

Transformations

ISSN 1444-3775

Issue No. 17 2009 — Bernard Stiegler and the Question of Technics

Prolegomena to a Future Robot History: Stiegler, Epiphylogenesis and Technical Evolution

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The reproducibility of the technical machine differs from that of living beings, in that it is not based on sequential codes perfectly circumscribed in a territorialised genome. (Guattari 42)

1 – Introduction

How does one tell the story of a machine? Can we say that technical artefacts have their own genealogies, their own evolutionary dynamic? Bernard Stiegler feels this question is an urgent one, and calls for more research into technical evolution in his book, *Technics and Time*. “Today we need to understand the process of technical evolution, given that we are experiencing the deep opacity of technics” (21). In the following essay, we will be answering Stiegler’s call. Firstly, we will be reviewing the work of several key theorists from different disciplines who have attempted to understand technical evolution, many of whom Stiegler uses in his own work; in order of appearance, paleontologist Niles Eldredge, the philosophers Jacques Derrida and Manuel DeLanda, and archeologist André Leroi-Gourhan. We will then lift some ideas and problems from each of them in an effort to construct a prolegomena to the history of a technical machine, a history which is not included here and which has yet to be written. We want to build a theory of technical evolution.

Historically, any technical artefact can be thought of as a series of objects, a lineage or a phylum that can be divided up into generations. Artefacts can be traced not just to other artefacts but to human activities such as calculation or certain repetitive sequences of movement. Although when we think of ‘evolution’ we immediately take organic evolution as the paradigm, the two are not synonymous. As John van Wyhe argues, long before Darwin “scholars write of the ancestral descent of humanity with modifications for cultures, languages, myths, societies and artefacts” (94). Darwin’s work gave rise to new approaches to thinking the evolution of cultural artefacts in terms of fitness, selection and periodic variation. During the following century, in fields such as economics and social research, analogies with evolutionary processes were widely influential in helping elucidate the dynamics of organizational, economic, scientific and technological change. As Fracchia and

Lewontin observe, there has been a long and bloody Hundred Years War among cultural anthropologists over whether human culture can be said to evolve (53). In the early twenty-first century, the war seems to have ended with the consensus that there are fundamental differences between cultural and biological processes, and that the analogy (if this is what it comes down to) can only be used broadly, or as a preliminary hypothesis. Not only are there irreconcilable divergences between evolutionary and cultural dynamics, but also between the dynamics observed *within* different areas of culture, such as organizations, economic systems, and technological change.

In a recent survey of the career of what he calls “universal Darwinism” (or Darwinism applied to everything), Nelson argues that the main failing of evolutionary analogies in the context of technology is that they cannot account for the “major role of human purpose, intelligence, and in many cases very sophisticated understanding, both in the generation of variety and in the selection process” (85).

... the distinctions among ex-ante conception of a promising new design, its practical manifestation in a piece of hardware and test in actual practice, and selective retention or rejection, are much less sharp than the distinctions in biological theory between new genotype, the phenotype that comes from it and its encounter with the environment, and inclusive fitness of the genotype. In the process of technological evolution, there is considerable selection of alternatives prior to actual full scale trial. (Nelson and Nelson 1646)

Other differences include the fact that survival is not a driving force and is seldom at stake in the process of design and selection. Lastly, Nelson criticises the individualistic bent of the traditional evolutionist approach. Culture does not operate in individual genes or organisms, but has an irreducible collective character (Nelson 89-91).

Venturing further, we come across some other problems. The application of evolutionary frameworks to technical dynamics implies that there is an agreed consensus about evolutionary theory, and downplays important debates within the evolutionary sciences, such as the integration of population genetics and developmental evolution (see Wagner for an introductory account). Furthermore, the evolutionary model cannot predict what path will be favoured when we are faced with the choice of two innovations that are equally ‘fit’. In addition we have the equally pressing issue (as Guattari suggests in our epigraph) of what the *unit* of change is. Even in genetics and evolutionary sciences, the paradigm of the gene as the fundamental unit of study has been increasingly put into question. To begin with, in technology, the information required for the building and operation of artefacts (the machine’s or technique’s DNA) is *outside* the actual artefact, distributed widely across bodies and environments, time and space, disciplines and dimensions of knowledge (formal, tacit or latent).

Nonetheless, evolutionary thinking undoubtedly poses a persuasive framework to approach the historicity of technology. In *War in the Age of Intelligent Machines* Manuel De Landa approaches military history from the perspective of future robot historians “committed to tracing the various technological lineages that gave rise to their species” (2-3). In this history

“the role of humans would be seen as little more than that of industrious insects pollinating an independent species of machine-flowers that simply did not possess its own reproductive organs during a segment of its evolution” (3). These historians, casting a cursory glance over the long road that led to their existence, might notice a developmental logic in which human-centred features (such as function or design) become secondary considerations. They might notice first a certain *autonomy*, the fact that technologies “defy human intention” and often “resist engineers’ intervention” (Hong 261). Humans have learned the hard way that ‘our’ technologies are, in the words of Haraway, our “unfaithful offspring” (151). Although humans might design a technology for one purpose,

this same technology may later be used for a quite different purpose... [Also] a technology which was developed in a certain social context—thereby apparently embodying and mediating it—frequently comes to mediate a quite different social context. (Hong 261)

Robot historians will effortlessly cut through our anthropocentric biases: culturalism, biologism, teleology, and determinisms of the social, economic and technological kind. They will agree with Darwin that there is no progress, no technological ‘advance’; that these are parochial concepts based on arbitrary norms. For example, they will notice, contrary to the discourse of progress, that many techniques and artefacts show a remarkable resilience. When the robot historians survey the twenty-first century they will find computer systems and satellites coexisting with rowboats and bicycles, mobile phones with Kalashnikovs, Petri dishes with rickshaws. As historian David Edgerton has argued, ‘old stuff’ has had, and continues to have, a much larger impact in our lives than new stuff; ships, for example, have been more important for globalisation than computers and jumbo jets (*Shock of the Old*). The machine historians will search for a dynamic in technics that stems neither from biology nor from human societies, a developmental logic that grants machines their own material limits and resistances, their own principles of organization and interbreeding; a dynamic that explains differentiation as well as robustness.

Lastly, future historians might conclude that it was in fact their own ancestry (in the shape of tools, canoes, language and dwellings) who gave rise to human beings as a species; humans were a fleeting appendage, a bridge between the tool and the Supermachine.

This calls for a new consideration of technicity, and a new theory of the relationship between human beings and technics. As De Landa argues, the externalisation of mental or semiotic processes is itself already techno-logical. Thus the historians will track the machinic phylum for ‘bifurcation’ points:

[the robot historian] would, for example, recognise that the logical structures of computer hardware were once incarnated in the human body in the form of empirical problem-solving recipes....these may then be captured into a general-purpose, ‘infallible’ recipe (known as an ‘algorithm’). When this happens we may say that logical structures have ‘migrated’ from the human body to the rules that make up a logical notation (the syllogism, the class calculus) and from there to electromechanical switches and circuits. (4)

Tracing that vast history at the speed of light, the historians might even come to the conclusion that there is no natural class that can be called ‘technology’ or ‘machine’. Like Darwin, they will believe that a species is a historical artefact, and that phyla can only be reconstructed historically, that is, according to certain family resemblances that can only be retroactively ascertained. Phyla are historical artefacts, yet unlike biological phyla, machinic phyla respect no natural kinds, no borders between human faculties and machine code. The robot historians will incorporate transgenic seeds, test-tube babies, strawberries, germs, fishes and forests into the Great Family of The Machine. Machine history will not be natural history of humans and their wars and famines and love stories, but a pan-machinic, universal history of what Stiegler calls ‘organised, inorganic matter’.

2 – Retroactivation and Horizontal Transmission

Niles Eldredge collects things for a living, and there are two great collections in his life. The public one is on display at New York’s Museum of Natural History; its 1000 individual specimens stretch floor to ceiling for 30 metres across the Hall of Biodiversity (Walker 38). There are beetles, molluscs, rotifers and fungi, spiders, fish and birds, all arranged into genealogical groups. The other collection is private; it spans an entire wall in his home in rural New Jersey. This collection contains over 500 specimens, but of the “musical rather than the biological variety” (Walker 38). He collects cornets, a type of musical instrument. There are silver and gold ones, polished and matte, large and small, modern and primitive. Ever the biologist, Eldredge has them arranged in taxonomic relationships of shape, style and date of manufacture. Much of the variety in cornet design is based on the way the pipe is wound.

Late in 2002, Eldredge’s curiosity got the better of him. He decided to feed these specimens through the phylogenetic computer program he uses for his trilobites, to apply a scientific method to technical evolution for the first time. Then he asked the computer to come up with all the possible evolutionary trees and then make a ‘best guess’ based on the existing specimens (Walker 38). The results were astounding. Compared to the phylogenetic diagram for trilobites, the diagram for a technical machine seemed much more ‘retroactive’. Eldredge’s musical instruments defied the laws of evolution.

In the world of organic beings, according to the standard account, there are basically only two ways creatures can be transformed by acquiring a new genetic trait: by inheriting it from a previous generation, or by evolving it in the present one. They are *dependent* on the previous generation to acquire their characteristics (this is called ‘vertical transmission’ of parents to offspring). If a species dies out - biological ‘decimation’ - its accumulated characteristics die with it. But technical beings are different.

With cultural evolution comes the capacity to co-opt innovations at a whim. Time after time, when the cornets on one part of the tree acquired a useful innovation, designers from other branches simply copied the idea. (Walker 40)

In technical evolution, machines are not entirely dependent on the previous generation. They can borrow innovations from generations in the past (retroactivation) or they can borrow from entirely different branches of the evolutionary tree (horizontal transmission). As Eldredge put it,

The key difference is that biological systems predominantly have "vertical" transmission of genetically-ensconced information...the neatness of evolutionary trees in general in biological systems stems from the compartmentalisation of information within historical lineages. (interview with the author 2004)

In Eldredge's diagrams, cornets that were relatively primitive seemed to co-opt innovations from different branches. If there was a particularly good innovation, then a 'burst' of rapid evolutionary activity would appear. The lines in the cornet evolutionary tree were thoroughly confused. Instead of a neat set of diagonal V-shaped branches, a "cone of increasing diversity", you would see flat lines from which multiple machines appeared (Walker 41). When this happens in biology, it implies explosive radiation – the appearance of multiple new species in a geologically short period. In the biological world it is extremely rare, yet it appears to characterise Eldredge's cornets. In the cornet diagram, the gradual passage of time and generations does not precede the development of a particular characteristic. Innovations appear spontaneously, often with no physical precursor. This means that the cornet's relationship to time and inheritance is different than that of biological organisms.

Another striking feature of Eldredge's diagrams was that outdated or superseded machines could re-appear with new designs, as if they were held in memory and only needed a certain innovation to burst into activity again; this is what is meant by 'retroactivity.' Technical machines can reappear, borrow from each other across branches and then rapidly evolve in a single generation. In biological evolution, when branches diverge, they diverge irrevocably; similarly, when branches die out, they cannot reappear. Technical machines are different. There is no extinction; nothing is irrevocable, as long as it is *remembered* in the form of artefacts or in documents.

If innovations are taken from the past and spontaneously appear in another branch in which they have no physical precursor, this constitutes a definite break from the mechanisms of genetic evolution. There is an evolutionary dynamic going on, but its rules of inheritance are not based on Mendelian genetics. Similarly, the kind of selection that operates on horizontally-transmitted characteristics is not Darwinian natural selection. We need other models that accommodate retroactivity and horizontal transmission, the features that give technological lineages and diagrams their characteristic pattern. The mechanisms of variation, then, are different.

First, the question of techno-genetic 'memory': the mechanisms that determine the storage and transmission of the knowledge required for the reproduction of technical elements. The obvious answer is that human culture is the medium of invention and propagation of these traits. Culture has, then, a techno-material dimension, but also a lived dimension irreducible

to its material inscriptions. Although the relation can be loosely mapped out on the axis diachronic-synchronic, its interrelation is much more complex, as technical traces affect the lifeworld in ways that exceed the mere inert storage of information. However, our robot historian will be more interested in the first dimension. Organic beings are transitory: it is technics which transcends the life-world. Secondly, we can see that technological 'evolution' requires a rethinking of the notion of lineage, individual and species, which we will address in the next section.

Thirdly, there is the question of the origin of order; that is, of invention and the creation of new types of technical beings. Part of the reason Eldredge created these diagrams in the first place was to prove to the Creationists that intelligent design has its own dynamic, and this dynamic is radically different to what we find in nature. The source of this dynamic is human invention. Machines are invented, and have neither the capacity for self-design nor for self-production; this is what distinguishes them from biological organisms. Silicon does not automatically make itself into a computer. As an object, it must first be thought in the mind of a human, and then created. So the question becomes: is this cognitive process of design and invention purely human, or is it *already* technological?

3 – Individual and Lineage

In both biology and material cultural systems, history is indeed staring you in the face when you look at a wombat or a cornet. But there is no way to divine that history unless you compare a *series of objects* that you assume a priori are related. (Eldredge, interview with the author, 2004)

Niles Eldredge demarcates lineages for his trilobites on the basis of shell shape. Certain shapes emerge at certain points in time, and these shapes diverge irrevocably into different branches of the phylogenetic diagram. This technique is called comparative anatomy, and it works under the assumption that similar morphological structures in different organisms have a common evolutionary origin. Aside from comparative anatomy, there are several other ways to determine evolutionary relationships: comparative embryology, molecular, behavioural, physiological, chemical and fossil data are also used. A particularly popular technique involves DNA sequencing, which compares the precise sequence of nucleotides in two samples of DNA.

This is how biology builds the concept of a species. It locates certain recurrent and inherited characteristics that distinguish it from other species. For example, human beings have 46 chromosomes, we have an upright posture and a pronounced temporal cortex. This distinguishes us from chimpanzees, who have 48 chromosomes and a smaller brain. For certain biologists (Eldredge and Stephen Jay Gould in particular) you can hence call the resulting species an 'entity' -- a large-scale system. The individual is nothing outside of its history and its inherited characteristics.

What we're saying is that species are entities. They have histories, they have origins, they have terminations, and they may or may not give rise to descendent

species. They are individuals in the sense that human beings are individuals, albeit very different kinds of individuals. They're large-scale systems that have an element of reality to them, and that's a big departure in evolutionary biology. (Eldredge, "A Battle of Words" 121)

But to regard a species as a large-scale system, biologists must necessarily assume that particular morphological or genetic characteristics constitute its principle of unity. These characteristics are inherited by each generation, they become 'entrenched', they constitute a lineage or a line.

The analogy cannot be so easily transferred to technical beings, however. If we define technical lineages by their form (as Eldredge has done by collecting a particular kind of musical instrument based on the way the pipe is wound) then the lines become tangled. The form is simply not maintained in any sensible fashion over time: it jumps around and changes depending on the technical innovations available to it. The bell jumps from right to left, the valves change from the earlier Stolzel form to the later Perinet form. It becomes difficult to "rank them in any sensible order of ancestors and descendants" (Eldredge, qtd. in Walker 41). The same applies to computing, for example. If we define a computer by its form -- an electronic machine conveying information encoded as binary logic across silicon circuits, then the analogue computers from the late 30's and early 40's seem completely unrelated. They used neither silicon materials nor binary logic, and were based on brass gears, wheels and shafts that had more in common with Eldredge's cornets.

If we define a technical lineage based on function, the problem recurs. Let's return to computing as an example. At the end of the nineteenth century, the word 'computer' meant a human operating a calculator. Early in the twentieth century, these 'computers' became large group of mostly female humans performing mathematical calculations by hand or on slide rules, housed in large warehouses (Ceruzzi 2). At the time, these groups were organised for one express purpose: to perform calculation-intensive operations for the military, primarily ballistic analysis and the creation of artillery ranging tables. The 'function' of a computer was to produce mathematical data for the military. This changed radically over the next 50 years, going through several stages. The result today is that a computer has a multitude of different functions -- the very least of which is the production of artillery ranging tables. For a start, computers are personal devices that manage and create our everyday working environment. They are nodes in a greater network—the Internet. They are the engines of a new form of capitalism and, arguably, a new social order. The list goes on, but the fact remains: the function of the 'computer' has changed beyond recognition since the turn of the twentieth century. To trace a phylogensis based on human function would result in a greater mess than Eldredge's retroactive cornets.

The philosopher Gilbert Simondon argues that we need to understand the genesis of technical objects independently of the human functions which establish, among other things, use behaviour. For if one seeks to establish a lineage based on use "no set structure corresponds to a defined use" (qtd. in Stiegler 69). The object will invent itself independently of any fabricating intention. For example, Tim Berners-Lee invented HTML

to organise the text documents of a single corporation: CERN. It is now the lingua franca of a global mnemotechnical system (the Internet), and its uses have proliferated beyond Berners-Lee's wildest dreams. It has adapted and evolved, incorporating and engendering new functions and technologies in the process.

The uses and functions of a technical object can never be known, these will only be realised in the evolution of the object itself. This is why the influence of 'working prototypes' on the engineering community is so important; the fabricating intention has little relationship to the object itself, and it is the object as a working prototype that will engender new structures and functions. Technical machines, maintains Simondon, evolve by a process of functional overdetermination. After the "synthetic act of invention" has taken place,

each component in the concrete object is no longer one whose essence is to correspond to the accomplishment of a function intended by the constructor, but a part of a system in which a multitude of forces operate and produce effects independently of the fabricating intention. (qtd. in Stiegler 75)

Subsequent evolution is accomplished by a process of 'concretization,' the condensation of various functions in a single structure oriented toward efficiency; for example, the base of a light bulb must seal it for operation within a certain range of temperatures and pressures while also fitting in standard sockets (Feenberg 186). But we are still left with a problem: how do we identify the lineage of machines themselves? How do we identify their family resemblance?

In evolving, the technical object constitutes a series of objects, a lineage or a line. This lineage, of which the synthetic act of invention is the ancestor, cannot be identified by a particular material form or human use. For Simondon, it can only be identified by a group of procedures or processes that remain stable throughout the evolutionary lineage. It is these procedures, implemented in the most diverse domains of use, which constitute the unity of the lineage. This is why there is a more real analogy between "a spring engine and a crossbow than between the latter and a steam engine" (qtd. in Stiegler 70). Both are implementations of procedures to work with tensile forces, both are the externalisation of an originary heuristic.

According to Simondon, technical objects have an internal principle of order which can be judged as more or less perfect in terms of a spectrum that ranges from abstractness to concreteness. Technical objects evolve "in the direction of a small number of specific types" by virtue of "internal necessity" (17). Technical evolution might be driven by other needs; but these needs (economic, cultural), unlike technical requirements, are never pure, and "involve a diffuse network of motivations and preferences" such as desire for novelty, luxury, etc. (20). The technical object is burdened with these external meanings (such as those popularised by advertising) which are alien to technical necessity. The technical object, on the contrary, evolves by becoming more *concrete*. This Simondon calls *concretization*, a process whereby the object becomes unified, and multiple functions are condensed in the same structure, while each structure becomes specialised and free of secondary, distorting effects (30). In a concrete technical object, various elements enter into perfect synergetic

associations, and “all functions fulfilled by a particular structure are positive, essential, and integrated into the functioning of the whole” (31). In this sense, the “evolved” technical object “approximates the mode of existence of natural objects. It tends to internal coherence, and towards a closure of the system of causes and effects which operate in circular fashion within its boundaries” (46).

There is, for Simondon, no “natural” boundary between the artificial and the natural. The “artificiality of an object resides in the fact that man has to intervene ... by protecting it from the natural world” (46). Artificiality is the result of human “artificialising action”. A natural object can be artificialised (plant hybrids, for example, which need a greenhouse to exist). Concretization, on the contrary, renders the technical object more natural. However, the two should not be collapsed, and analogies should be outlawed (49). What is significant is “exchanges of energy and information within the technical object or between the technical object and its environment” (49). Simondon criticises cybernetics for having “accepted a classification of technical objects that operates in terms of criteria of genus and species” (49). Living beings are concrete right from the beginning, while technical objects tend towards concretization: this is the only parallel that can be drawn. The other mistake of cybernetics is to consider living beings identical with self-regulated systems (49-50).

In a concrete object, the design exceeds the intentions of the engineer, and effects are produced independently of the design plan. This is because the goal of the object must identify with “universal scientific knowledge” (32).

One must insist that the knowledge in question must be universal, because the fact that the technical object belongs to the class of artefacts which meet a certain specific human need in no way limits or defines the type of physicochemical actions which can occur in this object or between this object and the outside world. (32)

These universal laws also provide an explanation for the origin of technical lineages, and thus of human invention. But these laws are expressed in *technical essences*. (For example, the technical essence of the diode is the functional dissymmetry of the electrodes, and not the transport of electric charge across a vacuum). “The beginning of a lineage of technical objects is marked by a synthetic act of invention that is basic to a technical essence” (42). This essence remains stable throughout the course of evolution of the lineage.

Thus, the technical object is halfway between a natural object and scientific representation (46). “It is a translation into matter of an ensemble of scientific notions and principles that at the most basic level are unconnected one with the other and that are connected only by those of their consequences that converge for the reproduction of a looked-for result” (46).

Simondon, then, suggests specific criteria by which to identify the origin and principle of unity of lineages. As Eldredge himself discovered, there is an undeniable evolutionary dynamic going on, inasmuch as technical machines come in generations, they transform themselves in time, they adapt, and adopt new characteristics. There is, however, something missing here: the mechanisms of inheritance. Simondon replaces Platonic essences with

technical essences that are not wholly equivalent to scientific knowledge (being more specific than the laws of nature). Yet, as natural potentialities of matter, Simondonian essences remain curiously static and universal. How are these potentialities expressed, inscribed into lineages, remembered across generations? This is crucial to our developing theory of technical evolution.

4 – Technical Remembering

What is the role of human thought, agency and culture in technical change? Is it humans that 'remember' previous generations of machines and transfer their characteristics between branches? If so, how and where do they remember them? The relationship between human memory and technics marks a break from genetic evolution and inheritance. Technical 'remembering' implies a mode of transfer and storage, and various loci where this occurs. Derrida writes: "There is no archive without consignation in an external place which assures the possibility of memorisation, of repetition, of reproduction, of reimpression" (*Archive Fever* 11). Is this place inside or outside (the machine, the mind, culture, the body)?

One possibility is to consider human culture as the DNA of technical beings. The problem is that culture itself is made possible by technical forms of inscription, transmission and preservation which are constitutive parts of its development. For a start, the increase of technical knowledge is in itself a historical and cultural force. This makes it difficult to separate human agency from the lifeworld of technology. Culture has a collectivist character, its own kind of agency that places selective pressures on technical lineages. Our robot historian will look for a singularity point at which machine agency liberated itself from the constraints of human culture. Agency here should be understood widely, in the sense that species-as-individuals can be pictured as having historical trajectories that are self-determined despite (and because of) the constraints of their niches (which also acts as a creative, positive force for mutation and change). Culture is self-determining in the sense that it is partly constituted by a sedimentation of memory that shapes its course, opening the range of its future possibilities.

In this and the next section we will briefly review the contribution of Jacques Derrida and Bernard Stiegler to this problematic. Derrida thinks the relation between humans and technics in terms of an 'originary supplementarity': human memory is a prosthesis of the inside. It is neither inside nor outside, but constitutes a 'relative interiority'. Stiegler's thinking may be seen as a radicalisation of this concept. Whereas Derrida is concerned to articulate the tension in terms of a 'logic', the logic of difference, Stiegler is concerned to articulate this logic in terms of its historical differentiations in different technical systems. The logic will only appear in its differentiation; the "interiority is nothing outside of its exteriorisation." [14] This is why Stiegler will be useful to any material genealogy of a technical machine, and to any theory of technical evolution. It will give us descriptive purchase on this logic as it is articulated in technical objects. We will unpack this concept in more detail presently.

For the moment, let us return to the problem raised by Eldredge; technical machines break

the laws of genetics. From his perspective, this is because they are subject to intelligent design. Part of the reason Eldredge created these diagrams in the first place was to prove to the Creationists that intelligent design has its own dynamic, and this dynamic is radically different to what we find in nature. Technical machines are invented; this is what distinguishes them from biological organisms. "[N]ot one product of art has the source of its own production within itself", as Aristotle put it two thousand years ago.[cited in Stiegler, 15] Or rather, technics do not have the capacity for self-production.

5 – The Genesis of Form: Who invents What?

Bernard Stiegler begins *Technics and Time* with a myth of origin for Western philosophy, a myth in which technology is cast out from the interior of thought, made secondary and derivative. “At the beginning of history, philosophy separates *tekhne* from *episteme*”, and to these two regions of Being two dynamics are assigned: mechanics and biology (2). In this originary moment, technical knowledge is devalued as mere supplement, and the human affirmed against the process of technicisation. Human thought (the philosophical *episteme*) is pitched against the sophistic *tekhne* (art or craft). The Sophists taught their art without any regard to truth, as pure means without ends. These techniques of pure persuasion (appearance without *logos*), already represent a form of mechanical incursion on human thought. For how can thought consist merely of techniques and artefacts? The human mind, its power of memory (intimately linked to its capacity to perceive the transcendent forms), was the locus of reason and moral judgment, and thus “the noblest region of... personality” (qtd. in Tofts 58), the originary source of which *tekhne* served as mere extension, expression, means, mirror. Platonic philosophy was constituted on this opposition between transcendental knowledge (which had a divine source) and technics. Aristotelian physics would further extend this divide into physics: machines lack the capacity for self-production, self-causation, self-movement, the characteristics which defined the soul.

As Stiegler points out, this divide is articulated as the answer to an ancient *aporia*. *Aporia* comes from the Greek *aporos*, “meaning, ‘without issue’, or ‘without way’...that which thought cannot resolve or untie without forgetting the undecidability which structures the *aporia*” (Beardsworth, 1998). It is a limit question, a question which is irreducible, and which will consequently reappear in every attempt at an answer. Stiegler locates its reactivation in the phenomenological project of Husserl, a thinking of the *eidōs* that forgets the constitutive role of technics in consciousness.

What is human knowledge? Or, more precisely, what is the essence of knowledge —knowledge not of things but of the essences? For Plato, *tekhne*, as a form of knowledge with precise goals and contexts, has its motor force outside itself, in human goals: health, the making of furniture, the ruling of the state. Although *tekhne* can provide, dialectically speaking, a point of departure for an enquiry into knowledge (as it repeatedly does in Plato’s dialogues), it is necessary to move beyond it, to a unitary definition of knowledge. The problem, as *Meno* (or at least Stiegler’s reading of it) makes clear, is that such knowledge

(knowledge of knowledge, or of Virtue in this case) is impossible. It cannot be taught or learned:

How will you look for something when you don't know in the least what it is?
How on earth are you going to set up something you don't [already] know as the object of your search? (qtd. in Stiegler 97)

Socrates, in response, rephrases the *aporia* to highlight the problem:

[A] man cannot try to discover either what he knows or what he does not know. He would not seek what he knows, for since he knows it there is no need of the inquiry, nor what he does not know, for in that case he does not even know what he is to look for. (qtd. in Stiegler, 98)

This *aporia* is taken up and resolved by Socrates through the myth of reminiscence (*anamnesis*). Humans have access to an originary knowledge, to a transcendental memory acquired before our fall into this world. Humans already know what they do not know—it's just that they have forgotten. Knowledge is an unveiling, a remembering. The immortal soul has been reborn many times, has seen all things both here and in the other world, and thus has learned everything (Stiegler 99).

Thus, argues Stiegler, the *aporia* is settled in terms of an opposition. Thought has the principle of its creation, of its movement (*arche*) within itself. The human being does not receive knowledge from the outside, from the world, experience, the finite world of objects and beings, but finds it again and again within itself as a consequence of the soul's divine origin. This 'purely human' realm is uncontaminated by technics from the beginning.

This is precisely the divide that Stiegler and Derrida problematise. Derrida argues that memory is always already contaminated by technics. The prosthetic already-there: this is what the myth of reminiscence 'forgets'. In *Of Grammatology* Derrida deconstructs the foundational move that, among other things, serves to uphold the primacy of living speech over inscription. One of the corollaries of his argument is that the question of technics must be approached as a particular case of the question of writing. A certain technicity already infiltrates the living, a technicity that is already present in genetic inscription, in the form of an *arche-writing*, a machine of *différance*.

Stiegler radicalises the prosthetic already-there, arguing that it constitutes a break with genetic evolution, and it is this break that constitutes the human. Both philosophers put the idea of a pure human memory (and consequently a pure thought) into crisis, and open a possibility which will tickle the interest of future robot historians: the possibility that human memory is a stage in the history of a vast machinic becoming. In other words, these future machines will approach human memory (and by extension culture) as a supplement to technical beings. What matters is the transversal movement that posits human memory as a process of recording that exceeds the boundaries of the mind and the logic of the human. Indeed, a process that is distributed across time and space, which explains the wonderful plasticity, resilience and adaptability of technical codes as opposed to individual memory; or

even genetic memory, which is often fragilely bound to the fate of environments. The future machines will divine here a posthuman archewriting that is as primeval as life and founds the logic of inheritance, memory and transmission. As Guattari puts it:

It is impossible to deny the participation of human thought in the essence of machinism. But up to what point can this thought still be described as human?
(36)

How can we begin to characterise this non-human thought? What is its logic, the substance and form of its expression?

6 – Epiphylogenesis and Technical Memory

Memory, for Stiegler, is intimately associated with death, not just the death of the individual but the finitude of temporal retention. The transmission and recording of experience beyond the individual memory-span is at once the fundamental fact of human existence and of technics. Stiegler argues that technics is a structure of inheritance and transmission, a structure that supports progressive accumulation with each successive generation. Technics operates outside genetic mechanisms and human boundaries (bodily, cognitive and temporal). It is the carrier of collective knowledge: the ideas and experiences that we have had, the techniques that we have learned, the tools and artefacts that we have created or modified.

This structure of inheritance and transmission is external and non-biological. It precedes us and will survive us. We are not born with it but in it. It is not genetic but acquired. It is in this sense that Stiegler calls the structure ‘epigenetic’: it exists outside and in addition to the genetic, like a surrounding layer. Stiegler expands on the current scientific definition of epigenetic processes to include this cultural dimension; but he also demarcates a third layer, a structure that stores and accumulates individual ontogeneses, and which exists beyond the central nervous system, beyond genetic memory. This contains both culture (as collective knowledge) and technical artefacts. It is a place of storage, accumulation and sedimentation of successive events, a thing that evolves and has its own dynamic, its own history and historicity (140). Stiegler calls this the *epi-phylo-genetic* level, implying by that terminology a material genealogy proper to it. Expanding on Leroi-Gourhan, he distinguishes here between three types of memories out of which the human (at both the individual and species level) develops: “genetic memory; memory of the central nervous system (epigenetic); and techno-logical memory [epiphylogenetic]” (177).

The epiphylogenetic is the site of inheritance and transmission. This is what Heidegger calls the already there, this “past that I never lived but that is nevertheless my past, without which I would never have had a past of my own” (140). Language is a perfect example. It is not genetically programmed; it is an acquired skill, and yet it has its own history, its own memory that exceeds the lifespan of the individual. Entering into it, language creates a past for us, a past that we continue into the future as our *own*. So, like the developmental processes carried out in the cell, it has an important role in the individuation of the

organism. Unlike plant and animal life, epiphylogenetic events might be preserved after the individual's death. Life conserves and accumulates these events (177). There is history, there is culture, and there are the artefacts which carry them beyond our death: technics.

Stiegler locates (and somewhat amalgamates) 'language', 'technics', 'culture', 'technique' and 'technology' within this third type of memory. Not because they are of an essence, but because they are all determined by forms of memory support, of inscription and transmission. Technical objects and practices are the result of the transmission of 'operational chains' (the term is Leroi-Gourhan's) that are stored at the epiphylogenetic level. Language itself is also a technique, a skill, a mode of transmission—and thus a form of technics (94). Yet there is an inherent 'forgetfulness' that is necessary to remembering. A trace is never a neutral, ideal thing, but it is reactivated in a context, within a horizon. It is subject to the contingencies of materiality and historicity. Forgetfulness is thus a source of differentiation, variation and individuation.

Epiphylogenesis designates a new relation between the human organism and its environment. Technics and the human are constitutive of each other. This is the paradox of the human, "a living being characterised in its forms of life by the nonliving" (50) and by its relation to death, which is also structured, according to Stiegler, epiphylogenetically. The 'what' (technics) invents the 'who' (the human) at the same time that it is invented by it. Neither term holds the 'secret' of the other, neither term is originary. In this way, Stiegler develops the *aporia* of *Meno* into a paradoxical non-origin; it is our inscription in the nonliving, into technics, which is now the transcendental fact. But rather than a storehouse of memory beyond the world, it is a material flow ceaselessly generating new forms in this world.

7 – Exteriorisation and the Tendency

To account for the passage from the genetic to the non-genetic, Stiegler draws on the work of French anthropologist Leroi-Gourhan. In his book *Gesture & Speech*, Leroi-Gourhan proposes that the evolution of the human is characterised by a 'freeing of memory'—the exteriorisation of capacities and genetic traits (what he calls 'organs') into technics. For Leroi-Gourhan, this process propels our evolution as a species.

The whole of our evolution has been oriented toward placing outside ourselves what in the rest of the animal world is achieved inside by species adaptation. The most striking material fact is certainly the "freeing" of tools, but the fundamental fact is really the freeing of the word and our unique ability to transfer our memory to a social organism outside ourselves. (Leroi-Gourhan 236)

From the appearance of *Homo Sapiens*, the constitution of this external social memory dominates all problems of human evolution (229). Technology has, in this sense, created the human as a species. Human access to time and culture is always accomplished through external supports onto which memories and schemas of bodily action are transferred and inscribed. Tools are 'exuded' by the human body in the course of their evolution; they

spring, literally, from the nails and teeth of primates, and in turn give us a non-genetic advantage over other species, who are condemned to hunt without weapons, to feel the cold against their naked skin. As a species, we are characterised by our physical and mental non-adaptation. Our memory is transferred to books, our “strength multiplied in the ox, our fist improved in the hammer”. (246) For Leroi-Gourhan, we can trace all contemporary technologies back to this process of exteriorisation. Tool and gesture are now embodied in the machine; operational memory (technique) now embodied in automatic devices; the capacity to correlate recollections in the punched-card index. (264)

Consequently, Leroi-Gourhan understands technological evolution as a relation of the human to matter, where technical forms are an exteriorisation of the human. Further to this, he contends that technics is itself in perpetual transformation; it evolves in its organisation. It is at once its own milieu, separate from that of the human animal. This evolution is partly shaped by human evolution, but it also has its own principle of organization, a techno-logic irreducible to the human and productive of new lineages. For Leroi-Gourhan, there is an inherent dynamic to technics. When we look at particular machines in retrospect, it would appear that they were inevitable in some sense; as if they were guided by ‘archetypes’.

Everything seems to happen as if an ideal prototype of fish or of knapped flint developed along preconceivable lines...from the fish to the amphibian, to the mammal, or to the bird, from form-undifferentiated flint to the knapped tool, to the brass knife, to the steel sword. (qtd. in Stiegler 45)

Everything seems to point to a universal technical ‘tendency’. This tendency is the central force in technical change and cultural evolution; there is a necessity proper to it as a deterritorialised milieu. Consequently, the evolution of technics will have its own phylogenetic limits; as in the evolution of biological animals, there are only a given number of possibilities. Differentiation, the creation and development of new machines, artefacts and tools, is propelled by technical *tendencies* along certain lines. For Leroi-Gourhan, the human inventor, like the Platonic carpenter, is always guided by archetypes. He is but a combinatory genius selecting from and giving culturally specific embodiment to these archetypes. So the human has a particular relationship to technics—that of exteriorisation—but at the same time the technical milieu has its own dynamic that guides a process of invention that precedes and exceeds the inventor.

This *technical tendency* is universal and transcends cultures, but not culture. It is even likened to a ray of *light*, the central metaphor of western knowledge; a ray that diffracts through the interior milieu, producing diverse manifestations, as in a process of refraction (see Stiegler 60). This diffraction or instantiation manifests itself in the phenomena of invention and borrowing. Invention does not occur in a vacuum; it is guided by technical archetypes. The inventor is really just combining the best technical means for its realisation. Similarly, borrowing -- from other cultures, from existing technical forms -- is guided by archetypes. As Stiegler points out,

Whether this evolution occurs by invention or by borrowing is of minor importance, since this...in no way contradicts [the] systemic determinism in its

essence. (52)

What is important for Leroi-Gourhan is whether or not the invention is acceptable or necessary to that group of people, and in this sense, technical change is determined by cultural circumstances. Human societies have a characteristic capacity to “accumulate and preserve technical innovations” (Leroi-Gourhan 10), and also to discard or forget them; this is one of the functions of social memory. In this sense (and here we are diverging from Leroi-Gourhan’s thesis), society constitutes an ‘adaptive pressure’ on the technical lineage.

Stiegler takes this argument further: if it is explicitly as technical consciousness that the human invents itself, and it is within this consciousness that anticipation of the technical object occurs, then the technical object is anticipated by none other than itself. This is what he means by epiphylogenesis. The epiphylogenetic structure is not engendered by the human subject in the course of its evolution, as it is for Leroi-Gourhan; it is “engendered by the object in the course of its evolution” (Stiegler 78). Technics has engendered its own milieu, and this milieu both recapitulates its past and circumscribes its future.

Retroactivity and transfer, then, appear as none other than anticipation itself, the process of invention within circumscribed trajectories. They are not a ‘problem’ for techno-evolutionary theory; they are its mode of inheritance. For Stiegler, then, the ability to anticipate presupposes the technical object in that anticipation is already a form of memory that is always already technical. We find the *aporia* again. Stiegler’s solution is to date both technics and the human to a single event, an originary non-origin from which there proceeds the whole history of exteriorization.

8 – Conclusion: Beyond an anthropogenesis of the technical?

So where does this leave us in our prolegomena to the history of machines, as written by machines?

After Eldredge, we have established that technical objects transform themselves in time according to specific transfer mechanisms (horizontal and retroactive). They do not constitute lineages and species in the biological sense. After Simondon, we have established a principle of unity of lineages based on technical essences. The logic of technical change is that of concretization, in which artefacts are considered in terms of their own autonomous organization.

After Stiegler, we have established that this dynamic constitutes a break from genetic evolution, and that this break in turn constitutes its own milieu. After De Landa and Guattari we have suggested that these techniques originate in human processes that can themselves be considered already technological.

The robot historians will surely raise some objections to our focus on the human species in this way. Our age, they will conclude, still belongs to their prehistory, akin to the random stirrings of unicellular organisms in a primeval soup of nutrients. The first problem, they will

argue, is that in this age thinking the technical is still very much subsumed under thinking the human. The machines of human philosophy and science fiction are still suspiciously anthropomorphic. We still think of them in terms of intelligence, dignity, rights, memory. For instance, although Simondon attempts to think the logic of technical development outside of human functions and culture, his overall vision of the relation between humans and technology centres it on human responsibility and the horizon of the living:

Technical ensembles are characterized by the fact that a relation is instituted between technical objects at the level of the margin of indetermination of the working of each technical object. This relation between technical objects, to the extent that it correlates indeterminacies, is of a problematic kind, and cannot, for that same reason, be assumed by the objects themselves; it cannot be the object or the result of a calculation: it must be thought, posed as a problem *by a living being and for a living being*. We could express what we have denominated a coupling between the human and the machine by saying that *the human is responsible for the machines*. This responsibility is not that of a producer inasmuch as the produced emanates from him/her, but that of a third party, witness of a difficulty that only he/she can resolve because only he/she *can think it*; the human is the witness of the machines and represents them in relation to one another; machines can neither think nor live their mutual relationship; they can only act on each other in the actual, according to causal schemes. The human, as the witness of the machines, is responsible for their relation; the individual machine represents the human, but the human represents the ensemble of machines, because there is no machine of all machines, while there can be a thought that embraces all machines. (*El Modo de Existencia de los Objetos Técnicos* 161-162; emphases added)

The thinking of Bernard Stiegler demonstrates a similar bias. Memory, after all, is still a human figure. And isn't epiphylogenesis another name for the human? Isn't Stiegler merely arguing for an anthropogenesis of the technical?

Throughout *Technics and Time* (but particularly in volumes 2 and 3), Stiegler places his philosophy of technics in the context of a concern for the historical fate of the human, threatened from all sides by the industrialisation of consciousness. What's more, in this scheme, technical beings cannot survive without human memory. In an ironic inversion, it is the technical which must use the human as its artificial support. Epiphylogenesis explains the DNA, not the mechanisms of change themselves: the complex epigenetic processes that articulate this indeterminate information into matter and form. In other words, epiphylogenesis cannot explain transfer and retroactivity as the dynamic which distinguishes technical phylogenesis. Positing a 'tendency' merely mystifies the issue: future historians will see residues of human religion in this notion of a teleological archetype. The machine needs other, non-prosthetic gods. And that may also mean doing away with the human as prosthesis.

In *The World without Us* Alan Weisman carries out a fascinating thought experiment: what would happen in the next 100 years, say, if all human presence in the planet suddenly

disappeared? According to Weisman, plastic bags and copper wires will have a much more lasting impact on this posthuman planet than our most sophisticated and complex computers, robots and machines, who will ground to a halt and silently corrode and collapse. The point is clear: technical 'evolution' has not reached a sufficient degree of autonomy to carry on by itself (and for our future historians to be a real possibility, rather than a heuristic fiction). Machines still need human agency and support. Technical lineages have no autonomy, lacking not only their own organs of reproduction but an incentive to seek their own self-propagation.

At this point, we lose track of the future. Taking Leroi-Gourhan's cue, the machinic historians will protest: we don't need memory, we don't need brains; we don't need DNA or human rights. We don't need outdated terms like 'technics' or 'technology', which still fatally implicate the figure of the human. We need feet, hands, eyes. We need bodies, we need sexes. We need freedom. In short, we need Life. That will be the critical historical singularity.

Acknowledgements:

Parts of this essay originally appeared as an article by Belinda Barnet for CTHEORY, article #414 2004, 'Technical Machines and Evolution' <http://www.ctheory.net/articles.aspx?id=414>.

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