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# **Epistemic Noise**

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Abstract: In *La Methode* Edgar Morin reveals entropy and its analogous concept, noise, to play a more fundamental role than merely that of a factor of thermal degradation or obstacle to communication. Morin continuously weaves together the empirical concern for entropy, as an aspect of both thermal degradation and organization in systems far from equilibrium, and the epistemological concern for noise, as an aspect both of perturbation of communication and of an uncertainty constitutive of new structures of the understanding. In the light of his theory of eco-complexity, entropy and noise become almost synonymous when considered as constitutive factors of self-organization. What Morin is after in his epic journey from cosmogenesis to the evolution of the biosphere and of human culture is not, as he says, an 'adventure novel' of cosmic and planetarian evolution, but an understanding of the transformation of concepts and theories, invigorated by the novel understanding of the constitutive role of entropy and noise in the emergence and organization of systems with increased complexity. This article argues that the gear-shift from the empirical narrative of ontogenetic aspects of entropy to the metasystemic analysis of the organisational factor of noise raises fundamental philosophical and specifically epistemological stakes: namely that the conditions and structures of our understanding may be, like every other system, subject to transformation on the basis of noise.

Keywords: Morin; complexity; noise; information; entropy; epistemology; metastability.

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# 1. From stability to meta-stability of form

In *La Methode* Edgar Morin reveals entropy and its analogous concept, noise, to play a more fundamental role than merely that of a factor of thermal degradation or obstacle to communication. Morin continuously weaves together the empirical concern for entropy, as an aspect of both thermal degradation and organization in systems far from equilibrium, and the epistemological concern for noise, as an aspect both of perturbation of communication and of an uncertainty constitutive of new structures of the understanding. What Morin is after in his epic journey from cosmogenesis to the evolution of the biosphere and of human culture is not, as he says, an 'adventure novel' of cosmic and planetarian evolution, but to understand the transformation of concepts and theories brought about by the novel understanding of the constitutive role of entropy and noise in the emergence of systems and their complexity.

In the light of his theory of eco-complexity entropy and noise become almost synonymous when considered as constitutive factors of self-organization of systems. This article argues that the gear-shift from the empirical investigation into ontogenetic aspects of entropy to the meta-systemic analysis of the organisational factor of noise raises fundamental philosophical and epistemological stakes: namely that the conditions and structures of our understanding can be understood, like every other system, as being subject to transformation on the basis of noise.

#### 1.1. The epic scenario of cosmogenesis

In *La Methode, La nature de la nature* (Edgar Morin, 2008) Morin hurdles the 'scenario' of cosmogenesis at the classical conception of cosmic order. His fast-paced summary of the profound upheaval during the past century and a half of our understanding of the cosmos, its history and our place in it, is compacted in order dramatize the blow to the classical conception of order. The ensuing faith in the perpetuity of natural laws were laid into the cradle of the 'steady state' of the Kepler, Newton and Laplace's mechanical clockwork universe. The music of the spheres is roughed by the chance encounter of isotropic rays during the 1960s. This back-ground noise of the universe rouses the natural laws from their slumber with the murmur of a catastrophic origin of the universe. The perpetuity of our cosmic order is henceforth folded into a hypothetical scenario of ongoing genesis and perpetual metamorphosis, the stability of its laws bent into the metastability of cosmic becoming.

The classical backdrop of cosmic equilibrium to our conceptions of order both in nature and in the structures of our understanding radically changes with the cosmogenetic hypothesis of a photon cloud that dilates at a counter-intuitive temperature of 10<sup>11°</sup>K, granulates as it cools, into electrons, neutrons, and protons, whose collision at still formidable temperatures force the nucleo-synthesis of deuterium, helium and hydrogen. The classical myth of cosmic origin in chaos dilates: cosmic noise becomes a reminiscence, of Proustian proportions, of a swarming "microgenesis of cosmogenesis". (Morin, 2008, p.77).

Cosmic expansion turns into dispersion, wrought with inequalities, subject to gravitational dynamics that put the expansive cloud under tension, fissure it under the pressure of regional self-amplifying density, from which a "schismatic morphogenetic" process ensues: the cloud "cracks, dislocates" into proto-galaxies. These in turn fissure and break up into gravitational assemblages, accelerating the localized growth of density to the

point where the collision of particles provoke a nuclear chain reaction: in a titanic explosion that is contained by the equally titanic force of gravitational pull a star is lit, a cog in the gravitational clockwork of the galaxy, industriously producing heavy matter from atoms that are forged in the kiln of the star, for the duration of its life-cycle before it finally implodes or explodes. (Morin, 2008, p.77)

# 1.2. The transformation of ideas: montage, fissures and reorganization of discourse

This epic scenario of cosmogenesis resembles by Morin's own account, an "adventure story with chance, suspense and drama" (Morin, 2008, p.76). Is not this epic narrative of astronomic proportions, however, that is the item of interest for Morin, but the transformation of concepts, theories and paradigms, enabled and forced by the breakdown of classical order.

In one essential way, Morin's problem is, however, strictly analogous to that which novelist Hans Magnus Enzenberger was facing, when writing *The short summer of anarchy* (Enzenberger, 1972): Morin relies, like Enzenberger's account of the life and death of Spanish revolutionary Durruti, on a myriad of sources and causal explanations, whose inequalities and tensions create fissures in the dominant narrative. The peculiarity of Enzenberger's account of the life and controversy surrounded death of the anarchist leader Buenaventura Durruti, is that he creates a discursive fugue, where historical sources, documents, interviews and accounts of Durruti's contemporaries appear to repeat a common theme, threading together the events, always from different viewpoints, resonating together to produce a riotous yet confluent discourse.

Yet Enzenberger's summoning of the great array of sources, does not serve the purpose of consolidating historical facts by synchronizing the sources. He derides the anxious avoidance of fellow historians to slide from historical fact to adventure novel. The peculiarity of Enzenberger's approach to fiction, (which is in our view of capital interest for Morin's *Methode*), is that the seriousness of the historical account lies not where diverse narratives converge into a powerful discourse, but in the friction that bristles between these narratives. The murmur of history is the irrepressible noise of micro-inconsistencies in the official tune:

"The contradictoriness of forms announces only the fissures that run through the material itself. The reconstruction resembles a puzzle, whose pieces do not join seamlessly. It is on the joints of this picture that one must dwell. Perhaps it is in these that the truth lies in view of which, unbeknown to the narrators, there is narration." (Enzenberger, 1977, p.14)

By analogy one may say that the history of the sciences is, as a magisterial discourse, the tune that emerges from synchronizing the heterogeneous sources and discourses. The historian relies, like the authoritative historical narrator for Enzenberger, on normalizing the singularity of its sources, on passing a blind eye on the self-interest of each narrator:

"What he finds is not mere "material", unintentionally dumped, in pure objectivity, untouched by human hands. On the contrary. Everything that you see here has gone through many hands, shows signs of use. (Enzenberger, 1977, p.16)

The great work of consolidation of scientific discourse furthermore relies, like the historical narrative, on the factor of cultural reception, in which it is cast. The consolidation of this myriad of experimental and theoretical narratives into one torrential flow of historical continuity masks the murmur of inconsistency, relegates it as mere noise to the periphery of historical discourse, dispensable as mere error or imprecision. The culturally consolidated discourse is then cast into the iron mould of a historical fact, armoured with the clout of established scientific truths.

# 1.3. The dialectical flicker of antagonism: from the myth of original chaos to the dialectical movement of order and disorder

Morin, like Enzenberger, is interested less in the authority of scientific or historical discourse, than in the dialectical tension that prevents scientific discourse from coming to rest. It is this tension and continuous movement that characterizes the scientific understanding of order and disorder, of entropy and negentropy for Morin. From the 1<sup>st</sup> principle of thermodynamics, which postulates the indestructible nature of energy, i.e. that there can be no loss of energy, to the 2<sup>nd</sup> principle of thermodynamics that subjects the polymorphous conversions of energy from mechanical to electrical or chemical energy to calorific degradation, the dialectical movement goes from perpetuity of energy to the irreversible loss of its potential for transformation. The dialectic of order and disorder enfolds the classical idea of perpetual cosmic order in the idea of its becoming: its inevitable entropic death, based on Clausius assumption that the universe can be seen as a closed system vowed to entropy, is only the first stage in this dialectic.

The eschatological scenario of entropic death of the cosmos, however, runs into the aporia of the genesis of order *against all probability*: the negentropic capacity of the cosmos to pull itself together at all levels, from gravitational order to biological organization. The loss of the classical ideal of the perpetual cosmic machine leads, not to disintegration, but to the mastery of statistical mechanics. The maximization of thermal efficiency in man-made machines reverses the reversal of order and reinstalls the reign of order. The dialectical pendulum swings back, from the catastrophic scenario of original chaos and inevitable entropic exhaustion to the marginalization of disorder: entropy is reduced to mere parasite, the sub-product of work, the waste of processes of transformation.

Where the metaphor of the pendulum is misleading, of course, is that the dialectical contortion of order and disorder, perpetuity and change, in fact corresponds for Morin to an irreversible transformation and complexification of these notions, to a refinement of an initially coarse opposition between order and disorder and to the increasing interpenetration of both.

The mastery of statistical entropy is eventually complemented by the constitutive uncertainty of matter itself at the sub-atomic level, which in turn is mathematically formalized. A refined understanding of metastable molar systems furthermore enables the articulation of entropy and the emergence of structure: such as the phenomenon of high molecular cooperativity under the effect of entropy in the emergence of hexagonal convection cells, observed by Benard and generalized by Prigogine in his theory of systems far from equilibrium.

Increasingly the opposition between order and disorder yields to the dialectical work of idea and experience, and both notions become more refined, interlaced, interdependent: Von Foerster discovers the principle of order from noise, based on the recognition of initial constraints, Von Neumann introduces an understanding of self-reproducing 'natural'

automata functioning with disorder and Atlan finally incorporates Shannon's definition of information in light of Ashby's law of requisite variety into a theory of organization where noise increases the complexity of systems at higher levels of organization.

Morin thus weaves the classical opposition of order and disorder into a dialogue, an increasingly intimate cooperation of both notions. Disorder, quantum uncertainty, entropic diffusion of heat, catastrophic bifurcations as in Rene Thom's catastrophe theory, and the emergence of structure in metastable states of systems in Prigogine theory, therefore do not eliminate order, but interweave constraints and determinism with the indelible singularity of evental conditions, subject order to the irreversibility that founders any discourse, but summary generalization, in actual complexity.

# 1.4. From noise and entropy as waste of industrial production to error as an industrial by-product of information

In the light of Morin's philosophical extradition of quantum uncertainty, entropy and noise from the classical opposition of order and disorder, it is worth asking ourselves: what is noise to us, nowadays, if not an environmental nuisance, an acoustic legacy of industrialisation, the brute backdrop to the age of high-speed communication and high-fidelity transmission? If we reduce noise to a quantitative definition of decibels and frequencies, as the World Health Organization does (Hydaralli, 2012, p.219), then noise is little more than the acoustic pendant to entropy, the waste of industrialization, waiting to be disposed of by better engineering and intelligent urbanization.

The definition of noise as an industrial side-effect already reduces to mere loudness the broad pre-scientific spectrum of the notion of noise – which hitherto evoked the din of children in the playground as much as the deafening tremor of an erupting volcano. Yet this reduced quantification of acoustic noise is oblivious, not only to the cultural and metaphorical spectrum of noise, but also to its modern formalization in information theory.

The lack of mechanical sophistication that accompanied early industrialization with the roaring futuristic noise of machines has faded into the background of the post-industrial era, noise has become error in signal transmission. The wide metaphorical bandwidth of the cultural notion of noise thus narrows dramatically with the first reduction from cultural, metaphorical to the quantitative acoustic definition and narrows once more, but far more radically, when noise becomes, in Shannon and Weaver's mathematical theory of communication, a concept of error woven from the sole fabric of mathematical probability.

The success of the information theoretical definition of noise in the context of cybernetics and informatics caused this new, reduced and formalized concept to migrate to other disciplines, notably back to physics from where it originated as an abstraction of the statistical account of thermal entropy, but also to the nascent discipline of molecular biology, where it denotes variances of cell activity around an average, and onwards to the increasingly statistically oriented human sciences, notably psychology and sociology.

In its trans-disciplinary appeal, the notion of noise thus reverberates back and forth, from its mathematical definition in terms of probability and its technological application of cybernetic feed-back mechanisms, to scientific disciplines that are not yet and perhaps never will be fully subsumed under the cybernetic paradigm.

## 2. From error to ambiguity

The missed opportunity in this generalization of the cybernetic concept of noise is, in Edgar Morin's eyes, that the notion of *positive feed-back* acknowledges the antagonistic relation between information and noise, but only in a one sided way, attributing to noise the shadowy status of a negative function that is flat and sterile when compared to the rich dialectical role of negativity in philosophy from Heraclitus to Hegel:

"Cybernetics [...] carried within itself an internal principle of antagonism (positive feedback), but it atrophied it, anaesthetized it, integrated it in a quasi-mechanistic theory of regulation; all that solicits deviance and antagonism is "noise" that the system must eliminate, when what is at stake is also its necessarily negative part. Biology equally avoided the problem of antagonism, in its organismic phase of harmonies and complementarities as much as in its new cybernetico-molecular phase." (Morin, 2008, p. 209)

The notion of noise migrates between scientific disciplines with the diplomatic clout of mathematical definition, yet operates on an increasingly metaphorical level that amplifies the negative bias of information theory against noise as dispensable, parasitic negativity.

Each transfer of the notion of noise from one to another scientific discipline could thus be called a transfer with noise, because each transfer brings with it an inevitable increase of ambiguity that mobilizes the potential for confusion present in the latent pool of prescientific, phenomenological and metaphorical significations: from perturbation, irregularity, mutation to pathology and error.

As Michel Morange argues, the concept of information enters biology without a shadow of a trace of its mathematization and therefore embeds the concepts of information, noise, program, code into the nascent discipline of molecular biology with a necessary margin of indeterminacy and metaphorical ambiguity. Rather than deplore this inevitable metaphorical ambiguity, however, Morange considers it to be a crucial enabling factor of communication between the sciences:

"If with the exception of the term generic code, the usage of informational terms in biology is always metaphorical and, what is more, often clumsy or inadequate, would it not be reasonable, as Henri Atlan suggested, to make the effort to suppress these informational terms in the language of biologists and return to their true language, which is a chemical language? [...] It is unlikely, however, that biologists would let go of the metaphorical use of informational terms. For one this metaphorical use allows them to "sell" their projects to a large public. More generally, this metaphorical use allows them to communicate their results with greater ease. Lastly, and perhaps most importantly, the use of metaphors and fuzzy concepts is very frequent in science. [It] does not impede scientific progress; it gives on the contrary a space of freedom in which scientific knowledge can, at any time, transform itself and redeploy itself. The reasoned and concerted abandonment of metaphorical terms would require enormous effort that no immediate benefit would justify." (Morange, 2006, p.620).

What is true of the notion of information must, *a fortiori*, be true of that of noise, which is considered, at this stage, as secondary to information, because it is understood merely as that which impinges on signal transmission.

Despite the appearance, the cybernetic paradigm under which the varied scientific disciplines appear to aggregate must therefore take into account the ambiguity that arises from these conceptual transfers between disciplines. The import of this transfer (of the notion of noise as scientific concept) with (metaphorical) noise is not, for us, that is calls for more stringent reduction and more narrow criteria of definition in order to eliminate this interdisciplinary noise. Even if the greatest possible accuracy of a concept is in principle desirable and even necessary to separate scientific conceptualization from mere opinion, there is in our view no short-cut to the self-criticism and progressive rationalization of each scientific discipline and its readiness to further integrate with other disciplines, as in the case of physical chemistry or molecular biology.

On the contrary, the import of this epistemological noise, accrued during the transfer of concepts like noise and information form one scientific discipline to another, could be seen to be the irreversible nature of the conceptual expansion of the notions of 'noise' and 'information'. By irreversibility we mean that the transfer of the cybernetically defined concept of noise to other disciplines does not guarantee a reversible logic, does not warrant in turn the reduction of these domains to the cybernetic paradigm, because the reduction of the operative logic of other scientific disciplines to the cybernetic paradigm is impeded by the noisy dispersion of the concept of noise.

### 2.1. Antagonistic views of epistemic noise

One may disagree with the idea of this irreversible translation of the information theoretical definition of noise to other disciplines and argue instead that the whole point of the information theoretical definition of noise is that one can tackle and reduce the deleterious effect of noise by increasing the redundancy of the message. What would such a redundancy look like at the level of conceptual definition in view of its inter-disciplinary circulation?

Deductive redundancy would be achieved where each proposition is, as in an axiomatic system, tightly related to the propositions that are deduced from it such that, step by step, a tight network arises, where each proposition is fully resonant with the others and no element can be modified without compromising the whole. (Blanché, 1995, p.10). The formal stringency of such an approach may indeed reduce the noise that arises from the circulation of concepts between disciplines, but it presupposes that all scientific domains are advanced enough in the determination of their domain of study that they may be axiomatized – such that these different axiomatized domains in fact become models, applications of a same axiomatic system. Their logical structures would be isomorphic, while its domains of application may be heterogeneous. If, however, all the scientific disciplines are not fully axiomatized, (which they are not, of course), then a single divergence between postulates may result in a plurality of axiomatic systems, such as was the case with Euclidian and non-Euclidian geometry. (Blanché, 1995, p.47).

To reduce the conceptual relations between the scientific disciplines to a deductive system, such as logical positivism proposed, presents us with a first problem. As the philosopher of biology Marjorie Greene argued, not only was logical positivism unable even to conceive of the problems specific to biology, in that they exceeded the criteria of logical precision, its incapacity to deal with the imprecision of the empirical world eventually reduced its method to sterility, hardened its structures to a catatonic state of the understanding:

"In the Anglophone tradition (which I derive partly from the Germano-Austrian tradition) that which one called the received view dominated until recently. I participated

personally in Carnap's seminar in Chicago during the year 1937-1938. Having previously studied zoology, I was rapidly disappointed. It seemed impossible to treat the praxis of zoology with a purely extensional logic. I tried to explain this difficulty to Hempel, who was Carnap's assistant in this seminar and he replied: "We only say what we can explain with precision". [...] twenty five years later [...] as a rule one taught logical positivism under its new less aggressive name of logical empiricism. One treated laws, theories, the deductive relation between theories and laws, the problem of confirmation etc. [...] Today however, this old orthodoxy is, if not entirely buried, then in a – how shall I say – catatonic, vegetative state." (Greene, 2007, p. 24-25).

Greene's severe indictment of logical positivism means, for us, that to supress the ambiguity of a shared concept, which arises from the empirical and theoretical disparity between the disciplines, is to kill off the potential of this concept to grow in complexity and to thus find a future articulation that could encompasses these disparities with an enriched rather than reduced understanding.

## 2.2. The grounds of reduction

The other problem with the deductive reduction of inter-disciplinary noise through redundancy, is that the engineer of knowledge who could quantify the 'noise in the channel of communication' between scientific disciplines and counterbalance it with the required deductive redundancy is absent. There is no meta-systemic guarantor, no birds-eye view of the place of each scientific discipline and their relation to each other, no Laplacean God who could regulate the transmission of concepts between scientific disciplines in order to eliminate the effects of epistemic noise. Classical science neutralized the problem of the observer, who was, according to Morin, always

" [...] like a photographer, outside the field. The limits of mind were suppressed since the mind was suppressed. Observations were thus the reflection of real things and all subjectivity (identified with error) could be eliminated by the accordance of observation and verification of experience. [...]

To this faith in the objectivity of scientific observation Morin opposes 'the irredeemable loss of the idea that a supreme being or at least a demon,

"[...] situated at the optimal point of observation and beholder of the master formula (considered then as a vast system of differential equations) "would embrace [...] the movements of the greatest bodies of the universe and those of the lightest atom, nothing would be uncertain for (his intelligence) and the future and past would be present to his eyes" (Laplace, 1812)". (Morin, 2008, p.131)

Even if the reduction of all empirical sciences to physics and of physics to mathematical physics were granted, two fundamental obstacles would oppose any God-like understanding of the physical causality of all things, capable of cancelling out inter-disciplinary noise.

The most fundamental empirical obstacle to such a single and objective view-point is that the very foundations of micro-physics have reintroduced the indelible ambiguity of the role of the observer. This prompted Gaston Bachelard to call for a 'pedagogy of ambiguity in order to give the scientific spirit the subtlety necessary to engage with new doctrines' (Bachelard, 2006, p.19). Where indeterminacy and noise could be attributed to independent factors, of which the object of study could be indefinitely purified, indefinitely pushed back by

the perfection of means of observation, Heisenberg instead introduced an essential principle of uncertainty that irrevocably implicates the observer in the observed:

"In order to find the place of an electron, one must illuminate it with a photon. The encounter of photon and electron modifies the place of the electron; it modifies, by the way, also the frequency of the photon. In microphysics, there is thus no method of observation without action of the method's procedures on the observed object." (Bachelard, 2006, p.126).

It is thus at the most fundamental level of determinacy of physical causality that the observer permeates his object and introduces a constitutive methodological ambiguity, which only the absence of observation could overcome: not a Laplacean God who beholds every aspect of micro-causation in the universe and their interrelation, but a God who is himself the universe, the absolute identity of knower and known, or as Fichte would say in the *Wissenschaftslehre* 'pure knowledge in and for itself, therefore knowledge of nothing, or, [...] truth and certainty in and for itself, which is not certainty of something, whereby a disjunction between being and knowledge would already be posited.' (Fichte, 1986, 98)

Even the very definition of entropy, and this is the second obstacle, is specific to the capacity of observation. The degree of entropy in a physical system is inseparable from the capacity of observation and measurement, as Gibbs' paradox of entropy of mixture shows: the spontaneous homogenization of two gases results in a measurable increase of entropy. The discovery of radioactivity, however, enables one to discern entropy of mixture when mixing the contents of two canisters containing the same gas, one radio-active the other not, where there was no entropy of mixture before the discovery of radioactivity (Atlan, 1979, p.32).

What this implies for the conceptual circulation of noise, is that the apparent absence of noise from a master discourse, to which all others would in principle be reducible, is itself liable to mask internal noise and ambiguity, which might be brought to light by a crisis, as for instance the crisis of the foundation of mathematics, which entailed a crisis of the foundation of classical logic and entailed the pluralization of logics. As Edgar Morin would say, we cannot regress to simple physics, to a simple cosmos, to a simple order:

"[...] the acquisition of irreversibility is irreversible. (Morin, 2008, p.103)

#### 2.3. The irreversible aquisition of complexity

The enquiry into the concept of noise thus leads us to the intersection between on the one hand the empirical observation of phenomena of transmission with perturbation or statistical variance of events from an expected norm and, on the other hand, the epistemological observation of the transmission of concepts between scientific disciplines with increasing conceptual ambiguity or 'epistemic noise'. Both the empirical and epistemological processes of transformation imply, if we stay true to Shannon's formal analogy with Bolzmann's statistical definition of entropy, that they are irreversible.

The conceptual circulation of the concept of noise can therefore not be likened to a simple generalization, a straight-forward abstraction that would facilitate its varied application, because the feed-back to the cybernetic paradigm is not that of a God-like regulator, but is distorted and transformed by the process of transmission and dissemination. The first consequence of taking noise seriously is thus the complexity that makes conceptual transfer irreversible. The second consequence is that this irreversible transformation, the increase in ambiguity of the concept, becomes an obstacle for any

reductive logic, because this complexity impedes the faithful reverse construction of the original concept, once it has been transformed by the disciplines that have adopted it.

The systematic approach to the unity of the natural sciences has thus far aimed at various types of reduction, physical, logical or mathematical, in order to defend the truth claims inherent in scientific discourse and avoid paradox and contradiction between the sciences. The alternative has been to accept these inconsistencies by relinquishing not only science's truth claims, but even its claim to an empirical reality that grounds these truth claims. In the latter case science produces models characterized not by their truth content, which is deemed falsifiable, but by their historically and socio-politically mediated use-value.

Rather than focussing on the existence or inexistence of an overarching logic or of an agreed upon empirical principle of causality, noise shifts our focus towards the historicity of scientific discourses, the irreversibility of their development, understood as a process of complexification.

If we look at the systematic nature of scientific discourse in terms of an evolving process of epistemic self-organization, whose foundation cannot, as Ashby has argued in the light of axiomatic set theory, lie within the 'self' i.e. within the scientific paradigm thus constituted, we arrive at an alternative to reductionist or constructivist models. When noise is taken into account as a positive contributing factor, if not the foundation of epistemic organization, then truth is no longer sought within the existing epistemic structures or denied to them, but perpetually anticipated, complexified and refined in the tension that qualifies the scientific relation with the unknown.

# 3. Conclusion

Morin's originality lies in his approach to complexity which embraces noise as that which, although it undeniably obstructs communication and hinders understanding between individuals and vis-à-vis their environment, nevertheless plays a fundamental role. In fact noise, according to Morin, provides the very foundation of communication and impetus for its 'complexity, sophistication and subtlety' (Morin, 2008, p.103) Morin's 'eco-communicational' concept of noise, illuminates not only the complexity, sophistication and subtlety of systems of communication, but the very process of learning as a dynamical relation to unpredictable events.

Our capacity to theorize and generate structures of knowledge arises from a speciesspecific evolutionary acquisition of cognitive complexity. Emerging from these biological and eco-systemic constraints, however, are formal systems of ideas that evolve according to an internal necessity, internal constraints and potentials that are not co-extensive with the capacity to perceive and interact with the environment, whose distinguishing feature is, in fact, that their insights are counter-intuitive. There is thus a gear shift from existential needs to formalized empirical observation, and from systematized empirical observation to the development of ideas that are bound neither by existential needs, perception or empirical observation, but obey their own formal constraints and possibilities that are not co-extensive with nor reducible to the existential needs that gave rise to them.

This is why Edgar Morin's eco-philosophy has epistemological implications beyond the empirical question of evolving eco-systems. It is the epistemological question of our knowledge of them that is implied in a meta-systemic analysis of the role of noise. To interpret noise in epistemic terms as contributing to the requisite variety of a system of thought, be it a theory, a scientific discipline harbouring a set of theories or a set of scientific

disciplines, enables an alternative model for the unity of the natural sciences than that of either reduction or post-modern dispersion into scepticism.

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Cecile is a Ph.D. candidate at Paris 7 Denis Diderot, supervised by Prof. Alain Leplege and Dr. Iain Hamilton Grant at the University of the West of England. The topic of her thesis is an investigation into the philosophical import of the relation between information and noise, at the intersection of existential, scientific and philosophical experience (the psychiatric definition of the 'mental state of noise', the neuro-cognitivist definition of information and Schellingian concept of 'stupefaction'). She is currently cotranslating Edgar Morin's *Methode II, La Vied de la Vie*, together with Prof. Rainer Zimmermann as well as translating Gilbert Simondon's *Mode of Existence of Technical Objects*.