Harmony and Beauty, Disease and Suffering: Indeterminacy a Necessary Condition for Free Will

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The order and harmony of the universe could be much more easily reconciled with the iniquity of nature (incomprehensible natural calamities) if we were to accept without thought that the universe is accidental and not something responding to a deliberate creative project. The exercise of free will, however, is possible only in the presence of a certain measure of indeterminacy, and this necessarily entails the possibility of unpredictable disaster. It follows, then, in the light of the Anthropic Principle, that, if man is to exist as a subject endowed with free will, the iniquity of nature, pain and suffering must also exist. The latter, it will be argued, are profoundly related to free will, not only because they may stem from an evil use of it, but also because they are the *sine qua non* for its very existence.

Introduction

In addition to the evil directly due to human perversity, we also witness the cruelty of nature. In addition to the victims of the ravages of war, we see those afflicted by the violence of hurricanes and earthquakes, or by the malignant nature of innumerable diseases. And it is by no means so easy for the rational mind to accept the many faces of nature itself, the beauty and order of which, according to many, are the expression of a creative divinity.

Unquestionably, the harmony of the universe requires the changing of its parts, and St. Augustine identifies the fundamental human limitation of being confined to a temporal existence as the metaphysical root of all evil. But St. Augustine himself, when recounting the death of Tagaste's twenty-year-old friend, expresses desperation and an inability to attribute any meaning to it.

It is indeed comprehensible that the process of becoming and of being in time may already be a form of dying and suffering, but what is outrageous, as Moschetti has noted (1989), "is often the absurd way people die. Death does not always come about simply as a natural biological process, as when a ripe fruit drops from the bough, but often it occurs in circumstances which our sense of piety finds most repugnant." Moschetti adds: "The tragic thing . . . is indeed tragic, in that, whenever an incomprehensible calamity occurs, it profoundly undermines any religious sentiment, giving rise to the suspicion of a profound disconnection of being . . ." (Moschetti, 1989).

It is this aspect of pain and suffering and its relation to the order of being that we wish to address in this article.

The Darwinian response

No meaning possible if universe emerged entirely by chance.

The Darwinian response to the iniquity of nature is precisely along the lines described by Moschetti as "tragic." Natural philosophy, as influenced by post-Darwinian biology, is, in fact, mainly a philosophy of human desperation. As Jacques Monod says (1972), "It is true that science attacks values; not directly, since it is no judge of values and has to ignore their existence, but it destroys all the ontogenetic myths or philosophies on which the animistic tradition . . . has founded its values, morality, duties, rights and prohibitions. The ancient alliance is shattered; man is at long last aware of being alone in the indifferent immensity of the universe from which he has emerged by chance."

In effect, there is no reason to wonder at the coexistence of harmony and precariousness if everything is governed by chance and the universe is accidental.

The same philosophy has been voiced more recently by D. C.

Dennett (1995), who writes that Darwin has changed for ever what it means to ask and answer the question *Why?* There is no future for any of our sacred myths. And he cites a passage from Locke, defining it as the "conceptual block" existing prior to the Darwinian revolution: "Matter can never begin to be; if we assume that it exists *ab aeterno* as Matter pure and simple without Motion, Motion cannot begin to be; if we assume that Matter and Motion are pre-existent or eternal, then Thought can never begin to be." Darwin, on the other hand, says: give me time, and I will produce evolution, complexification, design, and thought through a process of selection among mutations produced by chance.

In the generalisation of the use of the algorithm (selection among equally probable variants) discovered by Darwin and soon to become, in its application to prebiological and cosmological evolution, "omnivorous" (according to the definition of Dennett himself, 1995), lies the reason for the evolution of Darwinism itself from a scientific model to a fully fledged philosophy of chance and necessity.

Arguments based on infinite chance allow everything to be demonstrated.

According to Atkins's application of this algorithm (Atkins, 1997), "universes are created all the while and the present collection of universes is infinite." One deduces that it is necessary that our apparently ordered universe should exist, because, Atkins claims, "any event occurs, whatever its likelihood, so long as it is not absolutely impossible," or, in other words, the selection among infinite variants is a game where success is assured, a game in which the Darwinian algorithm leads to a kind of metaphysics which is the metaphysics of material actual infinity.[1] But with such arguments—i.e., those invoking the condition of infinite time and matter—the concept of probability is annulled and everything can be demonstrated.

[1] A number of Darwinists claim that causally isolated new universes originate from the black holes of previous universes, from which they differ to some extent, and this "filiation" with random variations and multiplications lends itself to the application of the Darwinian algorithm, in that the physical constants that favour the formation of black holes correspond to those necessary for the formation of stars, planets and living forms (Maynard Smith and Szathmary, 1996): the most suitable universes for the appearance of life would be those which have more black holes and therefore multiply more often.

Intrinsic laws of order of complex unities

Darwinism ignores inner causes of evolution—forms, archetypes, attractors—which are preferential laws for the stability of structures without which, even if such structures formed, their permanence would not be explained.

The fundamental integration, for a theory of evolution, requires the acknowledgement of the unity of sets capable of self-organisation: thus, life may have originated in a kind of sudden phase change, in which a network of molecules, replicating by virtue of their interdependence, arose from a primitive set of independent chemical reactions (Kauffman, 1993). The emergence of collective behaviours through far-reaching actions allows the generation of new forms in the context of complexification.

Biology also rediscovers its specificity in these concepts, above and beyond the reductionism that does not allow one to escape from a perspective of aggregates of components held together by fortunate accidental encounters in the process of environmental selection. What escapes from this perspective is the significance of formal unity, which today is understood and is increasingly the subject of thorough, in-depth investigation with the study of complex systems in their entirety (Prigogine and Stengers, 1979; Thom, 1975; Nicolis and Prigogine, 1989, Cramer, 1993).

Complexity (in the technical sense) appears in non-linear systems far from thermodynamic equilibrium (so-called dissipative systems, as are living beings). The maximum complexity can be represented as that of a structure containing an amount of information which cannot be compressed in an algorithm, or rather, which can be described only by an algorithm composed of a number of bits of information comparable to that of the structure itself: i.e., complexity corresponds to the size of the calculation program needed to describe it, and what is defined as fundamental complexity is that of a structure (e.g., a sequence) which—having no limits of symmetry, periodicity or redundance, but rather an aperiodic order—possesses for that very reason the prerequisite for the maximum possible information content, though no analytical expression thereof can be found.

Monod, on failing to find an analytical expression for the sequence of amino acids of a protein, deduced that it was a matter of absolute chance, taking no account of the brilliant definition which Erwin Schrödinger (1944) had used several years earlier to describe proteins, namely as "aperiodic crystals."

Monod's natural philosophy has managed to make a powerful impact on the worldview of many men, both scientists and non-scientists, and continues to do so. His philosophy, however, is based on totally erroneous assumptions.

Monod's natural philosophy ignores principles of self-organization required for complexity.

Monod expressed his faith in the absence of any design in the construction of the biological order, claiming that the message contained in the sequence of 200 amino acids of a protein constituted by the 20 different types of amino acids available—though objectively laden with significance—is written by chance, by a "completely blind game," given that, even when knowing 199 amino acids, nobody would be able to say which one would be the two-hundredth. But this means identifying the non-blind game as redundance, or symmetry: conversely, symmetry may be a factor limiting the information content, such as, for instance, in the case of a homogeneous sequence made up of the monotonous repetition of a single symbol and which is characterised by the maximum symmetry, but certainly not by the maximum intelligence and creativity. The misunderstanding is explained if we recall that the mathematical quantification of entropy (entropy is a measure of disorder and is the logarithm of the number of possible microstates) is similar to that of complexity, and, in fact, the algorithmic non-compressibility of the information program required to specify an entirely random sequence is analogous to the non-compressibility of that required to describe a sequence which is characterised by the maximum complexity, i.e. precisely owing to the lack of symmetry limits to the information content (non computability): the message in the protein is not the product of blind chance, but of the degree of complexity achieved, which finds its explanation in the principles of self-organisation and in form fields rather than in the sufficiency of time of a blind game (Zatti, 1996).

Order as self-organisation

Darwin would never have been able to suspect the amazing potentiality of matter when both non-linear dynamics and non-equilibrium constraints are present, that is to say in what

Prigogine has called "dissipative systems" (Prigogine and Stengers, 1979).

Mutations make the phenotypes fluid enough to change, and selection preferentially implements particular changes, but the overall result, the direction of the evolutionary flow, is to be attributed, as in the case of a watercourse, to the landscape that conditions it, though in this case it is an invisible landscape composed of the closest potential phenotypes and conditioned by the context, the mathematical space of the states which includes not only what is actually realised but also what might have happened as an alternative.

This space makes itself felt, constraining the potential dynamics within the behaviour that we effectively observe.

Systems with a highly complex microstructure typically develop recognisable macrodynamics and, as demonstrated by a number of mathematical models of Boolean networks, the microcomplexity gives rise to an emergent macrosimplicity (Kauffman, 1995; Stewart, 1996).

It is for this reason that many aspects of the development of organisms and their evolution are profoundly robust, and the evolutionary path much less contingent than the Darwinists believe, because it is constrained by the topology of its own phase space.

It is for these reasons that evolution, in a relatively short space of time, has been able to construct the sequence of 100 amino acids characteristic of cytochrome c with the 20 different types of amino acids available, choosing among all the possible sequences, and which, if one wanted to reproduce it by chance, making one attempt per second, would take 10^{120} years to appear. A protein with 100 amino acids takes on spontaneously and practically instantaneously a highly specific and complex three-dimensional structure, capable of an intramolecular mobility that conditions its function. It has been calculated that a super computer applying plausible rules for the molecular refolding would take 10^{127} years (to be added to the previous total!) to find the final form of such a protein (Casti, 1996).[2] Nature does not find the problem of computability so difficult, and indeed it would seem clear that the self-organised states allowed by non-equilibrium physics are produced with probability one.

[2] The age of the universe is 1.5×10^{10} years.

Order from self-organisation is the result of a morphogenetic field, of attractor archetypes (Thom, 1975), albeit through the instability of motion associated with chaotic dynamics, which enables the system to explore its phase space, finding its forms there. This means that matter, as Cramer (1993) says, is "a priori filled with ideas." Let us return to the borderline with philosophy, which is no longer the philosophy of Monod, but that expressed in the title of Kauffman's work (Kauffman, 1995) *At Home in the Universe*, a book which ends with "In the beginning was the Word."

Matter "a priori filled with ideas."

But if, as we have said, the incomprehensible calamity is not a problem in a philosophy of chance, the same cannot be said when one believes that "in the beginning was *the Law*."

This is a problem of meaning, and therefore philosophical and not scientific, but strictly implied by the demonstrable incompleteness of the natural order, and particularly of the biological order.

The indeterminacy of the biological order

The characteristic feature of biological machines is that they have mono-macromolecular instruments consisting of delicate, unstable organic molecules, which is fairly obvious if we think that their functional status would not be functional if it were distinctly stable.

It is well known that quantum indeterminacy plays a role in events on a submicroscopic scale at the atomic/molecular level. If, however, the DNA molecule is involved and the genetic message contained in it is altered in the indeterminacy game, the effect of the molecular "mutation" is amplified and becomes macroscopic in the living organism which depends on the genetic message, written and transcribed in the molecular alphabet, but translated and reflected in the structure and functioning or malfunctioning of cells, tissues and organs.

This amplifying action is a notable characteristic of the biological order, to the extent to which the phenotype depends on the genotype, i.e., on the informational macromolecules.

Now, the force of the chemical bonds in a macromolecule may vary with the fluctuations in vibrational energy, responsible for an uncertainty domain, which allows the mutations to take place unpredictably.

In the DNA replication process, the molecular chain that acts as a model has to form activated ternary complexes with the enzyme and with one of the four bases (nucleotides) that constitute the four letters of the alphabet of the genetic code, which are progressively mounted according to their compatibility with those of the model chain. The accuracy of the process is due to the specificity of the bonds (of intermolecular type) so that the correct coupling of a given base requires a ternary complex activation energy less than that required for the coupling of a "wrong" base.

This difference in energy (also conditioned by the structural and superstructural constraints of the DNA) can be overcome, though with low probability, by the thermal fluctuations possible at physiological temperature and in physiological conditions: in this way, the confines of the pre-existing codified order, the barrier against "mutations," may be crossed. In non-physiological conditions, mutations can be facilitated or induced by a variety of "perturbations" caused by chemical and physical agents.

The principles involved in the mutations, however, are two:

- the second law of thermodynamics, which promotes replication errors as ways whereby configurational randomness is increased, and this ensures that there will be mutations;
- the quantum indeterminacy of thermal energy, for the reasons outlined above, and this ensures that the mutations occur by chance.

Hence, the opening to evolution, but also at the same time necessarily to pain and suffering because in biology mistakes mean suffering, even in the form of the most incomprehensible calamity, such as the agony and death of a child.

Submicroscopic indeterminacy has more than one way of reflecting itself on a macroscopic scale in the biological world: one way consists in the amplification that a molecular mutation of the genotype undergoes in the course of the phenotypic expression of the mutated gene. Another has to do with the statistical microevents that generate a kind of biochemical noise coupled, across a critical threshold, with cellular quantal macroevents by the law of all or nothing. This second behavioural mechanism dependent on (unpredictable) fluctuations comes into play when the number of intracellular ions or molecules involved is relatively low, and not if it is greater than 60,000 per cell. For example, the concentration of Ca^{++} in resting cells is approximately 100 nM, and therefore there are not more than 20,000 in any given cell. The number of membrane receptors for many agonists is even lower and the number of channels for the transmembrane transport of the main cations in many cells is of the order of only a few hundred, etc. (Hallett, 1989). To give a familiar example, the rarefied atoms of a neon tube manifest a macroscopic behaviour at ignition consisting in the fact that they are all characterised by uncertainty. In the same way, given the above-mentioned role of receptors and ions in cell behaviours, these would not appear to be deterministic, in that, though they are observable on a large scale, they are related not to a mean of very large numbers of independent submicroscopic states, but to a small number or even only one of these microstates, each of which is governed by indeterminacy.

Hence, in addition to the possibility of suffering as a mistake, we also have the guarantee, for the purposes of the exercise of freedom, consisting in a certain, albeit controlled, degree of indeterminacy at the level of mental action on cerebral matter.

Mental action on cerebral matter entails controlled indeterminacy.

In this connection, J. C. Eccles (1986) described the quantum uncertainty demonstrable in the junctions between neurons known as *synapses*, in which the stimulus passes from one neuron to another via the release of biochemical quanta of "neurotransmitters."

These are contained in vesicles whose membrane can fuse, as a result of the actions produced by the nerve stimulus, with that of the junction (presynaptic membrane) causing the emptying of the vesicle and the emission of the neurotransmitter.

One might understand that in the cortical synapses mental events (that is to say, intentions, acts of will) interfere with the likelihood of emission of these biochemical quanta, i.e. with the vesicles and thus with the neuronal activity, if one could apply the uncertainty equation of quantum states to the relationship between these vesicles and the presynaptic grid, i.e. in the prefusion stage. The mass of a synaptic vesicle, in fact, is not such as to exceed the limits of Heisenberg's uncertainty equation and therefore could be affected by the magnitude of the effect produced by a quantum mechanics probability wave.

In fact, according to the usual uncertainty equation as adopted by Margenau for non-atomic situations and reported by Eccles:

$$\Delta x \ \Delta v \geq k/m \quad (k=h/2\pi)$$

the mass (m) of a synaptic vesicle measuring approximately 40 nm in diameter being g 3×10^{-17}, for Δx of a vesicle in the active zone equal to 1 nm, Δv would be 3.5 nm/msec, which is not far from the right order of magnitude, bearing in mind the distances of the vesicles from the presynaptic membrane[3] and the exocytosis process times.

Possibility of behaviour unrelated to algorithmic processes allows exercise of human will.

This confirms the case upheld by Penrose (Penrose, 1989 and 1997), Swinburne (Swinburne, 1986) and others, whereby even if the only source of indeterminacy in the physical world were that of the quantum states, this would be enough to guarantee scope for non-computability, the possibility of behaviour unrelated to algorithmic processes allowing the exercise of human intelligence and freedom.

This basically echoes the attempts made by the ancients Epicurus and Lucretius to describe the indeterminacy (*clinamen*) of the atomic motions as a justification of free will. Be that as it may, we are talking about an unpredictability related to amplifications on a macroscopic scale of submicroscopic fluctuations, whether such amplifications be related to non-linear dynamics in the presence of non-equilibrium constraints, or cellular quantal events, produced according to the law of all or nothing, as a result

[3] Analysis of the synaptic transmissions of the CNS has revealed possible influences of changes in the postsynaptic membrane, taking all due account, however, of the presynaptic significance of some of the parameters (n, number of active zones; l, likelihood of release of a quantal package). Cf. H. Korn and D. S. Faber, "Quantal Analysis and Synaptic Efficacy in the CNS," in *Trends in Neurosciences* (1991), 14, 439-445; cf. also J. M. Bekkers and C. H. Stevens, "Presynaptic Mechanisms for Long-term Potentiation in the Hippocampus,"in *Nature* (1990), 346, 724-729; R. Malinow and R. W. Tsien, "Presynaptic Enhancement Shown by Whole-cell Recordings of Long-term Potentiation in Hippocampal Slices," in *Nature* (1990), 346, 177-180. The critical point of the neuronal activity is activation of voltage-dependent Ca^{2+} channels and the subsequent presynaptic exocytosis of the neurotransmitter, contained in vesicles whose protein p65 interacts with the syntaxins of the active zone of the presynaptic membrane. The literature describes quantal variability of these junctional activities, stochastic properties of the interactions between receptors and transmitters, the possibility of interference of various types with the efficiency of communication between nerve cells (D. S. Faber et al., in *Science* [1982], 258, 1494; P. Greengard et al., in *Science* [1993], 259, 780). One of the variables consists in changes in the number of vesicles in the reserve pool compared with the number that can be released in a synaptic ending with a transition regulated by the phosphorylation/dephosphorylation of a protein. By and large, it can be said that there are multiple fluctuation settings potentially subject to the influence of a quantum mechanics probability wave.

of a threshold effect, when the threshold is crossed by fluctuations governed by indeterminacy.

The cerebral hardware thus contains the conditions necessary for man to exercise his freedom, i.e. his creative *causality* freed in some way from the laws of determinism—necessary, but not sufficient conditions for the exercise of freedom.

If the matter of which our bodies and particularly our brains are composed totally obeyed the laws of causal determinism, as Laplace believed, every neural event would have a proportionate physical cause, in turn related to other previous causes, with the result that one could hardly postulate neural events (with their behavioural correlates) not determined by the chain of physical causes. Any exercise of freedom would be precluded. But some domain of relative indeterminacy would appear to exist.

We have also demonstrated that these conditions of indeterminacy, being widely represented in the laws of matter, also imply the occurrence of events of the "incomprehensible calamity" type, events involving suffering and death which therefore appear to us as the hard price that the matter of this universe has had to pay in order to accommodate the existence of free subjects (Zatti, 1994).

Suffering, which is implicit in the conditions described, would be useless and absurd if there were not a subject free to exercise self-determination. The problem of freedom thus becomes crucial: if man only had an illusion of free choice, every incomprehensible calamity would, in fact, remain incomprehensible, and all suffering would be totally absurd, at least for a non-causal natural philosophy.

To have a metaphysics of freedom, there must be a creator who as such is a free agent. If the creative choice has wanted man to be free, then it must have seen his suffering, i.e., the prerequisite of his freedom, as basically a "very good" thing (Gen. 1, 31).

According to Ruse (2001), "No sound argument has been mounted showing that Darwinism implies atheism." On the contrary, the Christian believer needs (also) chance, hence Darwinism, to solve the classic problem of theology, the problem of pain.

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