The Mind and its Quantal Substrate

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ABSTRACT

This paper is written from an energy stance on the ground that energy is the universal substrate of the dynamical universe.

The first part is about the dynamical structure of natural systems, whose origins are traced to their evolutionary character. A distinction is made between the ways in which energy is transformed in the process of cosmic evolution and the ways it is distributed in local contexts.

The second part is given to philosophical considerations of some of the points raised in the first part.

Keywords: Natural Systems, Interactions, Synergy, Wave Reduction, Entanglement.

1- Natural Systems

The most obvious example of a natural system is the world we inhabit, along with many other systems such as the people we see, the animals we encounter, and more generally the various ecosystems within which all these systems exist. There is however an important difference to be made, having to do with what is accessible to the human observer. Natural systems like the universe are observed internally, hence there is no way for us to talk intelligently about them as single entities since we only observe their internal processes, and know from experience that internal processes are not predictors of behaviour in an external environment [Schweber 1993]. Natural systems are scientifically describable only from the outside, observations being interactive processes between observer and observed [Bell 1990].

1.1 The Evolutionary Context

Natural systems are best understood in what follows as the active dynamical constituents of the material universe. Its dominant characteristic is its evolutionary history, the result of two events: the *birthing* event, or Hot Bang as it is sometimes called by allusion to its high concentration of energy, and its *explosive nature* with its symmetrical expansion. The direct effect of Cosmic expansion under conservative constraints is the progressive decrease of local energy densities, forming an energy gradient punctuated by various energy transformations accompanied by observable events and consequences. The first of these is the spontaneous materialisation of radiant energy, a process studied in some details in the context of the electro-weak interactions, though its generalisation to higher energy levels is not yet confirmed experimentally [Salam 1990]. It is the first instance of a break in the symmetries associated with the homogeneity of the original burst. This process is that of *wave reduction* (or *wave collapse*).

The appearance of corpuscular matter marks the onset of new types of energy transformation. The first of these, leading from particulate matter back to radiant field, is a two-stage process which may be regarded as the two phases in the unfolding of an *entanglement process: the interactive phase* and the *synergetic phase*. Experience has shown that the *reductive process* of the radiant wave and the *entanglement process* of the particles, follow each other sequentially, cascading down the energy gradient. This may be regarded as the chief mechanism in the emergence of natural systems which find stable conditions in a less energetic ambient milieu[1]. An important consequence of the series of reduction and of entanglement processes is the diversification of localities, leading eventually to the emergence of a great diversity of natural systems.

There is a second type of energy transformation associated with the genesis of natural systems in the context of cosmic evolution. Experience shows that interactions between material systems occur within well defined energy strata[2]. Furthermore, all natural systems, with the possible exception of the so-called elementary particles, are hierarchies of such strata, the innermost dynamical régime marshalling greater energy resources than their interactions with their emergent environment do [Farre 1998]. These strata, whose energy cut offs demarcate the various stages in the development of natural systems, are separated from each other by *energy gaps* wherein no observable events are to be found. Natural systems being hierarchical, it follows that some new type of energy transformation occurs in the stratification process to effect the linkage of adjacent strata. Since they leave no observable traces, they are neither interactive nor synergetic but are likely to be radiant in character. They will be referred to here as *interlevel processes* to distinguish them from the

(1) These processes of energy transformation are comparable to the phase transitions familiar to anyone who has observed the freezing of water and the melting of ice as the ambient temperature fluctuates about 0°C.

(2) These strata are well defined in the ambient energy gradient, both empirically and theoretically. [Cao and Schweber, 1993; Cao 1997].

entanglement processes, which are *intralevel*.

As noted earlier, an effect of the cascading of the reductive and entanglement processes down the energy gradient is the appearance of new localities in which different modes of interactions become observable. It is therefore instructive to distinguish two *functional types* of science[3]. The first type, *fundamental science*, is given to the development of a mathematical language suitable for the mapping of observable events resulting from the basic processes of energy transformation, as well as for the modelling of nature; so construed, its outcome is *a mechanics* rather than a theory[4]. The language provides the means needed to account for the dynamical nature of the physical substrate which *enables* the locally observed types of energy transformation, as well as the roles they play in the evolutionary picture. The fundamental science is therefore *physics*, the science of matter, more specifically a version of Quantum Field Theory (QFT). The second type of science is exemplified by the *modal theories* which construct functional models of the stratification of natural systems in their emergent contexts, e.g. chemistry, molecular biology, neurology, etc. They include all the sciences in which observations satisfy the requirements of the Heisenberg Cut[5], up to and including Cognitive Neurology [Heisenberg 1926; Primas 1993 ; Atmanspacher 199 7], but not the behavioural and social sciences which are more akin to natural history. This is a functionally more satisfactory classification of the sciences from the energy point of view, which is inherently evolutionary.

1.2 Natural Systems

Given the evolutionary character of the observable universe, it makes sense to define a natural system as one which *evolves from the bottom-up*. The reason is to be found in the expansive nature of universal, or cosmic evolution, which occurs under conservative constraints.

As a result, the *emergence* of a natural system takes place in an environmental milieu that is less energetically dense than the one in which its internal régime established itself Such systems are said to be *self organised* [Haken 1983; Eigen and Schuster 1979, Prigogine & Stengers 1979], a process normally accompanied by a local decrease of entropy symptomatic of a more efficient processing of energy.

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(3) A similar distinction was made by Weisskopf, who refers to the two types are *intensive* and *extensive*. There is a partial overlap between these distinctions and those made here. Cf. E.g. [Weisskopf 1966]

(4) It is the language in which *laws of nature* are expresssed. The same language may also be used to construct theories, with their theorems, principles and the so-called *laws of science* designed to account for the former.

(5) More on this notion below, section 2

We may distinguish three distinct though related steps in the entanglement process that leads to the self-organisation of energetically complex natural systems. The process begins with the interactions of initially independent systems, e.g. particles, endowed with some compatible external characteristics, such as charges, (gravitational, electrical, etc.), and their *conjugate* environmental properties, the corresponding fields in their surrounds. The second step in self organisation is the establishment of cyclical processes which bring closure to the interactive phase, an entanglement process in which the initially independent systems lose much of their original degrees of freedom [Haken 1983 ; Haken & Vallée 1997]. The synergetic closure of the interactive phase provides the emerging system with its functional unity, a *sine qua non conditio* of its stability in its environment. The third step is the emergence of an *energy boundary* which effectively rules out causal interactions between the material constituents of the internal régime and those found in the new system's environment. Consequently, the energy gap separating these two domains, the inside and the outside of the system, is opaque to observation, which is an interactive process; its functional structure can only be inferred from its consequences.

The *system boundary* sports two sets of external characteristics on the low energy side which define the conjugate identities of both the emergent system and its environment[6]. In as much as these external characteristics are *enabled by* the dynamics of the internal régime of the emergent system, these characteristics are *endogenous* rather than exogenous. More specifically, the endogenous characteristics (the intrinsic ones) are of two kinds: one set, referred to earlier as the *charges,* is localised on the boundary, while the others, the conjugate *fields*, are properties of the surrounds of the system [Farre 1998 a,b]. In this sense, the endogenous fields define the system's environment. This is an important point, since the interactions of initially independent systems is mediated by the fields, with the so-called field particles effecting the entanglement of these systems and the subsequent synergies [Farre 1998 b].

The conjugate endogenous characteristic being very specific, the interactions are too. However, while a system defines the energetic nature of its interactive environment, it does not define its topography, since the systems it may interact with are initially independent of it. Spatial and temporal dispositions, which are circumstantial in emergence, determine the topography of the localities in terms of the superposed fields which reflect the complexity of the energetic structure of the systems in that environment. For example, while all material systems are in general endowed with some gravitational charge, most also sport other charges, the conjugate fields in their surrounds having an effect on the manner of their possible entanglements. Therein lies the origin of the diversity of natural systems, the source of the modalities alluded to earlier.

Given this, *the Modal Theories* account for the modes by which *energy*, transformed

(6) Contrary to what the naturalists who study the evolution of populations have found, in the evolution of individual systems (the basic evolutionary systems), it is the emergence of the system which defines the characteristics of its environment, not the other way around. Populations exist in the milieu created by their members.

according to the principles that govern the fundamental theory, *is channelled by* the topography of the contexts in which it occurs.

Two features stand out in this process. The first is that all processes of energy transformation are *effected* at the fundamental level of the physical substrate, alternating between radiant and discrete forms. The second is the manner in which this *distributed* energy is modalised by the context in which it is transformed, resulting in the emergence of diverse natural systems

Of particular interest is the process of *Quantum Holography*, which effectively bridges the gaps that separate adjacent energy strata in natural hierarchies. It involves an interference phenomenon between a pattern encoded wave (the object wave), and another wave of the same type bereft of the encoded information. The result is a pattern of interferences which, when properly decoded, yields patterns in an emergent domain that are different from, but causally related to, those encoded in the substrate. The theory underlying all these phenomena, which occur between adjacent strata, has been thoroughly analysed in a number of recent publications [Schempp 1998a,b]. The theory of quantum holography, being generic, belongs to fundamental science, while its applications extend to any radiant context with suitable modal constraints [Marcer 1997].

To recap the main points in what precedes:

(a) The fundamental science is expressed in the language used to represent the various processes of energy transformation

(b) The modal theories account for the manner in which energy is distributed in the local context where it is transformed

(c) The contexts are local while the processes of energy transformation are universal, resulting in the complexification of the local dynamical structures

(d) The energy gaps inherent in the stratification of natural systems guarantee the integrity of the internal régime of individual levels by ruling out the possibility of type/type interactions between elements belonging to different strata. By the same token, this also rules out the possibility of reducing a modal science to another or to the fundamental one.

(e) Hence, although the mechanics of energy transformations is common to all the natural systems, the local contexts within which hierarchisation occurs are different. The distributive topography of local energy groups the events in its context into original phenomenological patterns that require different modes of representation.

(f) To use an old metaphor, quantum physics represents the trunk in the tree of natural philosophy. Its branches are all distinct, both in their lateral and in their vertical complexities. The same sap energizes all, becoming progressively less energetically dense as the complexity of the tree becomes greater.

This holistic aspect is the source of the Cartesian transdeterminism that enervates the whole of evolutionary nature [Rössler 1994]. Thus, while the local occurrence of individual events may remain aleatory, the character of their observed patterns is in principle determined in a manner that is consistent with our experience of the whole of nature.

2- The Cuts

From a philosophical point of view, two of the energy gaps play a particularly significant role, largely because of their importance for the description and the consequent modelling of nature. Their importance is underlined by the use of the expression *Cut* to denote them, a locution introduced originally in the language of physics by Heisenberg in the context of measurement [Heisenberg 1936].

We may conclude from all this that, if natural processes are all computational in nature, as current wisdom has it, then the proper representation of all fundamental processes are quantal. At the least, quantum computation applies to the inter-level processes that bind strata together[7]. Classical computation would then apply preferentially to intralevel interactions, and probably only to some of them. This question cannot be pursued further within the confines of this short paper.

2.1- The Heisenberg Cut (HC for short) is defined in terms of the processes of observation or of measurement. It separates the inside of a system from its outside, the high energy side of the system's boundary from its low energy or environment side. Since all observations are from the outside, it also demarcates the epistemic domain from the non observable one. The *epistemic domain* is defined as the domain wherein *information* is generated as a set of observable traces left by interactive processes between observer and observed.

The Cartesian Cut (CC for short) denotes the energy gap separating the conceptual domain from the material one, and is symptomatic of the mind/body dichotomy. Its chief consequence in the present context is to transform the *information* found in the epistemic domain into *intelligence*, the effect of the *Semantic Filter*, in which the observable traces left by the interactions between observer and observed are interpreted in the light of a conceptual matrix[8].

2-2- Information and Intelligence The empirical origins of the Cartesian Cut can be found in the common experience of consciousness, which need not be discussed here; it also rests

(7) Schempp 1998 a

(8) Farre 1998a; Rössler 1994

on methodological grounds according to Descartes[9]. Like all that exists, information is inherently *local*, whereas concepts are inherently *global*, i.e. independent of contexts of observation. In order to extract intelligence from information, it is necessary to contextualise the global notions, a process whereby conceptual *morphisms* are projected onto semantic spaces to yield the phenomenologies that order those subsets of information which are seen as significant when viewed in the conceptual perspective of a theory.

Without going into the details of the process whereby information becomes intelligence, which I have discussed elsewhere[10], the following points are worth considering in the context of the modalisation of those parts of the sciences that are *not fundamental* in the sense defined by Anderson[11].

Unlike natural language, which is object oriented, the language of description is *structure specific.* This opends the possibility of representing phenomena by means of the perspicuous notations found in mathematics[12]. Perspicuity has a double advantage: on the one hand, it displays in an overt fashion the structural properties of the phenomena to be represented, just as a musical score does for the pattern of sounds it represents. In this sense, *it shows what it stands for* as Wittgenstein once put it. This is its *referential function.* On the other hand, it has the further advantage of making it possible to *weave the phenomenological structure* out of the very fabric of a theoretical model of nature, thereby providing the elements of the referential representation with the conceptual grammar that defines their semantics, and by way of consequence, projecting that conceptual framework onto the information got in the domain of observation. This is its *inferential function.*

The net effect of the perspicuity of the representation of *what there is,* is to bring the conceptual framework, which specifies the *whatness* of the phenomenon, to bear on the information got through the interactions of the observer with the observed, i.e. *to channel it* by means of a predetermined semantic filter which molds it conceptually. The last few decades of research in the high energy regions of observation, both empirical and theoretical, have shown that nature is stratified, and that the interactions between the observer and nature are confined within well defined energy strata [Cao & Schweber 1993]. Each stratum is identified experimentally by the observable traces left by the entanglements taking place within its range, and more specifically by the patterns that emerge as the effect of the

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(9) The methodologies employed in the exploration of the *res extensa,* and the language used for mapping its events, i.e. *mechanics,* cannot be used to explore the characteristics of the *res cogitans.* This is the fundamental dualism of Descartes, on which the metaphysical one rests.

(10) Farre 1998a,b

(11) Anderson, Op. Cit.

(12) Indeed, the development of the sciences of matter is closely matched to that of the mathematical instruments used for their articulations [Bochner 1966]

Semantic Filter become apparent in their representation. Each stratum is also identified theoretically by way of the symmetry group which characterises the structure of the phenomena observed within its domain. A salient consequence of the theoretical identification of hierarchies is that the loose coupling of adjacent strata is marked by breaks in some of the symmetries as one goes from the more energetic stratum to the emergent one [Schweber 1993, Atmanspacher 1997].

Therein lies another aspect of the modellisation of the context dependent interactions, characterised by the perspicuous syntax used in the representation of observed phenomena.

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