices can easily be appreciated from the two-sidedness of Kant's discussion on the implications of transcendental philosophy for scientists. On the one hand, in the *Transcendental aesthetic* section of his *Critique of pure reason* Kant states that space is not a

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[63] L. Wittgenstein, *Philosophische Bemerkungen,* Basil Blackwell, 1964, §68

[64] 'Soteriology' means 'doctrine of salvation'.

concept abstracted from our outer experiences, but rather the *a priori* form of all outer intuitions. It is only this way that one can understand how it is possible to have a knowledge of the *necessary* propositions of geometry. But on the other hand, in paragraph 13 of his *Prolegomena,* Kant also accepts that, with respect to any possible experience and to any possible geometrical practice, everything remains exactly *as if* ("als ob") space were an intrinsic feature of things and of their relations. The critical attitude thus stems from the meta-standpoint of the philosopher, and it proves mostly irrelevant from the ordinary standpoint of the man-in-the-street or the scientist who are immersed into their more or less sophisticated practices.

But once one has stepped back from the ordinary standpoint of practitioners, once one has adopted the philosopher's meta-standpoint in Kant's sense, some consequences become unavoidable. One crucial consequence is complete disconnection between objectivity and ontological reality, between the intentional objects and the putative 'thing-in-itself'. This distinction is usually found very difficult to understand by scientists. Indeed, most of them take for granted that framing objective entities is tantamount to grasping reality; they accept without discussion that the striving for invariance is at the same time a striving towards reality in the absolute; they cannot figure out that universally valid relations, as expressed by a formalism, do not tend unavoidably to be identical with (ontologically) real relations. Their main argument is that, *by definition,* the sought absolute reality has to be independent of any particular perspective and of any special mode of experimental investigation. *Therefore,* they say, increasing the range of perspectives and modes of experimental investigations with respect to which our formal models are independent, can but bring us nearer and nearer from reality in the absolute. But this reasoning is manifestly flawed. First, the fact that invariance with respect to any generalized standpoint is a *necessary* condition for defining "absolute reality" does not entail that it is a *sufficient* condition. The absoluteness of this reality has invariance as a consequence, but the converse has yet to be proved. Second, there is a gap between defining a concept of "absolute reality" *in abstracto* and trying to characterize it. This is so because the very acceptance of the definition of an "absolute reality" makes the project of finding out its determinations self-defeating. Indeed, if this definition is taken at face value, the project has to assume that it makes sense to seek what

is reality independently of any activity of seeking; or to characterize reality relative to no procedure of characterization at all[65]. Characterizing something, even in such a way that part of the characterization becomes invariant with respect to contexts and perspectives, involves two steps, not one. It involves one step of defining determinations *relative* to a large (but not arbitrary) class of contexts, and then another step of abductive[66] extraction of a *stable* element among these determinations. Asserting that this invariant tends to represent something of an "absolute reality" disconnected from *any* contextual background, is only possible if one has forgotten the initial step of the procedure by means of which the invariant was extracted. In order to avoid this inaccuracy, one should not lose sight of the fact that the kind of universality and invariance science is able to reach only holds for a wide class of perspectives, of methodological approaches, and of interests within the world; it does *not* hold for some utopic "nowhere" having nothing to do with perspectives, situations, methods and interests. As F. Klein would have it, every invariant must be referred to its group of symmetry; it is only the invariant *of this group*. Here again, objectivity implies independence with respect to situations belonging to a certain comprehensive class; it does not imply absolute lack of relevance of the concept of situation.

The most obvious reason why many scientists (and also philosophers of the analytic tradition) are so prone to forget it, is that they just happen to be immersed in these situations, to adopt these approaches, and to share these interests. But there is also another, more subtle, reason for this forgetfulness. It is the philosophical circumstance that if the emergence of invariants of a wider and wider class of modes of investigation is not to be ascribed to some convergence towards some pre-structured independent reality, then one usually does not know how to explain it[67]. This kind of remark can be found, for instance, in B. Williams' *Ethics and the limits of philosophy:* "In a scientific inquiry there should ideally be convergence on an answer, where the best explanation of the

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[65] See M. Mugur-Schächter, "Mécanique quantique, réalité et sens" and C. Schmitz, "Objectivité et temporalité", and the answers by B. d'Espagnat, in: M. Bitbol & S. Laugier (eds.) *Physique et Réalité, un débat avec Bernard d'Espagnat,* Editions Frontières-Diderot, 1997.

[66] in the sense of C.S. Peirce.

[67] On this point, see the long and thorough discussion of B. d'Espagnat, in: M. Bitbol & S. Laugier (eds.) *Physique et Réalité, un débat avec Bernard d'Espagnat,* op. cit.

convergence involves the idea that the answer represents how things are"[68]. The problem is that the strong version of this belief, according to which realism "(...) is the only philosophy that does not make the success of science a miracle"[69], might well arise from the same family of prejudices as that of somebody who identifies himself so strongly to a certain set of perspectives (here a familiar set of foundational perspectives) that he loses sight of the fact that they are nevertheless *only perspectives*. Here, freeing oneself from the prejudice would mean remaining open to a variety of interpretations of the evolution and of the success of scientific theories. After all, the so-called "convergent realism" is not necessarily the best, and by no means the only, explanation of the growing generality and success of the invariants of scientific investigation. On the one hand the soundness of this explanation has recently been challenged with a series of strong arguments coming from the neo-rationalist and the neo-empiricist philosophies of sciences as well[70]; and on the other hand alternative explanations are not out of reach. Among these alternatives, let me emphasize the pragmatic-transcendental explanation of the success of quantum mechanics I have myself suggested[71]. It consists in showing that it is perfectly possible to regard the Hilbert-space structure of quantum mechanics, and the general form of its equations of evolution, as an embodiment of the necessary pre-conditions of a wide class of activities of seeking and predicting. This being granted, the quantum theory no longer appears as a reflection of some (exhaustive or non-exhaustive) aspect of a pre-given nature, but as the structural expression of the *co-emergence* of a new type of experimental activity and of the 'factual' elements which constrain it. Nothing then prevents one from extending tentatively the latter conclusion to other branches of physics, and to cognitive activities in general[72]. This would involve recognition that the major invariants of scientific theories are neither to be taken as a direct

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[68] B. Williams, *Ethics and the limits of philosophy,* Harvard University Press, 1985

[69] H. Putnam, *Mathematics, matter and method,* Vol. 1, Cambridge University Press, 1975

[70] L Laudan, *Science and values,* University of California Press, 1984. See especially chapter 5; also: B. Van Fraassen, *The scientific image,* Oxford University Press, 1980. For a reply from the realist side, see J.L. Aronson, R. Harré, & E.C. Way, *Realism rescued,* Blackwell, 1993

[71] M. Bitbol, *Mécanique quantique, une introduction philosophique,* Flammarion, 1996; M. Bitbol, "Some steps towards a transcendental deduction of quantum mechanics", *Philosophia Naturalis,* (To be published, 1998).

[72] This view of cognitive science was developed by: F. Varela, E. Thompson, & E. Rosch, *The embodied mind,* MIT Press, 1993

expression of some independent reality, nor as the mere projection of the structure of our thought, but as a formal expression of the conditions for the *co-stabilization* of a class of objects and its (bodily or instrumental) modes of investigation. In terms borrowed from F. Varela et al., "cognition in its broadest acceptation consists of *enaction,* that is to say making a world emerge through a viable history of structural coupling"[73].

In view of this alternative orientation of the philosophy of science, there is no reason left to give any *metaphysical* priority to form over actuality, or to invariants over the flux of appearances, beyond the *epistemological* priority it understantably has for scientists.

I am aware that it sounds paradoxical to advocate renouncement to any attempt at catching some absolute reality beyond phenomena by invoking Kant's dissociation between ontological reality and objectivity. After all, the elementary concept of a 'thing-in-itself' underpinning the immanent appearances is likely to stimulate, rather than to inhibit, the project of looking for something immutable and true below the changing and sometimes deceptive actuality. This is so because the dualism of phenomenon and thing-in-itself unavoidably generates a representation of transcendence.

But one should not forget that the concept of 'thing-in-itself' has undergone a momentous evolution in the work of Kant, and then in the analysis of the successive generations of neo-Kantian philosophers. The key-process of this evolution was that of a progressive merging of the 'thing-in-itself' into the flux of immanence. According to L. Ferry, for instance, "The thing-in-itself should no longer be construed as a cause of the representations, *but as the very fact of representation* "[74]. Along with this move, the concept of 'thing-in-itself' has completely lost the power of suggesting that there is something *out there* which causes the appearances, and that scientists tend to grasp it asymptotically by identifying more and more comprehensive formal invariants. *Accordingly, reality is no longer construed as something very deep, very abstract, very general, far beyond the narrowly located actualities, but as essentially akin to actuality in general.*

It is interesting to notice that this immanent conception of reality, which was advocated long ago by neo-kantian or pragmatist

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[73] ibid.

[74] I. Kant, *Critique de la raison pure,* Flammarion (GF), 1987, préface de L. Ferry, p. XIX

philosophers, is also pervading the views of some contemporary realist and materialist philosophers. T. Nagel, who defines his own position as a variety of realism, emphasized repeatedly that objectivity and invariance do not exhaust reality: "The way the world is *includes (local) appearances,* and there is no single point of view from which they can all be fully grasped"[75]. As for M. Lockwood, who presented an interesting materialist view of mental processes in his *Mind, brain and the quantum,* he insisted that objective knowledge of the brain events by means of perception and elaboration of formal models is only *one* possible way of access to these events. Another way in which the same events might be known is "(...) self-awareness: knowing certain brain events (...) 'from the inside', by living them, or one might almost say, by self-reflectively *being* them"[76]. The actual complex of experienced *qualia,* of perceptive identification, and of intentional directedness, precisely represents this kind of apprehension of reality from within, according to M. Lockwood. If one makes an exception of the inaccuracy which consists in conflating the internal and external standpoints, namely asserting that one has knowledge 'from the *inside'* of a series of events (the brain events) which were initially defined relative to the *external* mode of access, this remark contains an important insight. It consists in pointing out that actuality is not to be considered, dualistically, as a pure local appearance-for-us of some transcendent reality which formal models tend to describe. Actuality should rather be thought of, non-dualistically, as an admittedly bound and partial *mode* of the immanent reality self-reflectively *being* itself.

As I mentioned previously, the second strategy tending to undermine the transcendental illusion is Wittgenstein's "therapy". As Wittgenstein writes, "The philosopher's treatment of a question is like treatment of an illness"[77]. Now, the etiology of this illness is not very difficult to elucidate: it is the powerful spell of language. As a consequence, "Philosophy is a battle against the bewitchment of our intelligence by means of language"[78]. The Wittgensteinian therapy is then primarily directed against the philosophical disease which

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[75] T. Nagel, *The view from nowhere,* Oxford University Press, 1986

[76] M. Lockwood, *Mind, Brain and the Quantum,* Blackwell, 1989, p. 159; M. Lockwood, "The grain problem", in: H. M. Robinson (ed.), *Objections to physicalism*, Oxford University Press, 1991

[77] L. Wittgenstein, *Philosophical investigations,* B. Blackwell 1958, §255

[78] ibid. §109

consists in reifying the presuppositions of everyday life and speech, and elaborating a metaphysics out of this. Accordingly, the job of a Wittgensteinian philosopher consists in undoing the complex metaphysical architectures inherited from past philosophy, and pointing out its roots in the use of language. Each possible locus of bewitchment by language has to be explored in turn. A reasonable list includes the use of substantives, predicates, and (grammatical or mathematical) rules.

To begin with, one of the greatest source of "philosophical bewilderment" is that "a substantive makes us look for a thing which correspond to it"[79]. Substantives like 'meaning' or 'truth' seem to force us to point to something, and our incapacity to do so produces a "mental cramp". It is only if one transforms the question of correspondance into a question of use, that the mental cramp is cured at its source. Wittgenstein's criticism of our fascination for substantives also extends to what one might call the urge for Substances, namely for a metaphysical ground of the division of 'all that is the case' into individualized intrinsically existent objects. Firstly, we have no need of such a ground: "Children do not learn that books exist, that armchairs exist, etc. - they learn to fetch books, sit in armchairs, etc."[80]. Secondly, attempting to identify a metaphysical ground unavoidably generates sceptical reactions which are almost impossible to overcome by arguments. Our certainties do not arise from any firm ontological knowledge; they only express the interplay of our linguistic and gestural practices. "My life shews that I know or am certain that there is a chair over there"[81]. "The end (...) is an ungrounded way of acting"[82]. One teaching quantum physicists should draw from this analysis of certainties concerns the emergence of a macroscopic quasi-classical world from the so-called quantum world. Instead of trying desperately to make the macro-world come out of the internal functioning of the Hilbert space model construed as a reasonably faithful description of reality, they should realize that this macro-world partakes of the ungrounded *knowing-how* of experimenters; and that their tentative theoretical knowing-that being based on this initial knowing-how, it can pride itself on no logical or

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[79] L. Wittgenstein, *The blue and brown books,* Blackwell, 1969, p. 1
[80] L. Wittgenstein, *On certainty,* Blackwell, 1974, §476
[81] ibid. §7
[82] L. Wittgenstein, *On certainty,* op. cit. §110

metaphysical priority whatsoever. My reading of the decoherence theories in paragraph 3 was in good agreement with this anti-foundationalist stance. It said that decoherence does *not* show that the appearance of a classical world can literally be grounded on a real quantum world. Decoherence only displays the possibility of a reasonable quantitative agreement between the initial knowing-how of the quantum physicist and his/her theoretical end-product; it is part of a demonstration that the overall epistemic process can be made self-consistent, in spite of its being ungrounded. A metaphor used by Wittgenstein nicely expresses this substitution of a feed-back loop for the traditional foundationalist stratified scheme: "(...) one might almost say that these foundation-walls are carried by the whole house"[83].

Another aspect of the philosophical illness to be cured is fascination with concepts. Concepts seem to require rigid limits, and therefore possibility to locate unambiguously an object on one side or the other of the limit. This is a prerequisite for the extensional definition of concepts, and this appears to be indispensible if one is to grasp a true 'natural kind' by means of a concept. But, says Wittgenstein, the situation in which we may define the strict limits of our concepts is exceptional. The ideal of such a situation has a purely regulative function, and the meta-concept of 'natural kind' is to be construed as a way of hypostasizing this ideal. The usual case is that of a fuzzy definition of the domain covered by a concept, by means of some 'family resemblance'[84]. Of course, one could argue against Wittgenstein that 'family resemblance' is only useful in everyday language, and that science has nothing to do with it because it provides strict definition of its concepts. But even here, things are not so clear-cut. Enactment of a concept, i.e. *making use of it,* in actual experimental science as in actual life, supposes a sufficient plasticity of its form. An interesting example is provided by modern physics, whose persistent talk of "particles" has only been made possible by a remarkable capacity of extending the range of this concept well beyond what would have been acceptable in the context of classical science, and by acceptance of a certain amount of extensibility of its

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[83] L. Wittgenstein, *On certainty,* op. cit. §248; see M. Bitbol, *Mécanique quantique, une introduction philosophique,* op. cit.

[84] L. Wittgenstein, *Philosophical investigations,* op. cit. §67

limits. "Particle" is what H. Putnam[85] would call a "broad spectrum notion".

The third and last element of the philosophical disease in Wittgenstein's sense, is the belief that, when we perform an ordered activity, we follow an inner rail called a 'rule'. But this way of putting things is misleading. For saying that somebody's actions are in accordance to a rule is not tantamount to saying that the person is explicitly guided by the rule. According to S. Kripke's reading[86] of Wittgenstein's analysis of the process of rule-following, one should then completely revert the priorities between the rules and the forms of life. In the same way as, in Hume's analysis of causation, one should not say that regularities manifest underlying causal powers, but rather that speaking of causal powers is a way of integrating the regularity within one's discourse, in Wittgenstein's analysis of rule-following, one should not say that regular behaviour manifests a real 'internal rail' called a rule, but rather that speaking of rule-following is a way of integrating the regular behaviour (and its more or less explicit normative ideal) within one's language game[87]. Such a reversal of priorities, if extended to science, has momentous consequences. It means renouncing the logical priority usually given to laws or to symmetries over the delegates of actuality called 'measurement outcomes'. And it pushes one to consider that these laws, or the propensities associated to these symmetries, are only a way of integrating the (deterministic or statistical, certified or *expected)* regularities of measurement outcomes within the project one ascribes to the experimental game of seeking and finding. This is the general version of the "Copernican revolution" of science which has already been documented in some readings of statistical physics and quantum mechanics (see §2 and §3 of this paper).

Finally, I must sketch briefly the third and most radical strategy tending to undermine the transcendental illusion. This strategy is that of the soteriological discourse of Indian thought. It goes beyond mere criticism of the hypostasis of both the heuristic principles of science and the regulative ideals of metaphysics; it goes beyond the therapy of the 'mental cramps' of those philosophers who look for substances underlying the substantives; it does not content itself with a

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[85] H. Putnam, *Définitions,* L'éclat, 1992, interview in French with C. Bouchindhomme.
[86] S. Kripke, *On rules and private language,* Blackwell, 1982
[87] ibid. p. 97-98

philosophical cure of the philosophical temptation to reify the tacit guiding principles of everyday life and speech. It aims at drying up the very source of these wanderings, by moving to a level of awareness where the basic presuppositions which underly our action, our discourse, and even the way we *see* things, do not operate any longer. After all, one should not forget that endowing the regulative ideals of human investigations with a metaphysical significance, is a tendency which has its roots deep into the *natural ontological attitude* of the man-in-the-street. Whereas Kant and Wittgenstein only aimed at denouncing the *philosophical* consequences of the reification of substantives and theoretical entities used respectively in philosophical extrapolations and in scientific extrapolations of everyday speech, Indian soteriology had (and still has) the project of unrooting the *natural ontological attitude* of everyday life itself, by carefully identifying and defusing its existential motivations.

Before we examine the way this project is carried out, we have to direct our attention towards two aspects of the opposition between form and actuality which have been overlooked until now; two aspects which are really crucial if we are to understand the alien attitude of the Indian civilization with regard to form. The first aspect is the connection of form with the *future*. And the second aspect is what we could refer to as the *entanglement* of form and actuality.

At first sight, actuality is restricted to the present whereas formal models allow one to master the future by means of their predictive contents. But things are not so simple; these two judgments have to be qualified in turn.

On the one hand, pure actuality is not averse to an internal orientation, called intentionality, towards the future (see below for more details); yet this latent future of intentionality is likely to be more *open* than the enlisted future of predictive formalisms.

On the other hand, as N. Goodman emphasized[88], any formalized *projective* attempt is bound to have a basis in the present and the past. However, this basis is not necessarily restricted to present and past *facts,* as it would be the case in mere induction. According to Goodman, it rather extends to current and past successful *predictions*. A new projective hypothesis or formalism is not adopted if it only agrees with a finite set of past *facts:* it is accepted if it is more

[88] N. Goodman, *Facts, fiction, and forecast,* Athlone Press, 1954

comprehensive than past *hypothesis,* and if it does not contradict the most entranched elements of the previous *overall projective network*. In other terms, a new projective formalism does not depend *anecdotally* on the past, but it depends *holistically* on it. A good illustration of this situation in physics is the way new theories take previous theories as their limiting case in a restricted domain of validity. It thus becomes clear that the relation between predictive formalisms and the future is quite ambivalent. They allow a reasonably reliable projection into the future, but they also tend surreptitiously to present the future as a more or less complete continuation of the past. Their very ideal of mastery of nature implies the belief that, some day, a 'Theory of everything' will enable us to behave with respect to the future with the same confidence and the same feeling of closure as with respect to the past[89]. The only two circumstances that leave this project in suspense is (i) the current incompleteness of physical theories, which leaves room for further scientific revolutions, and (ii) the element of irreducible indeterminism incorporated in these theories.

Let us now come to the problem of the entanglement between form and actuality. This issue is all the more important since it may retrospectively cast a doubt on the clearcut distinction we have accepted until now. At this point, we must take into account the thorough criticism which has been directed by the psychology and the philosophy of the twentieth century against the traditional Kantian divide between the pure 'matter' of sensation and the forms (of intuition and of thought). According to the Gestalt psychologists, to begin with, a perception does not split up into a purely passive sensorial input and an intellectual activity of interpretation; it so to speak carries its interpretation with it. There is not on the one side a pure present actuality devoid of any predictive element, and on the other side an intellectual projective form which takes the aspect of an explicitly stated set of hypothesis. Rather, as J. Bouveresse notices, "perception *is* the hypothesis"[90]. Perception incorporates tacit rules of anticipations which can be formalized retrospectively.

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[89] See C. Schmitz, "Objectivité et temporalité", in: M. Bitbol & S. Laugier, (eds.), *Physique et réalité, un débat avec Bernard d'Espagnat,* op. cit.

[90] J. Bouveresse, *Langage, perception et réalité,* Tome 1, *Perception et jugement,* Jacqueline Chambon, 1995, p. 335

This point was repeatedly insisted upon by the phenomenological tradition. Husserl's analysis of what remains after the 'bracketing' of the *natural attitude* has taken place, involves what he calls a 'noema'. This 'noema' may be construed as a stable form which persists from one appearance to another, which incorporates an immanently intentional aspect in it, and which therefore operates as a generalization of the notion of meaning[91]. Now, despite its formal components, the noema is not separable from the whole act of perception. As Husserl explained, perception can be taken as a low-level epistemic operation, or an *implicit judgment*[92], even though the epistemic operations and judgements proper can only arise after a certain amount of elaboration of the ante-predicative layer of perception has taken place.

Later on, M. Merleau-Ponty amplified the anti-intellectualist stance of phenomenology. He especially emphasized that, unlike Kantian philosophy (especially in its neo-kantian reading), phenomenology deals with a formal and intentional component of perception which *cannot* be reduced to any operation of the understanding. According to Merleau-Ponty, "Each part (of experience) foretells more than its contents, and therefore this elementary perception is already loaded with *meaning*"[93]. Perception goes beyond the stage of a mere flux of sensations even before the intervention of the categorical forms of thought.

Wittgenstein himself undertook a remarkable 'grammatical' (and sometimes phenomenological) analysis of the formal aspect of actual perceptions, which he named 'seeing as'. The examples he gave range from the 'duck-rabbit' to the Necker cube. The drawing of a 'duck-rabbit' can (obviously) be perceived either *as* a duck or *as* a rabbit. As for the cube, it can be perceived under two three-dimensional orientations, which are equally compatible with the two-dimensional image on the paper; it can also be seen as the representation of many distinct objects. The key point of Wittgenstein's reflection is the major difference between *seeing* and *interpreting*. Even though we really *see* a certain illustration under one or another form, "(...) it is remarkable that we can equally use the term *interpretation* for

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91 H.L. Dreyfus, *Husserl, intentionality and cognitive science,* MIT Press, 1982

92 E. Husserl, *Erfahrung und Urteil,* Glaassen & Goverts, 1954, p. 62

93 M. Merleau-Ponty, *Phenoménologie de la perception,* Gallimard, 1945, p. 9

describing what is immediately perceived!"[94]. We actually *see* something *as* such and such object, but, after careful retrospective analysis, we can also conceive this *view* as loaded with interpretation. Just in the same way as the fact that somebody's reliable behaviour can retrospectively be considered as a sign that this person is explicitly guided by a rule.

In view of this pre-verbal entanglement of actuality and form, as well as of present perceptions and intentionally aimed at future, the task of somebody who would like to defuse the *natural ontological attitude* appears very difficult, not to say hopeless. At any rate, disentanglement should involve an attempt at working below the level of verbal reasoning and argument. Now, this move from the verbal to the pre-verbal is exactly what most Indian philosophies would recommend. The universal method they use for that, to wit the *Yoga*[95], is several thousands years old. The yoga has some western analogs, ranging from psychological introspection to phenomenological reduction, not to mention mystical contemplation. But this very multiplicity of equivalents shows that no such analogy is perfect[96]. For instance, the yoga differs radically from its much criticized western counterpart (introspection), in so far as it is intrinsically non-dualistic. However, it has more interesting connections with phenomenological reduction (or 'bracketing'). Indeed, in phenomenological reduction, as in yoga, "(...) the only reason why [one] should bracket the belief in the existence of the world is to *see* it (...)"[97]. In phenomenological reduction, as in yoga, "(...) [one] must sink into the world instead of dominating it"[98]. But there are also two major differences between the yoga and the phenomenological reduction, bearing on their maturity and on their function. Firstly, the yoga has been much more carefully codified than the phenomenological reduction during its long life-span, and this allowed systematic teaching. Secondly, whereas the function of phenomenological reduction is primarily epistemic, yoga's is soteriological: it aims at freeing man from his/her worldly bondage.

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[94] L. Wittgenstein, *Bemerkungen über die Philosophie der Psychologie,* B. Blackwell, 1980, §9

[95] M. Eliade, *Le yoga,* Payot, 1954; see also Patañjali's *Yoga-Sûtras* translated by F. Tola and C. Dragonetti, Motilal Banarsidass, 1987

[96] See F. Varela, E. Thompson, & E. Rosch, *The embodied mind,* op. cit. for a thorough discussion of this point.

[97] M. Merleau-Ponty, *Le visible et l'invisible,* Gallimard, 1964, p. 61

[98] ibid.

Now, the fact that the methods recommended to disentangle form, intention, and actuality, *have* to be non-verbal while they are used, does not prevent one from expressing their essential features in retrospect. One must only remember that this expression does not provide a faithful description of what is at stake (this would be self-contradictory), but only a *guide* intended for other *practioners*. The Indian soteriologists as well as the western phenomenologists have made several attempts in this direction. A most remarkable point about these attempts is that Indian practioners of yoga and phenomenologists are in reasonable agreement with one another; and that moreover their views are both compatible, on the experiential side, with the objectifying descriptions of some specialists of cognitive science[99].

Let us begin with practitioners of yoga (for, after all, they have a historical priority). According to them, our bondage, to wit our being compelled to adopt the *natural ontological attitude* whereby we *see* things dualistically, (essentially) comes from desire, action, and grasping. Desire is motivated by our relating every appearance to our egocentric needs. Action arises from an understandable attempt at appeasing the desire. And grasping is the consequence of one's hope that it is possible to *freeze* the situation wherein the needs are satisfied (and the threats avoided). Accordingly, the yoga tends to dissolve the ego, to liberate the action from craving, and to release the urge of grasping:

(i) Promoting the immediate awareness of the cosmic unity (the 'That art thou [Tat tvam asi]' of the Upanishads[100]) is obviously a radical way of dissolving the individual ego.

(ii) The perfect immobility of the yoga practitioner is a first (though extrinsic and superficial) approach towards the solution of the problem of action. As Nâgârjuna writes, "The root of cyclic existence is action, Therefore the wise one does not act"[101]. However, the latter sentence is best understood not in the sense of complete and definitive withdrawal from active life, but in the sense of an attempt at freeing the acts from the chain of conditions. This idea is remarkably

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[99] F. Varela, E. Thompson, & E. Rosch, *The embodied mind,* op. cit.

[100] A. Huxley, *The perennial philosophy,* Triad Grafton Books, 1985, chapter 1; also: E. Schrödinger, *My view of the world,* Ox Bow Press,

[101] Nâgârjuna, *Mûlamadhyamakakârikâ,* XXVI, 10, in: J. Garfield, *The fundamental wisdom of the middle way,* Oxford University Press, 1995

conveyed by M. Eliade: "the yoga recommends to live, but not to remain the instrument of life"[102].

(iii) Finally, since grasping is part of an attempt at casting out the effect of time, it has to be counterbalanced by a meditation on impermanence. This does not mean that a yogi (or yogini) does not care for the future; but he/she equanimously considers each present act as a seed which may or may not sprout, rather than as part of a heroic attempt at dominating time by reaching the immutable form of nature.

Once this process is completed, one reaches "The pacification of all objectification and the pacification of illusion (...)"[103]. The world is no longer *seen as* a collection of individual substances corresponding to the lexical substantives; rather, one "(...) *see(s)* things *as* they are - as merely (...) dependent, impermanent and non-substantial (...)"[104]. Unlike Kant, Indian (especially Buddhist) thinkers thus consider that the transcendental illusion *can* be overcome, and they give detailed and coherent instructions for that[105].

Further information about this process of emancipation from the very source of every metaphysical wandering can be found in contemporary philosophy and cognitive science. They also concern the three points which have already been documented, namely egocentration, action, and time.

To begin with, M. Merleau-Ponty repeatedly criticized the subjectivist tendency of transcendental philosophy. According to him, if I am to overcome the transcencental illusion, "(...) if I am to be ek-statically within the world and the things", then "nothing must retain me far away from them (...) not even this (philosophical) description of myself as a 'subject', as a 'mind' or as an 'ego' (...) which reintroduces in me a ghost of reality and arouses the belief that I am a *res cogitans* (...)"[106]. I must no longer represent myself as some separate entity facing Being, for my view on Being arises from within the midst of it[107]. This is an indispensible preliminary step in order to recognize that things and minds are all "(...) differences or extreme

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[102] M. Eliade, *Le yoga,* op. cit. p. 67

[103] Nâgârjuna, *Mûlamadhyamakakârikâ,* XXV, 24, in: J. Garfield, *The fundamental wisdom of the middle way,* op. cit.

[104] J. Garfield, *The fundamental wisdom of the middle way,* op. cit., p.332

[105] T.R.V. Murti, *The central philosophy of Buddhism,* G. Allen & Unwin, 1955, p. 300

[106] M. Merleau-Ponty, *Le visible et l'invisible,* op. cit. p. 77

[107] ibid. p. 154

gaps of an unique something"[108]. And this obviously also prevents one from thinking that he/she can reach the position of a *Kosmotheoros*[109], a pure abstract detached observer seeing things from nowhere.

The second point is action. It is well accepted in contemporary philosophy that perception and intentionality cannot be separated from both the motivating forces of desire and the schemes of activity. In some early writings of Husserl's, one finds that these issues are completely intermingled: "The interest is not at rest, it is not bound to the image; it struggles to escape from it. Therefore, there arises an *intention,* a tensed interest, which tends to confront the matter. If nothing happens next, we feel tensed, dissatisfied; if it happens, we feel satisfied"[110]. Intentionality, and the 'noema' which is the formal basis of it, thus clearly have a partly pragmatic background which Husserl expressed in phenomenological terms.

This pragmatic background of the formal component of any perception (the *seeing-as)* has been suggested even more insistently by Wittgenstein, even though he finally reverted to a purely 'grammatical' analysis. As J. Bouveresse notices[111], seeing a drawing *as* A or *as* B might well depend on a different ordering of the eye-movements which come before recognition; it may also depend on the different activity schemes which are mobilized when something is perceived *as* one or *as* another possible objects of manipulation.

To summarize, Husserl and Wittgenstein both recognized a pragmatic component of intentionality or *seeing-as*. But they also both rejected the temptation of naturalizing it; they rather gave it the transcendental position of a phenomenological or grammatical pre-condition. This does not mean that the transcendentalist trend of thought dismisses any approach of the same issues by the methods of a natural science, but only that, if such an investigation were carried out, its outcomes should have to be related with the phenomenological / grammatical analysis in terms of parallelism[112] or supervenience,

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[108] ibid. p. 117

[109] ibid. p. 152

[110] E. Husserl, *Aufsätze und Rezensionen, 1890-1910,* Husserliana XXII, (ed. B. Rang), Martinus Nijhoff, p. 411; French translation in: E. Husserl, K. Twardowski, *Sur les objets intentionnels,* Vrin, 1993, p. 262.

[111] J. Bouveresse, *Langage, perception et réalité,* Tome 1, *Perception et jugement,* op. cit. p. 357

[112] About parallelism in the philosophy of mind and the philosophy of physics, see M. Bitbol, *Schrödinger's philosophy of physics,* Boston Studies in the Philosophy of Science 188, Kluwer, 1996, Chapter 6.

rather than in terms of reductionism or materialist foundationalism. This precaution being taken, it is very interesting, even from a phenomenological or Wittgensteinian standpoint, to notice that cognitive sciences have *also* recognized the intermingling of perception and action. A classical experiment[113] (commented by Varela et al.[114]) for instance shows that when kittens have been made completely passive, they lose the possibility of perceiving standard obstacles.

Along with these remarks, it becomes clearer than ever that disentangling actual perceptions from its formal-intentional component, to wit allowing one to *see* rather than to *see-as,* presupposes either suspension of action or lucid identification of the motor schemes involved in perception as soon as they operate. This is the price which would have to be paid if our life-long commitment to the *natural ontological attitude* were to be alleviated. In the same way as one has to step back from a scientific practice and from its regulative ideals in order to overcome the special variety of transcendental illusion which is associated to it, one would have to step back from *any* practice, or at least from any *commitment* to practices, in order to overcome the ultimate source of transcendental illusion. That this is possible is usually accepted without difficulty in the East. Whether this is desirable or not in our Western context, is obviously an open question, but the mere *possibility* of such a radical move should modify thoroughly, in the long term, our basic epistemological attitudes. This is one of the most important aspects of the *Renaissance* of the Western outlook[115], which could be prompted by our ever more insistant contact with the Eastern culture.

Finally, there is the question of time. As I mentioned in the introduction, science as a whole can be construed as the most advanced attempt of mankind for mastering the productiveness of/in time. Defining stable objects is the usual first step of this process. The second step consists in identifying the law-like behaviour of the changes in these objects, for, as M. Schlick explained: "(...) the permanent in an alteration is called its *law*"[116]. As for the third step, it

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[113] R. Held and A. Hein, "Adaptation of disarranged hand-eye coordination contingent upon re-afferent stimulation", *Motor skills,* 8, 87-90, 1958

[114] F. Varela, E. Thompson, & E. Rosch, *The embodied mind,* op. cit. p. 237

[115] ibid. p. 51; also: R-P. Droit, *L'oubli de l'Inde,* P.U.F. 1989

[116] M. Schlick, *Philosophical papers II, 1925-1936,* Reidel, 1979, p. 8

is the project of elaborating an all-encompassing and hopefully immutable formalism (the 'final' theory 'of everything'), which nevertheless accounts for every 'apparently' fluent aspect of *all that is the case*. This is our civilization's most elaborate version of the urge to lock time up[117]. Of course, the attitude of scientists towards time is much more ambivalent than that in their everyday work. True, their project of formulating a theory of everything, as well as their attempts at encompassing every single transient feature of phenomena within the scope of their formalisms, manifests a neo-Parmenidean project. But as soon as a difficulty arises, implementation of the project is postponed until an indeterminate future. This openness of the scientific future might well be the way by which the blind spot of actuality manifests itself insistently in the midst of the all-embracing formalist design.

6-Conclusion

The purpose of the present paper was obviously not to prevent one from using the method of formalization in science, but rather to remind one repeatedly of its restricted *function*. This function is to elaborate a coherent, integrated, and universal system of *projection* (in Goodman's sense) for any activity of exploration of our environment. Coherence is provided by the precise (deductive and abductive) rules to which the formalism is subjected; integration prevails as a regulative ideal; and universality (namely validity irrespective of location, time, and individual) arises from the tendency of formalisms towards symmetry and abstraction. As long as these statements are borne in mind, nobody can loose sight of the fact that actuality is an indispensible *presupposition* of formalization, not a by-product of the entities postulated by a theory associated to that formalism; that formalisms are elaborated to *anticipate* particular actualities as efficiently and as universally as possible, not to *justify* the existence or the characteristics of any given actuality. It is only when one looses trace of very process of abstraction which led to the formalism that it becomes tempting to ascribe to the formalism the impossible task of accounting in retrospect for the existence and characteristics of actuality.

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[117] See C. Schmitz, "Objectivité et temporalité", loc. cit. for a "rehabilitation of time"

These remarks provide us with a useful insight into what should be expected from a *formal epistemology*. Instead of adding one more step to the process of formalization, thus favouring the process of forgetfulness of the restricted function of formalisms, a formal epistemology should promote the clarification of the origin and purpose of presently available predictive formalisms in physics and in other sciences. This can easily be done if one accepts, as I did in my paper "Formal epistemology, logic and grammar", that a formal epistemology is only meant to *show* or to *manifest* the coordinated structure of anticipation of physical theories, not to elaborate one more theory; exactly in the same way as logic and grammar are only meant to *show* or to *manifest* the tacit rules of use of (actual or possible) languages, not to add something to language.