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A Look at the Inference Engine underlying 'Evolutionary Epistemology' Accounts of the Production of Heuristics

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Abstract

This paper evaluates the claim that it is possible to use nature's variation in conjunction with retention and selection on the one hand, and the absence of ultimate groundedness of hypotheses generated by the human mind as it knows on the other hand, to discard the ascription of ultimate certainty to the rationality of human conjectures in the cognitive realm. This leads to an evaluation of the further assumption that successful hypotheses with specific applications, in other words heuristics, seem to have a firm footing because they were useful in another context. I argue that usefulness evaluated through adaptation misconstrues the search for truth, and that it is possible to generate talk of randomness by neglecting aspects of a system's insertion into a larger situation. The framing of the problem in terms of the elimination of unfit hypotheses is found to be unsatisfying. It is suggested that theories exist in a dimension where they can be kept alive rather than dying as phenotypes do. The proposal that the subconscious could suggest random variations is found to be a category mistake. A final appeal to phenomenology shows that this proposal is orphan in the history of epistemology, not in virtue of its being a remarkable find, but rather because it is ill-conceived.

Keywords

evolutionary epistemology, evolutionary psychology, heuristics, context of discovery, hypotheses, chaos, information, Edward Stein, Peter Lipton, genetics, variations, probability

Introduction

The purpose of this paper is to introduce and then criticize the claim that some elements that seem to be essential to human knowledge in its capacities of invention of hypotheses have come about exclusively through evolutionary means. Evolutionary epistemology says, among other things, that the criterion of survival value applies not only to genetic ratios

in naturally occurring gene pools, but also to the proposals made by human beings when they find explanatory schemes and work out the way to their full constitution by, as it were, "secreting" heuristics. I will not survey the totality of the literature on this subject nor try to cover its essential storyline, but rather attempt to focus on a principle of parallelism suggested as a partial reason why we should no longer oppose our knowledge deemed "certain" and "guided" to unguided variations in nature sifted by natural selection. I will restrict my focus to the bold suggestion made by Edward Stein and Peter Lipton that there is no good reason to assert that our knowledge is guided in some unrestricted sense because it can be shown that its base is just as chaotic as the genetic changes at the heart of evolutionary somatic modifications.

In their article "Where Guesses Come From" (1989), Stein and Lipton have challenged the accepted view that scientific explanation is the construction of a form of knowledge secured from chaos and variation, since it would be inherently guided by rational norms. The authors shift the focus and ask that we consider the *variability* of epistemic invention. Many popular presentations and purported refutations of the theory of evolution through natural selection argue to its being a thoroughly random process. In fact, genetic variation is more restricted than it seems at first. Charles Darwin imagined natural selection to be the conjoined operation of all the laws of nature discovered by physics and, like so many in the century that preceded him, he was impressed by the successes of Newtonian mechanics. When this has been understood, there still remains a piece that is generally missing, and this is the blind character of epistemic variation. How does the scientist know which hypothesis is the right one? Only conjectures and guesses can serve in the process of finding out. Trial and retention of that which "holds firm," by having a lasting and a generalizing power, is all that is possible. With this comes another feature of the evolutionary account of things: many surprising and even awe-inspiring theoretical finds are in fact the reinsertion into a theoretical framework of elements that are known to help explanation but in another context, and which therefore constitute preadaptations in the Darwinian sense. So Stein and Lipton argue in favour of the chaos-based primary generation of heuristics "which says that variations seem guided only because their underlying randomness is suppressed." Additionally, they posit

the presence of heuristics restricting the sheer wide range of possibilities, introducing a look at epistemic preadaptations "which says that the variations are guided, in that they are restricted by heuristics, but that these heuristics are themselves retained from a process that was mostly random." (1989: 35)

The claim these authors make is that their case is only seen and understood in its full force when both parts of this analogy work together. For instance, it used to be possible to infer the 'benignity' of a Designer of nature that has made organisms always perfectly adapted to the environment they are in, until it was realized that this adaptation is the product of selection in the midst of constant variability. Thus, that adaptation very often is far from perfect, so that even without dramatic environmental changes genetic variability will constantly modify the phenotype. The purported force of Stein and Lipton's suggestion is revealed when one realizes just how nobody ever "has" a true hypothesis, that an approximation to truth is all that is possible, and that nothing other than trial and error guides the process of explanatory invention: "Just as biological mutations and biological preadaptations must work together to explain away the seeming guidedness of biological variation, hidden chaos and epistemic preadaptation must work together to explain away the seeming guidedness of epistemic variation." (1989: 41) On the road to a successful theory, many suggestions will have been discarded and hence will not have proven strong enough to survive. The proposal, however, is not to account for innate heuristics, but rather for those that are acquired (1989: 44). The thesis proposed is not that all our knowledge capacities are the product of natural selection *in the end*, since this is something one would consider trivial. According to them, there is greater substantiation for the claim that epistemic evolution is analogous to biological evolution. This contains a nuance that allows for this last claim to have more content: the point is not to prove that epistemic variation is the product of biological variation, or to claim that we can put together an evolutionary *psychology*, explaining all our choices and actions by a greater adaptation and survival value. Lipton and Stein's point is that we can draw an analogy between the way in which our invention of hypotheses develops and the way in which an organism "knows", by applying and trying on its environment that which has been generated through a random search. If human beings are truly rein-

troduced into nature, our cognitive powers would not prove to be essentially different.

1 The first horn: the central place of preadaptation

Two elements of this analysis should be considered in greater detail, namely the aspect of preadaptation and that of elimination. Let us deal with preadaptation first. Some evolutionary biologists and palaeontologists have suggested that certain systems in evolutionary development, having been selected for function, continue operating even while their end-result could be as it were inserted in a different somatic context. For instance, the digestive lining of a fish, even if it is different to that in a mammal, is better than no lining at all, and could be reused in a mammal. An ocellus, with a translucid pellicle, is better than no translucid tissue and might be used in the construction of an eye. Exaptations like those can be found in the developmental story of living forms. The authors repeatedly use the example of a half-wing which, although not functioning as a wing, could be adapted for this purpose. Sometimes it is presented as a device for capturing insects with fan-like elongation properties, while other writers may emphasize its function as a radiator (e. g., Cowen 2000: 91). I cannot go into this story of preadaptations at length, but some theorists have imagined proto-birds that jumped and others creatures that glided down trees. What matters for the authors on this point is to be able to make a similar claim concerning the generation of hypotheses. Take an example that has been popularized through the debate over "intelligent design" in the United States. It was claimed by M. Behe that a rotary flagellum of some eubacteria needed all its parts to function, the forty-odd proteins that make it being without a causal assembly route that would show some specific ones having previously functioning in isolation, with a lesser number of components (2006: 69–76). K. Miller objected to this, arguing that some components of the flagellum propeller do exist elsewhere, e. g. in the 'molecular syringe' or Type III Secretory Complex (in Manson 2003: 299–304). Even if this were the case, one would still need to account for the additional components of a fully functioning flagellum: they can't pop up out of nowhere. Yet I will not evaluate the intrinsic worth of responses by Behe and S. Min-

nich's to Miller's challenge, purportedly a step on the road to explaining away Behe's main idea of 'irreducible complexity,' but I will simply concentrate on a more specific point made by Behe about the preadaptation aspect of Miller's rejoinder. Behe contended that Miller made his case rest on an equivocation around the use of the term "function" (in Dembski and Ruse 2007: 359–60).

Let us draw a few implications of this counter-rejoinder. Indeed, is it not possible to pre-define the term 'preadaptation' in such a way that everything must fall under it, hence making it a universal claim? If this is the case, all we would need is a single counter-example to refute it. It is significant that Stein and Lipton suggest a potential refutation of their position in the only case where *all* our heuristics would be innate, in other words if we could never learn from past experience by building on stepping stones in the process of understanding (1989: 45–6). This looks like a reversal of Popper's position, which I address later. This is also where the complementary strategy would apply, finding no matter what a function for any "part" of an earlier less complex physiological process, operating in an almost autistic fashion despite all the relations that surround it having been modified. To say that something which has a different function in a previous structure is the same "thing" as what we study later, seems indeed to require that one somehow minimize the integral structural character of the earlier function, predicating an "openness" of something, while it is supposed to be at the same time a mechanical and inertial contrivance. The question to ask would be: does this not presuppose a finalism much stronger than the traditional, and often misunderstood one,[1] arguing that the universe would have the development of a meta-structure as its goal which would allow us to validly step from an anterior to a posterior case, thereby qualifying them both with the operationally defined concept of "structure"? Isn't there only a function "relative to x"? This would turn biological time into an assembly-line of a huge "meccano" where all the pieces could be recycled, and all the sub-systems and

[1] The mathematician A. A. Cournot saw with perfect clarity that in traditional finalism something like the eye is adapted to conditions of light propagations on earth rather than having those conditions preset to be shot inside the retina of an eye-to-come, see his *Traité de l'enchaînement des idées fondamentales dans les sciences et dans l'histoire*, §317, N. Bruyère (ed.) (Paris: Vrin, 1982), 293.

parts of organisms would have to overcome an additional inertial step since they would be inserted in a dynamic which could be pulled back and used for something else at any time during some algorithmic run through the developmental landscape. This reasoning considers combinatorial possibilities as though they existed in "thin air" without any ties, and the question arises: is this not in the end reasoning on possibilities existing outside the real world? The philosophical question to ask is whether a preadaptation in the cognitive realm, an idea that has served successfully in a different context, leaves a "piece" intact, or does it transform it completely when it is reinserted in a theoretical framework. Relying on early remarks of Wittgenstein (1974: II–XI), but most importantly on Kuhn's epoch-making work, one would have to ask whether there is, intimately tied to the idea that paradigms are incommensurable, a vision of theories which models them after a qualitative *Gestalt*-type perception; hence we would see in them an organism reinforming and changing the relations of its elements. Canguilhem has argued that the discipline whose history one is studying changes with every epistemological break (1988: 16). When Toulmin pioneered seeing theories competing in a Darwinian fashion (1963: 110–14), or when Kuhn saw them abruptly changing the very nature of the problems making them the centre of the next stretch of "puzzle-solving" activity (1970: 108–10), does this not imply that they are treated as animated by some internal logic and not as a piece of meccano?

The question arises: is the winged horse possible? This animal is possible now if it previously was, but this is *now* blocked, the development of such an animal having been discarded by nature. Due to other selections, this developmental pathway would not be easily accessible. If, however – something I will address later – finality in the sense of advanced action from an archetype situated in an observer's present, which is another observer's 'elsewhere,' is not so much forbidden as it is severely repressed, then blind retrodiction, which normally seems forbidden by Bayesian and causal reasoning due to causal forks having been what they are (Reichenbach 1999; Salmon 1984), could itself, in virtue of the law-like reversibility known to obtain at subatomic level, also be said to be repressed instead of forbidden. The winged horse would have a *very unlikely* integration to the "limb to wing" scheme as a means of aerial locomotion, yet strictly speaking not an

impossible one. This is not just far-fetched. If *ambulocetus* that re-entered into water 50 million years ago succeeded to a mammal, which can be seen by the biomechanical upward shift of a cetacean's backbone in action, the way a sea-lion uses its flippers as limbs in walking could actually be a reversal of fins to limbs, following the adaptation of limbs to swimming with an hybrid status. This would indicate the capacity to wait for a challenge and reactivate some regulatory gene, perhaps under the animal's control.

A corollary of all weight bearing on preadaptation is the need to evaluate the claim that in the properly epistemological realm, natural selection would only retain that which is useful. If one accepts, following a Darwinian account of rationality such as the one embraced by W. James, that what is rational is what is useful, then it would be easy to see that error can perfectly correspond to the useful. Truth can be indifferent to our needs, as Nietzsche objected to the pragmatist's account of things (see Ratner-Rosenhagen 2006: 264–5). To avoid the misguided reconstruction that sees theories as error-laden and rescued by the final truth we would now possess, Kuhn's account of the morphology of theories and their meta-cohesion in a paradigm has reinjected some truth into the past account of things. He has also avoided the question of truth as a central piece of his model. In other words, without a suspension of judgment in a detached and theoretical outlook, as in the Ancient Greek sense of *theoria*, one would find a perpetual reinforcement of error without a control of the variation by a central norm, lest it be a stochastically-generated one. An error is only seen as such against an overall direction, so that nobody in the present proposal could explain why, in a theoretical context, the *judgment* that an error exists could itself be immunized against variation. Logically speaking, the "explosion" principle would never allow us to find a meta-language in this case. The dilemma cannot be avoided: either we fall into unsurpassable chaos, or we have access to a vision of things from a unified and singular perspective. For instance, Aquinas argued against radical pluralism in epistemology (1947: Ia q. 47 a. 3), as if he was answering D. K. Lewis' ontology seven centuries ahead. For argument's sake, if one grants that a hypothesis that is true would come to mean the same as one that is useful, one would see that a new hypothesis can be very well "true" in a theoretical network of concepts which does not yet exist. Not only does one have to rule out, in searching for scientific laws, things like "no

gold sphere has mass greater than 100,000 kg," but one needs to see if false accidental generalizations cannot be the occasion for the discovery of truth. It is a challenging problem to determine whether or not this "non-actual true" could be "actual false." Standard monotonic logic is not comfortable with the idea, but its principles of universal extension are not preserved in inductive reasoning.

2 The other horn of the purported mechanism: elimination

I now come to an evaluation of natural selection. Many things have been ascribed to this process, but one ought to keep in mind that in its original formulation it was to be a simple, inertial, and mechanical principle of containment of variation. Darwin was impressed by Newtonian successes, in fact it has been suggested that he was trying to reproduce them (see Depew and Weber 1996: 78–9; 114–5).[2] When the purpose is only to look at variation and see if it could be unguided in the world of mind as it is in the world of life, grafting the first entirely on the second, one can either make our knowledge a "mirroring" of what is out there, or make it a pre-given insight before any encounter of the data. It is to the merit of P. Munz that he helped sort out the positions of evolutionary epistemology by pointing out that some build on the Lockean passivity in front of sense impressions, while other ones claim that there is an element of truth in the Platonic account of things (2006: 132; see also von Bertalanffy 1974: 6–10). If this dichotomy is correct, Stein and Lipton would be in the camp of the Lockeans for reasons already indicated. Our knowledge can also be presented as *a priori*, not taken from the consideration of the structure of this world, with the corrective that instead of reflecting a world of forms, it would replicate the knowledge which our simian ancestors passed along.

[2] To give a thorough account, one would have to also recognize that – like all really great scientific advances – Newtonianism generated multifold responses. In this particular case, notions such as "action at a distance" and "forces" introduced into matter have given an external caution even to vitalism: see T. Hall, "On Biological Analogs of Newtonian Paradigms," *Philosophy of Science* 35 (1), 1968: 12–3.

It is possible that the authors bring their position close to triviality when they act as though one could consider variation independently of selection, an objection they themselves voice. It seems indeed that any variation apart from its principle of stabilization in a given configuration will inevitably look like it is stochastically generated. The key question would be to ask whether there could be a "stochastization" by artificialization, in other words whether the fact of considering a system as a black box, a unit located somewhere in a network of interconnected nodes, would not be sufficient to create the impression that the relationship between the inputs and the outputs is random, in the sense of not having any identifiable cause or pre-assigned function. As Laborit argued, this could be due to the theoretician's extremely restrictive focus, failing or neglecting to consider that the system one has under observation operates as part of a servomechanism, i.e. of a larger whole with interflowing regulatory switches. This is at the heart of the proposals of an evolution generating "order from noise." These have been assessed elsewhere (see, e. g., F. T. Arecchi in Coyne, Schmitz-Moorman and Wassermann 1994: 20–1). I will note that in this context several stimuli are received in a disorderly fashion and end-up building an organism's complexity, yet what they do in reality is to reinforce and extend an already present network of causal pathways.

By appealing to variation as a principle of understanding in the case of mind as much as in that of life, Stein and Lipton steer the problem closer to an apprehension of the inherent instability of all that surrounds us; they want to bridge worlds as opposed to considering them apart. If this is so, then it would seem that what will be justified in the end are the blindly operating laws of nature. This could eliminate the *sui generis* character of the products of biological evolution. As a correlate, I imagine this would mean that, confronted by E. Mayr's defence of the uniqueness of biology among the sciences, the authors would argue that their account, on the contrary, wants to justify all the known laws of nature.[3] A number of questions are raised by this last statement. Following some suggestions stemming from the recent work

[3] On their being "laws" of biology or not, see J. Beatty, "The Evolutionary Contingency Thesis", in *Conceptual Issues in Evolutionary Biology*, E. Sober (ed.), 3rd ed. (Cambridge: MIT Press, 20006), 238, where three prominent positions are mentioned.

on far from equilibrium thermodynamics, one would have to grant that the two inverse directions of entropy and neguentropy can't be said to coexist for real, apart from a bias of ours and an effect of perspective. According to research presently conducted by R. Dewar and others on the "principle of maximum entropy production," islets of neguentropy would only be improbable moments destined to disappear, and they would use the highly ordered biological structures to get to their predictable end-result faster. This raises the difficulty, already alluded to, of understanding why our minds seek truth and find a seeming peace and tranquillity when they obtain it, while they would be driven at bottom by a principle of usefulness. Why would the brain in our species consume so much of our daily intake of energy, and why would selection have retained the capacity for someone to argue that selection isn't a true explanation? Bacteria and insects, some of them panchronic, have been around for millions of years and they never had to increase in size. Unless one posits, borrowing the term *Selbstständig* already applied to matter by Karl Marx, a self-standing realm of Value, as Plato did, one would have to account for the extraordinary amount of time human knowledge pursues ends that are useless from a usefulness perspective (Polkinghorne 2005: 50–8; Margenau in Varghese 1984: 45–6; von Bertalanffy 1973: 191–2). The selection of quality would not be derivable from this theoretical framework, and yet just as much as Popperian "verisimilitude," this conceptual infrastructure is inherently qualitative, since from a probabilistic point of view it contains no "long run."

3 A thought-experiment

Stein and Lipton rely heavily on understanding life as problem solving, following on Popper's conviction that the same strategy explains the survival of hypotheses, whether they be somatic or belong to "world 3," and this "from the amoeba to Einstein," but they also follow closely a thought-experiment of Dennett expressed in *Elbow Room*. It goes somewhat like this: suppose one would have a mailing list of gamblers, divide it in half and send to one half the prediction that team A will win, and to the other half the prediction that team A will lose. When the event takes place, half the gamblers will have received a true prediction; if one repeats this again by halving the list once

more, some gamblers will have received two proofs of one's divinatory art. The whole thing is spiced up by saying that those two predictions can be had for free, but that they should be made to pay for the third (Stein and Lipton 1989: 36). This is suggested as an analogy to what happens in biological evolution, where seeing only those organisms that survive and not knowing the wrong hypotheses that have been eliminated, one is prone to marvel at the guidedness of evolutionary variations. If one pauses a moment to think about this thought-experiment, from the strict viewpoint of logical explanation, one will realize that it introduces Laplace's omniscient "demon" operating in reverse. Indeed it is not the random draws that justify the impressive omniscience of someone who makes two true predictions in a row, it is rather one's awareness of the regulation of chance and one's strategy, i. e. one's knowledge of Bernouilli's theorem and the *a priori* probability of winning in about half the cases. This shows that probability lends itself to a conceptual appraisal, since in the mind's consideration, none of the throws or draws has any preponderance over any other. Needless to say, the winners will always be surprised and the losers eliminated, but we must not forget that the main protagonist is nowhere assured that his strategy will survive if he cares to take an example not in the world of throws and draws, but in the world of biology. In other words, if one could not make any prediction from this viewpoint, it is not for the same reasons in both cases.

The problem of post facto recognition

To clarify some previous statements, I will devote a few words to the *post facto* character of this peculiar type of "prediction." When we are told that there must be an advantage for a bird to possess a half-wing, what is stated seems to make good sense, and yet if one questions it further, is this not an appeal to the bird *as we now perceive it to have functional wings?* In other words, it is easy knowing the bird to call on it to explain its appearance. Without delving deeply into the problem of Darwinian explanation's circularity, let me state a commonly encountered theoretical guiding principle: "the organisms that survive are the better adapted ones." This statement is not tautological, but as Popper put it, "quasi-tautological." (1986: 69) It does not say: the ones that survive are the ones that survive. All will depend on the projected definition of adaptation. If one considers the situation carefully,

one will see that adaptation does not need to be restricted to reproduction; there are other aspects such as physiological, anatomical, and/or environmental changes. When we speak of a capacity to adapt, the expression has an implicit empirical content. There are so many factors that could be listed here, that the only category that seems wide enough to subsume them all is that of reproductive rate and its success.

It is possible however that the idea of "preadaptation" introduces a further difficulty. This indeed would put us on the side of the sender of that gamblers' list, not that of the receivers. Preadaptation is never demonstrated, since it tacitly calls on the "organism" of total becoming, and it is defined from the position that the functions considered *must have been* at the original branching point that led to the more recent ones. If a human engineer builds something, he will look at what is available and strong enough to fulfil some function. It cannot be said that natural selection acts accordingly; selection takes what is there at a given moment. If we place ourselves *before* the fact, we would need to be able to say that our evaluations would also be those of selection, since only then would the process have anything to do with our heuristics. The problem is that we ignore the totality of the factors in operation, and because of this certain structures will appear as bad designs: the human pharynx, or the backbone (as pregnant women sometimes experience), etc. The real problem in all this might not so much be chance as nearsightedness in front of the future. And this nearsightedness can be said to be in us and not in nature. A flashback to the situation of the human engineer should make us hesitate here. Nature seems to have its own dead-ends, but the real question to ask is: does it have them in the framework of what we call 'evolution', and picture as such, or does it have them in an unqualified way? It is impossible, reasoning on a "catch all" hypothesis, to say that nature has not taken the right orientation (Sober 2008: 28–32; 127–8). We can say it in the light of our understanding of what it *should* have done. Yet evolutionism seems to practically rule out the come-back of discarded solutions, since if it admitted it the space of random search would be so extended that the simplest amino acid compound's appearance would be an impossibility rather than an improbability (every partially built structure and "preadaptation" would be destroyed by further modification), and this seemingly puts its mode of reasoning in the second of those two options.

Evolutionism seems to be built on the judgment that primarily considers human engineering recipes, and the triumphant proclamations of this fact, such as those of Dennett, might turn out to reveal its inescapably anthropomorphic inspiration (in Brockman 1996: 109).

4 The guidedness of nature's stable variety

This leads me to consider the question of the "fitness" of our heuristics. There is a process that selects amidst the variations, i.e. the possibilities that are present to the mind upon the consideration of a problem and, like mutations, this allows our beliefs to be evaluated as to their "fitness" in front of the real world. Our theories are like a physiological scheme being tested when a somatic mutation takes place, with the difference that the conjecture we make in our minds can die in our stead. Just like the monkey jumping from tree to tree and succeeding or failing, according to whether he lives or not, our "net" is thrown out there and firmly hangs or is discarded (G. G. Simpson's example in 1963: 84). We test ideas and not phenotypes. We must understand however that some preconditions to this thesis were present in Popper's methodology, and they played a role in Munz's defence and admiration of Popper's brand of Darwinism. Munz had the interesting idea of relating the fact that a theory is always approximately true (verisimilitude) and the fact that a mutation is approximately good. From this hypothesis one could derive the idea that mutations can escape the criterion of usefulness and be given more freedom of exploration, yet doing this by fulfilling a role. Indeed something important must take place in the cell's cytoplasm, between selection pressure on the phenotype and DNA coding, for processes of inheritance of traits to be present without making it all the way to nucleic acids and modifying their sequence. The question is, is it attributable to a modified version of the Baldwin effect or to a Lamarckian process? S. J. Gould objected to Dennett's metaphor of "cranes and skyhooks" that he was actually showing little understanding of contemporary biological research by not seeing that genetic drift is as much of a crane as natural selection (1997: §2). In the same way and by parity of reasoning, a theoretical construct, containing what Holton has dubbed a "*themata*," will continue to fulfil a role, and its elimination will not be dependent on a selective kill or preserve response,

but rather on a "death sentence" uttered by convention and a consensus of scientists, not by adaptive immediate response (Dumouchel 1992: 149–51). In summary, this means that it is possible for scientists to continue their efforts at saving a theory that seems to be in muddled waters, as historians of science have convincingly established. If one abandoned every theory every time there is an anomaly, it would be detrimental to the growth of scientific knowledge.

Another implication of such an observation is that conjectures will have to be guided by partly successful prior attempts, which is what is meant by a heuristic; and this seems to entail that the rules of usage stemming from past experience will be called on as a launching pad to explore reality. This also calls for a few words of analysis. For instance, it seems to concede the presence of a "material logic" in the heart of reality and requires a look at the operations of the mind in relation to its understand of the world, not the mind in isolation. Furthermore, this seems to reintroduce into the discourse of these authors a high degree of conventionalism, since a theory would resist not because it obeys our criteria but because it would conform itself to the "reliable" base of nature, sifted through our criteria, but in conjunction with a trial process. The authors claim that it could be in its *initium* chaotic but not without creating a "groove" that communicates its force to the present search for true hypotheses. They get the advantage of stability and can still affirm the "chancey" nature of the appearance of the initial variations.

5 Chance and the searching abilities of the mind

What are we to make of chance in this framework? The best way to introduce it is to recall how, for Lipton and Stein, when a scientist considers a theory T which aims at explaining the world, we normally think the scientist adopts it in virtue of an intelligently guided process, but "there may have been some unconscious variation going on in her mind. She may have unconsciously thought of many theories, but only one enters her consciousness. … she might have consciously considered many alternative theories before she settled on T, but forgotten these pondered alternatives." (1989: 39)

These seemingly innocent statements contain a difficulty. Let us ask outright: how could theories be at the same time *considered* and said to be *un-*

conscious? This is not meant to deny that we discard ideas that come to our minds, but precisely once gone for a psychologically significant amount of time they are gone: they should not be put on a par with the retained ones. What is more, to say that theories were unconscious, and to say that they came about by randomness are two different statements. No one knows what terms such as "unconscious" or "instinct" contain, and the reason we use them is to point to an overall efficient use of the occasions made possible by the world and the environment.

Many are familiar with Freud's use of the *Es* of Nietzsche, which became Latinized as *Id* in his system, and was intended as a symbolic marker for the subconscious; but Freud understood his project to be Lamarckian, like Haeckel and Spencer who did so much to popularize Darwinism, but perhaps a little more consciously than they (Freud 1975: 317).

If we say that everything depends on a blind guess, it is the adjective 'blind' that poses a problem, and this cannot be related to the subconscious which means an adaptation by transmitted and integrated knowledge. Once again, in terms of cybernetics and systems theory, one would have to speak of an epistemological "order from noise" proposal, but what order from noise means is invariance as much as variation. For example, Piaget and his disciples used it to support constructivism *against* Darwinian selectionism in the famous debate they had with Chomsky at Royaumont (Piattelli-Palmarini 1994: 333). If someone writes a text, and borrows from a draft, one does not discard suggestions only because they are bad or unsustainable, but often because there are "missing links" between them as presently stated and the full force they would have in a yet to come theoretical context where they, being shots at the full truth, would come supplied with all the steps of the argument and stop functioning as an enthymeme. They are suspended and hanging in a retention zone much more than discarded. Most of what an educated mind does is this; it is not the elimination of radically unfit ideas. Where one would start to have things go wrong would be in the context of a field one is not familiar with. This is an example of the extraordinary importance of a proximity to one's object of inquiry, in the sense advocated by Wittgenstein for whom a term such as "deoxyribonucleic acid" would be perfectly familiar to someone whose "family" belongingness has made it such, while "halieutic" might not be to that same person.

Randomness in all this is not so much defined as it is claimed for the production of an illusion of guidedness. Two things must be noted. First, this would make our human faculties completely unreliable, yet those are complex, since they mean the interplay of sensory perception and imagination working with mental judgment. If we mean that our senses get it wrong, that they can mislead us, this is well understood in epistemology. What applies to them however does not apply to judgment, which *re*-compares a purported statement of what there is, and so comes to an ultimately unknowable reality both directly and indirectly. If a theory is inadequate, it will be eliminated, not by comparison to reality but to a statement conveying an angle of approach to reality. What makes a hypothesis true is that it reduces the arbitrary character of description, that it excludes contingency. The world of judgment is a reconstruction of what is, and in itself it does not admit the sort of mitigation that is said to take place in this proposal.

6 On the uncertainty of the knowledge base

One needs to grant to this hypothesis that we do not ever know when a proposition is evident. Ever since the failed attempts at connecting Euclid's fifth postulate with the four previous ones and the non-contradictory character of its denial, we have been made sensitive to this verdict of "experience" to guarantee the rightfulness of a proposition, even in the "divine science" that geometry is. And yet geometry has not been made less divine for all this: it is still the fascination in it that drove Einstein and Minkowski to suggest, in their "geometry of light" (Reichenbach 1980: 67), a revaluation of our conceptions of the independence of space and time. The crisis in the foundations of both empirical science and mathematics has indeed shaken our trust in the automatic truthfulness of statements about the world. It is perfectly right to say that the progression of knowledge, and the systematization of our results in a logically derivable form, which can be inserted in a methodology of science constructed *post facto*, in fact hides the enormous amount of groping on the periphery of the recognized rules and the beaten paths. What this testifies to however, is the progressive victory over chance-like events and the insertion of our true heuristics in a world of knowledge where they are secured from the come-back of those random perturbations. One can see,

as in Bachelard's epistemology, the penetration of rationality in the whole of reality,[4] instead of trying to identify a fixed point that would be a chaotic basis.

This problem would be better stated if it were grounded in human cognition without this dubious identification of mutational genetic variation with epistemic variation. There is room for the presence of phenomenology in the consideration of what our theories really say about reality. It is always possible to say that the whole of a process is not guided, but only in reference to a criterion that *we* pre-specify. Yet there is something extraneous and strange about this strategy. Considered from an epistemological standpoint and in itself, the process will only be non-guided punctually, in one of its parts, since the consideration of its totality might very well hide a code which in fact converts, upon its discovery, this chaos into an ordered *n*-tuple. This identification of a program from its own strictures has been a guiding heuristic in algorithmic information theory, which makes no reference to probability and is not conceived to be applicable to nature proper. Nobody possesses a representation of nor has defined what chaos might be; it remains a myth, the result of an inductively amplifying operation through which we consider there to be *more order* after a certain point in time. We then pretend we could go backwards and, unweaving the process, incrementally subtract all the way down to perfect jumbledness (Bergson 1913: 223–36; Ambacher 1967: 159–63). But this only exists in theory. The theorems that apply to the rolling of dice, for instance, only operate *provided* these are "fair," whatever that means physically. Plato used this myth to withdraw any efficiency to the *chôra*, and to account for the non-adjustments of archetypes to their realisation in a substratum.

Another way to approach this phenomenon is to stay outside a process and, considering it as a whole, to wait until it reaches a pre-defined goal instead of trying to specify it from within. The goal being highly specific, it is possible that only one combination of it gets there. It is also possible, as the studies in complexity have suggested, that part of the route could be covered through the natural encounter of elements possessing emergent

[4] "The world in which we think is not the world in which we live." *The Philosophy of No*, trans. G. Waterston (New York: Orion Press, 1968), 95.

properties when they act in large-scale cooperation (Kauffman 1991). If the process is reduced and its conditions are stated, and if we can ignore them as insignificant, then it is the great specificity of the law that would account for its instantiation.

7 From life's successes to the mind's grasp of reality

In conclusion, I suggest a different account of the guidedness of our hypotheses. As long as one sees through the Neo-Darwinian paradigm of typographical mistakes and selective retention, one is bound to ignore that nature's equilibrium, like so many fundamental concepts, has two complementary meanings. One can see in any encroachment to equilibrium, in a rupture of harmony and integration of parts, a disintegration akin to flirting with death. The physico-chemist is bound to react and blame the biologist who would say this for equivocation, since for him equilibrium would not even permit life (P. Clément in Brans, Stengers and Vincke 1988: 227–8). I just spoke of integration of parts, but it is doubtful that we would ever recognize this without our experience of building, assembling and seeing that elements hang together in a virtual scheme of their connectedness that we have not produced. If one asks that inert elements give rise to this structural concatenation, and if one waits and sees, one will not produce life out of this but might get part of the way. Life works in tandem with a semiotic system: it seems to have adjusted itself to contexts, and to depend on them in order to process its operations. Taking the flipside, the other half of the route, where meaning is given to symbolic and semiotic cues, and pretending it can be secreted by the material and chaotic basis will not work. Dennett's "touting pyramid" analogy, on which Stein and Lipton rely heavily, just would not make sense outside the knowledge of a process acquired through an interplay with its empirical correlate.

In this vision, one could not really invent. All that would be possible would be to rely on past imprints, the traces they have left, and to randomly search for combinations among them. In keeping with Goodman's nominalism, one would stop the selection process and hit something in virtue of the presence of "entrenched predicates." This amounts to a cancellation of novelty. No one

can prove that there is ever anything new under the sun, but one can point to the fact that the experience of understanding, the Archimedean cry of "*eurêka*," convinces the knower of being completely out of oneself, and puts the mind in a state of rest. It looks as though, as Ruyer (1952) suggested, invention is the reestablishment of information. It is imparting to the outer world a degree of order, an order which we previously benefited from. In the mind this order is experienced as unchanging. The condition for chaotic exploration to rely on successes, what has been referred to as "heuristics," is for equilibrium to have an internalized meaning.

It is not us who work like biological creatures, it is they who work like us. Even when we find more efficient engineering solutions in nature (e. g. in signal detection, flight efficiency, stickiness of glues, etc.), we need to understand and reconstruct them so that they make sense for us. It is a wager that all things would be rational, that there would not be zones of obscurity and irrationality with things groping and searching to find that repose for themselves. This is the impressive initial take of Parmenides on the project of rationality. Is it going to suffer a deposition in the end, to use Whitehead's famous phrase? Like any philosophical proposal, it will be found to be true or false. But this is not what we have been concerned with here. Assigning genes a certain directionality, and even if they claim it to be that of natural selection, Stein and Lipton transfer back with this assignment some of the properties of human cognition, and they subscribe to this anthropomorphism omnipresent on the contemporary scene of the popularization of science, with talks of molecules and genes being "selfish," "reaching," "crawling," and "knowing." (Berlinski in Lightman 2005: 233–6) By defining the problem as human guidedness versus genetic randomness, and playing on the degree of lateral transfer from one to the other, the authors have obscured the problem rather than helping us see it more clearly. If common ancestry is true, nature has remained victorious ever since life appeared and this restricts our sample space to 1. If we reason in a Bayesian way, it forces us to assign a high prior probability to its ongoing success. The lack of successes and the dead-ends become more dubious the more we look, and hardly an objection to the force of a perpetuation by progressively cancelling any talk of internalized randomness. Therefore, there are far more reasons to say that human knowledge in its guidedness and life's partly successful strategies are both part of

a larger whole which we have not yet comprehended fully, than there are to juggle with them in an ever-contradictory fashion.

Scientists will not accept the "cracks in the cosmic egg" type of theories, and this is understandable. Western science has had to triumph over our determination to confuse dreams and wishful thinking with "hard" evidence. The rest of the story has been the demise of this very idea of hard evidence, since it can only be established through inter-subjective agreement. If science's polarization and aim is to endure in affirming the value of objectivity, two things must be said. First, science will prefer the incapacity to understand material and energetic unfurling over a too-cheaply-obtained explanation of everything through the "powers of the mind" that one would graft on it. Second, the attempts to give a "mind" to genes (when they themselves are so ill-defined, see Pichot 2001: 102–4), albeit a stochastically stabilized one, will be mistaken just as much. A "scientific" attempt to show the necessary character of the content of our ideas and thoughts is bound to involve a phenomenology and a re-living of the experience of seeing (knowing is most often like seeing, as Wittgenstein aptly remarked in 1972: §90; §204). For this it is Descartes who should be our guide. If we part ways with him, we are bound to predicate an identity between the order of ideas in our minds and in reality, laying the cornerstone for Frege, the 'first' Wittgenstein, and the whole analytical project which ends up reducing our thoughts to logic and discarding from epistemology the context of discovery. This approach stemming from Spinoza is deterministic to the core and hence not prepared to integrate chaos. The former one is better prepared to work out a theory of the mind's control over chaos, as in Plato's *Timaeus*, by imposing on it independently existing patterns, but a mind originating from chaos is one of those oxymorons that has never been thought through consistently by anyone.

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