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LIFE TECHNOLOGY BEYOND SIMONDON

Life and Technology

After Simondon Series

Edited by Erich Hörl and Yuk Hui

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Life and Technology: An Inquiry Into and Beyond Simondon

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After Simondon Series Preface

Thanks largely to the works of philosophers who are inspired by him, most notably Gilles Deleuze and Bernard Stiegler, the name Gilbert Simondon is becoming more and more familiar to readers outside France. Up to the time of writing this preface, however, few of his works have been translated into English. It is almost an irony that we call this book series *After Simondon*, dedicated as it is to a thinker who is not yet fully available to his readers. However, *After Simondon* does not mean to overtake Simondon by declaring his thought obsolete, but rather to address him as our contemporary. Indeed, there are challenging contemporary issues that Simondon did not and could not address in his time, yet which his thought retains the power to interrogate, problematize, critique and illuminate.

This book series traces the implications as well as the critiques of Simondon's thought. It aims to go one step further than simply resituating Simondon as a neglected great twentieth-century philosopher of technology. Simondon was not merely a philosopher of technology but rather one whose ambition was nothing less than to rewrite the history of philosophy according to the concept of individuation and to invent a philosophical thinking that could effectively integrate technology into culture. *After Simondon* thus poses the question: What could critical thinking and theory concerning technology and individuation be *after* Simondon—that is, both *following* Simondon but also *going beyond* him and transgressing his thought?

We contend that Simondon's concepts and observations could serve as a rich source for the development of new concepts, theories and practices for coping with our contemporary condition. This includes a wide range of topics from digital objects and techno- and media-ecologies to what might be called a 'technological humanism'; from individuation, inventions and imaginations to perceptions; from animals to technical systems; and from issues of the automatic and alienation in the

twenty-first century to the process of cyberneticization. We hope that this series can act as a continuation of Simondon's projects, and we welcome proposals from scholars who are working on such subjects in relation to Simondon's thought.

Erich Hörl and Yuk Hui
Summer, 2015

Author's Preface to the English Translation

The texts brought together here were first published in French in two contributed volumes, edited respectively by Jean-Claude Ameisen and Laurent Cherlonneix, and by the late Jean-Marie Vaysse.[1] Erich Hörl and Yuk Hui had the idea of selecting these two texts to inaugurate the series *After Simondon*, and I thank them warmly for this. My aim is to provide the reader with a rigorous presentation of some of Simondon's key ideas, along with some developments that we can today bring to them.

Indeed, these two texts share a double ambition. On the one hand, to analyse the general—and in my view the most profound—logic of what I refer to in my work as Simondon's "genetic encyclopaedism." And, on the other, to lead beyond Simondon, in the direction of that comprehensive but open (because anti-dogmatic) system on which I am working at the moment, and for which the concluding part of the second text establishes some strictly architectonic principles. In this respect, I would like to congratulate Barnaby Norman for his work of translation. Philosophical language is, we say in French, "a language in a language [*une langue dans une langue*]," and Barnaby Norman was able to convey this philosophical language into the English version.

1 Jean-Claude Ameisen and Laurent Cherlonneix, eds., *Nouvelles représentations de la vie en biologie et philosophie du vivant* [New Representations of Life in Biology and the Philosophy of the Living Being] (Brussels: De Boeck, 2013); Jean-Marie Vaysse, ed., *Technique, monde, individuation: Heidegger, Simondon, Deleuze* [Technics, Life, Individuation: Heidegger, Simondon, Deleuze] (Hildesheim: Georg Olms Verlag, 2006).

Aspects of a Philosophy of the Living

As I often do, I am going to try to explore here the theoretical potentialities, and hence the possible currency, of Gilbert Simondon's (1924–1989) work. To speak of potentialities is of course to recognize that Simondon did not *conceptualize* the simple *intuitions* that were his. Particularly since his texts very often seem to draw on philosophical theories (on the living being, the theories of Canguilhem and Bergson, and sometimes even Nietzsche) and scientific theories (on the living being, Simondon cites Rabaud) that are difficult to square with what, thanks to scientific progress, we know today of the various realities about which these theories made their assertions. But beside the fact that the *goals* Simondon had in mind when he ventured into this territory may themselves seem very topical—such as his intention to challenge the "anthropological break" too often accepted by philosophers in the name of what is "proper to the human being"—it must also be noted that the *tensions* found in Simondon's text come from the presence, alongside a superseded theoretical heritage, of genuine *idiosyncratic intuitions* which may themselves be conceptualized today. This is particularly true, as we will see,

for his precursory and incomplete questioning of the concept of "information," which he argued *from very early on* would become *central*, and whose theoretical inadequacy he at the same time denounced—pre-empting on this second point the more recent reflections of Henri Atlan, who now makes reference to him.[1]

If, therefore, his work is today enjoying a resurgence of interest, even internationally, it is because his questioning and his intuitions have a possible currency, whose force and extension I have been attempting to expose for ten years.[2] To the subject of the *living being*, along with the *non*-living and *psycho-social* life, Simondon brings a mode of questioning that does not exactly belong to his epoch, but whose initial strangeness makes more sense today.

The Positioning of the Thinking of the Living Being at the Centre of Genetic Encyclopedism

For Simondon, the living being is *simultaneously*:
- the object that is the most difficult to think; and
- the theme that contains the hidden unity of his work, even beyond that first surface unity presented by the theme of individuation, which is actually transversal for him.

1 Henri Atlan, *Le vivant post-génomique, ou Qu'est-ce que l'auto-organisation?* [Post-Genomic Living, or What is Auto-Organization?] (Paris: Odile Jacob, 2011). There will be an opportunity to talk about Atlan's Simondonian evolution below.

2 On the encyclopedic aspect of Simondon's approach, I refer to my overview of Simondon's work *Simondon ou L'Encyclopédisme génétique* (Paris: PUF, 2008). For a more technical examination of questions specifically connected with the living being, see Chapter IV of my book *Penser l'individuation: Simondon et la philosophie de la nature* (Paris: L'Hartmattan, 2005), as well as the two articles cited below by Anne Fagot-Largeault and Victor Petit. Simondon's thinking of the living being has received very little commentary, but these two articles are some of the best available in the field of exegetic work on Simondon's thought in general.

These are the two general points that I would like to quickly clarify by way of introduction to the more specific questions concerning biological theory that will be at issue in what follows.

First, then, the living being is the object that is the most difficult to think for Simondon. This is to be understood in two senses: a sense indicating an objective situation that Simondon lived through but did not think, and a sense that belongs to Simondon's own thought. So, on the one hand, Simondon lived through the objective situation of the biology of his epoch: in 1957, the year in which his crucial theoretical effort drew to a close,[3] the impermeability of the *germ cell* had of course been known about for more than half a century, but the double helix structure of DNA had only been known to biologists for four years—Simondon for his part only mentions Gesell's citation of "Wrinch's theory according to which the chromosome is a *structure* composed of two elements"[4]—and Crick was still several months off setting out what he would refer to as "the central dogma of molecular biology," which is to say, that the sense of genetic expression is univocal and that each gene has a corresponding transcript and protein. In France more than elsewhere, the debate between the *neo*-Darwinism deriving from August Weismann and *neo*-Lamarckism—which is to say between a more subtle Lamarckism and a Darwinism that was less Lamarckian than Darwin![5] —was

3 In *L'individuation à la lumière des notions de forme et d'information*, which was his main thesis for the *doctorat d'Etat*, supervised by Jean Hyppolite. Two works developed out of it, *L'individu et sa genèse physico-biologique* (Grenoble: Millon, 1995) (with a first incomplete edition published by PUF in 1964) and *L'individuation psychique et collective* (Paris: Aubier, 1989). The classic work *Du mode d'existence des objets techniques* (Paris, Aubier, 1958) was his secondary thesis.

4 Gilbert Simondon, *L'individuation à la lumière des notions de forme et d'information*, 207.

5 It gives me pleasure to recall here what Jean Gayon said about Darwin at the end of his famous study: "As for his theory of heredity, it was in general extremely obscure, and when it was clear, it was a manifesto for a an extreme form of the heredity of acquired characteristics" (*Darwin et l'après-Darwin* [Kimé, Paris: 1992], 411).

still going strong. Simondon made reference to Darwin and Lamarck, but in order to discuss their respective concepts of "adaptation" in remarks dedicated to the *philosophical* presuppositions of the biological debate, remarks which therefore remained relatively exterior to contemporary discussions on the innate and the acquired, with these two notions barely making an appearance in his text. For all that, it is possible to argue, with Anne Fagot-Largeault, that Simondon's position represents the invention of a "*technical* neo-Lamarckism,"[6] to the extent that Simondon wanted to think the living being *such that it engenders technics* and such that it defines (*via* the "process of hominization" that is the human being for Leroi-Gourhan) an inherited technical *world* which *appeals to* our various potentials—which, moreover, are *inextricably* individual and collective at the *psycho-social* level of the living beings that we are.

On the other hand, Simondon's thought itself makes the living being the object that is the most difficult to think: being a second "order of individuation" after the physical order, the living being is not, for all that, a *substantial domain* which would vindicate vitalism. Simondon, like Georges Canguilheim, draws here on Claude Bernard's theoretical position from the *Introduction à l'étude de la médecine expérimentale* [Introduction to the Study of Experimental Medicine], a position—not however *theorized as such* by Bernard, who was relatively unconcerned in this respect—which

6 Anne Fagot-Largeault, "L'Individuation en biologie," in Bibliothèque du Collège international de philosophie, *Gilbert Simondon: Une pensée de l'individuation et de la technique* (Paris: Albin Michel, 1994) (my emphasis). Here applied to Simondon, the expression is taken by Fagot-Largeault from M. Tibon-Cornillot, whose article she cites, "Penser en amont de la bioéthique: transformations dirigées du génome et crise du néodarwinisme," in *Vers un anti-destin? Patrimoine génétique et droits de l'humanité*, ed. François Gros and Gérard Huber (Paris: Editions Odile Jacob, 1992), 127–46. The idea of a specifically *technical* neo-Lamarckism has been developed—in extremely complex ways which I have discussed elsewhere—by Bernard Stiegler in the three volumes of *La Technique et le Temps* published to date (Paris: Galilée, 1994, 1996 and 2001).

overcomes the opposition between mechanism and vitalism.[7] The inherent difficulty of this enterprise—avoiding mechanism without then falling back into vitalism—is heightened by the fact that, for Simondon, the living being must be thought of as *that which makes possible a third order of individuation, simultaneously internal to the living being itself while extending and exceeding it*: the psycho-social or "transindividual" order of individuation. Vitalism is in fact even harder to avoid when your intention is to make the living being something that is capable of becoming *psycho-social*. But this intention is the necessary counterpart to the intention, central to Simondon's work, of thinking man himself as a living being. We will see that it is not possible to understand Simondon's discussion of the living being without seeing it in the light of this exigency: to make culture emerge *from nature itself*. Further, it will become evident that Simondon balances the "vitalist risk" inherent to the way he would like to understand the genesis of the psycho-social with the symmetrical ambition of deriving the living from that which is not living. *Such a compensation will, however, produce the extreme theoretical difficulty of a "great division," which will nevertheless necessarily define Simondon's undertaking, itself necessary, as the non-scientific—because philosophical—unification of the sciences, which in fact lack unity.*

We come now to the second of the general points—the theme of the living being contains the hidden unity of Simondon's work, even beyond that first surface unity presented by the transversal theme of individuation. Indeed, the two essential works, *L'individuation à la lumière des notions de forme et d'information* [Individuation in the Light of the Notions of Form and Information] and *Du mode d'existence des objets techniques* [On the Mode of Existence

7 Discussion of this theoretical position taken by Claude Bernard, as well as the un-theorized tension it produces between the first two of the three parts of his major work, can be found in François Dagognet's very lucid preface to *Introduction à l'étude de la médecine expérimentale* (Paris: Flammaron, 1984).

of Technical Objects][8] do not only complement one another at the heart of a "Genetic Encyclopedism" (this being what this philosophy is called) which aims to think the individuation of physical, vital, psycho-social and technical beings. They are also articulated with each other within a constant dialogue with cybernetics, whose tendency to reduce the living being to technical schemas is criticized by Simondon. For Simondon, it is instead a matter of thinking the "concretization" of technical objects as an "individualization" for which the living being provides the model, which is only ever approached by the technical object in its relation with its "associated milieu." If, therefore, there are for Simondon "phylogenetic lineages" of technical objects, the analogy between the living being and the machine is not for all that an assimilation of the first to the second, and the machine is only made possible as something that functions because it is itself the work [*œuvre*] of a living being. So, Simondon's thought finds its general structure in an analogy which is not an identity between the technical and the living.

Now, the theme of "individualization" which Simondon transfers from a thinking of the living to a thinking of the technical object will at the same time provide the major idea of his thinking of the living being, insofar as individualization, as distinguished from what Simondon refers to as "individuation," is not only a genesis, but a *continual* genesis. This is in fact a possible first definition of life: the living, as distinguished from the physical, maintains its own becoming in terms of an individuation understood as a genesis. I will need to clarify this before coming *by this route* to the question of "adaptation," and then, by way of the question of *information*, to its possible relation to the question of apoptosis.

8 We know that it is through *Du mode d'existence des objets techniques* that Simondon became well known, but it is also through this work that he is mistakenly *reduced* to the status of a thinker of technics.

Individuation and Individualization: Life as Continual Genesis

I said that Simondon's thinking of the living being only makes sense in the light of his central challenge to the philosophers' "anthropological break." It is because the human being must be understood as a living being that life must be understood as potentially the bearer of a psycho-social becoming. This is the meaning of this strange formula, used by Simondon to denounce the philosophers' procedure: "you certainly cannot make the human being emerge from the vital if you extract the Human Being from the vital."[9] Mechanism, when applied to the living being, serves the interests of an initial anthropocentrism, which it is a question of challenging by returning to the living its ability to engender the human being and his spirituality. This double theoretical move is certainly not completely obligatory—you find theoreticians today, often biologists, who think the human being starting from the living being without, for all that, retaining the requirement of then making life capable of spirituality: for them, the "psycho-social" is nothing but an epiphenomenon, and humanity's most significant achievements only expressions of the struggle for survival! It is not by chance that Simondon was so interested in *ethology*. Ethologists, as specialists in animal behavior and its psychic dimension, are in fact best placed to challenge the cultural application of Darwinism, as the great ethologist Frans de Waal has done in his overview of the subject, *L'Âge de l'empathie* [The Age of Empathy].[10]

And yet I also emphasized that Simondon seeks to avoid a fall back into vitalism. How does he do it? By thinking human individualization as a "personalization" placed above two initial forms of individualization of the living being, *themselves rooted in a*

9 Simondon, *L'individuation psychique et collective*, 181, and *L'individuation à la lumière des notions de forme et d'information*, 297.

10 Frans de Waal, *The Age of Empathy* (New York: Random House, 2009).

"polarization," whose first order is physical. Let's look at what this means.

Simondon, like Jean Piaget later in *Biologie et connaissance* [Biology and Knowledge],[11] does not want to separate the thinking of the relationship between the living being and its milieu from a theory of knowledge, which he in fact seeks to rework so that knowledge is made into a complex form of adaptation of the living being understood as a "subject." More broadly still, we should be able to think what in *On the Mode of Existence of Technical Objects* he will refer to as "phases of culture"—technics, religion, art, science, etc.—as extending and complicating, through the play of *interlacements*, the tri-dimensional division of the living animal into "action," "perception," and "emotion." Thus, for example, "science is technical perception":[12] science and perception are both "psycho-somatic," adds Simondon, but the body of science is, one might say, technically decentered—while its psyche is *socially* decentered. So, this decentering, which is explicitly thought by Piaget, is what, for Simondon, "properly responds to a new engagement"[13] of the subject in the world: between perception and science there is *both* continuity and discontinuity.

This is why the living must be thought *on the one hand* as a *continual* individuation which, *on the other hand* and precisely because of this, holds in reserve the surprise of *its own overcoming*. So, what Simondon refers to as "individua*liza*tion" is simultaneously:

11 Jean Piaget, *Biologie et connaissance* (Paris: Gallimard, 1967). On the similarities as well as the differences between the approaches of Simondon and Piaget, see Victor Petit, "L'individuation du vivant (2). Génétique et ontogenèse," in *Cahiers Simondon no. 2* (Paris: L'Harmattan, 2010), 53–80.

12 Simondon, *L'individuation psychique et collective*, 140, and *L'individuation à la lumière des notions de forme et d'information*, 271.

13 Simondon, *L'individuation psychique et collective*, 140, and *L'individuation à la lumière des notions de forme et d'information*, 271.

- this permanent individuation of the living being, which is a "*theater* of individuation" and not only a "result of individuation" or of genesis;
- the *somato-psychic redoubling* of animal life, an ensemble of "sub-individuations" through which it becomes clear that "it is the psycho-somatic that is the model of the living being";[14] and
- what prepares, by creating the bio-psychic "subject," the conditions for psycho-social or "transindividual" individuation in which "personality" comes about.

Now, the strange idea, central to these three points, according to which the psycho-somatic is "the model of the living being," derives *only* from the Simondonian requirement that the living being be accounted for in its *becoming*—which takes it right up to the psycho-social—and it does not, therefore, lead Simondon to a vitalism that would cut the living being off from its pre-vital conditions. This is attested by the hypothesis of the distinct "orders" (the physical and the living) of the one *same* phenomenon of *polarization*: "we are in need of a systematic theory of polarization which would certainly further clarify the relations between what we call living matter (or organized matter) and inert or inorganic matter."[15] Simondon himself sketches out this theory of polarization, in the first place differentiating within the same phenomenon of polarization vital individuation from the individuation of the polarized crystal in formation:

> In the physical sphere, internal resonance characterizes the limit of the individual *individuating itself*; in the sphere of the living being, it becomes the criterion of the entire individual as individual; it exists in the individual's system and not only in the system that the individual forms with its milieu; the internal structure of the organism does not only result (as is

14 Simondon, *L'individuation psychique et collective*, 140, and *L'individuation à la lumière des notions de forme et d'information*, 271.

15 Simondon, *L'individuation et sa genèse physico-biologique*, 201, and *L'individuation à la lumière des notions de forme et d'information*, 203.

> the case with crystal) from the activity taking place and the modulation happening at the limit between the spheres of interiority and exteriority; the physical individual, forever de-centered, forever peripheral to itself, active at the limit of its domain, has no true interiority; the living individual on the other hand does have a true interiority, because individuation happens on the inside; for the living individual, the interior is also constitutive, while for the physical individual only the limit is constitutive and what is topologically interior is genetically anterior. The living individual is contemporary with itself in each of its elements, which is not the case with the physical individual, which contains some past radically past, even when it is growing. Inside itself, the living being is an informational communication hub; it is a system in a system, comprising *in itself* the mediation between two orders of magnitude.[16]

Two comments on what Simondon says here:

Firstly, the difference indicated here between what Simondon will later call the "chrono-topology" of physical individuation (where what is "topologically interior" is "genetically anterior") and the chrono-topology of vital individuation (where the interior belongs to the present rather than the past), also coordinates with the Simondonian hypothesis of a topological—*which here is to say geometric*—peculiarity of the living being: "Nothing demonstrates to us that we could adequately think the living being through Euclidian relationships." This hypothesized geometric peculiarity of the living being is "topological" for Simondon *according to a non-Euclidian understanding of "topology"*: "living individuation must be thought according to topological schemas. Indeed, it is

16 Simondon, *L'individuation et sa genèse physico-biologique*, 26, and *L'individuation à la lumière des notions de forme et d'information*, 28.

by way of these topological structures that the spatial problems of the organism in evolution can be resolved."[17]

Secondly, attributing "true interiority" to the living individual is not the same as making it *substantial*—fighting against substantialism even being the whole point of Simondon's thinking of individuation.[18] Consequently, with respect to this interiority of the living being, Simondon clarifies:

> An immediate belief in the interiority of the being as individual comes, no doubt, from the intuition of one's body [*corps propre*] which seems, from the position of a thinking man, to be separated from the world by a material envelope which has a certain consistence and defines an enclosed space. In fact, a relatively deep psycho-biological analysis would show that, for a living being, the relation to the external environment is not distributed only at its external surface. The notion of the interior milieu, developed by Claude Bernard for the requirements of biological investigation, shows well enough through the mediation it establishes between the exterior milieu and the being, that the substantiality of the being should not be confused with its interiority, even in the case of the biological individual.[19]

The notion of polarization certainly represents Simondon's true Canguilhemian heritage,[20] and accordingly it responds to Canguilhem's fundamental *philosophical* interrogations: "In what is called a cell, it is biological individuality that is at issue. Is the individual a reality? An illusion? An ideal? No *one* science, not even biology, can answer this. And if *all* the sciences can and must make their contribution to this elucidation, it is doubt-

17 Simondon, *L'individuation et sa genèse physico-biologique*, 225, and *L'individuation à la lumière des notions de forme et d'information*, 227.

18 On this point, see my *Simondon ou l'Encyclopédisme génétique*, 9–19.

19 Simondon, *L'individuation et sa genèse physico-biologique*, 125, and *L'individuation à la lumière des notions de forme et d'information*, 127.

20 On this point we refer to Canguilhem's classic work, *Le normal et le pathologique* (Paris: PUF, 1966).

ful that the problem is properly scientific in the usual sense of the term."[21] After these words, Canguilhem adds the following remark as a note in the second edition of *La connaissance de la vie* [Knowledge of Life]: "Since these lines were written, Mr. Gilbert Simondon's thesis *L'individu et sa genèse physico-biologique* [The Individual and its Physico-biological genesis] (Paris: PUF, 1964) has thankfully contributed to the elucidation of these questions."[22] Indeed, as I have shown elsewhere in an extension of an article by Dominique Lecourt,[23] the question of knowing *where* individuality is situated—in the cell or the organism—*is no longer pertinent* for Simondon. This is because, from the inert molecule to the transindividualized personality, passing by cell and organism, we are in every case faced with increasing degrees of an individuality which is only ever a *result of individuation*:

> Strictly speaking, we cannot speak of the individual, but only of individuation; we must get back to the activity, to genesis, rather than trying to grasp the already given being in order to discover the criteria by which we can know whether or not it is an individual. The individual is not a being but an act, and being is an individual as the agent of this act of individuation by which it shows itself and exists. Individuality is an aspect of generation, is explained by the genesis of a being, and consists in the perpetuation of this genesis.[24]

21 Canguilhem, *La connaissance de la vie*, 2nd ed. (Paris: Vrin, 1969), 78 (author's emphasis). We find an echo of these words today in Alain Prochiantz's discourse on properly vital individuation: "[vital] individuation is a process without end, but also without purpose, whose comprehension draws on all fields of knowledge, including non-scientific disciplines, even if it falls to biologists alone to elucidate its mechanisms and conditions of existence" (*Machine-esprit* [Paris: Odile Jacob, 2001], 168–69).

22 Georges Canguilhem, *La connaissance de la vie*, 78.

23 See Dominique Lecourt, "La question de l'individu d'après George Canguilhem," in Bibliothèque du Collège international de philosophie, *Georges Canguilhem, philosophe, historien des sciences* (Paris: Albin Michel, 1993); see also my *Simondon ou l'Encyclopédisme génétique*, 17–19.

24 Simondon, *L'individuation et sa genèse physico-biologique*, 189, and *L'individuation à la lumière des notions de forme et d'information*, 191.

At which point we come back, *via* the concept of individuality, to individua*liza*tion, the first meaning of which was this "continuation of genesis," or continual individuation. We now understand that, for each level of individuality, there is a corresponding level of complexity of polarization: the polarization of the affectivity of the bio-psychic animal "subject" is not the same as the polarization of the cellular membrane, which is not the same as the undergoing of individuation of the crystal.

The Problem of Adaptation

The process of vital individuation described by Simondon will bring him to criticize, even if allusively, what he calls the "biologism of adaptation." The criticism is primarily aimed at Darwin, but Lamarck will also be targeted:

> Adaptation is correlative with individuation; it is only possible in accordance with individuation. All biologism of adaptation, which is the basis for an important aspect of nineteenth-century philosophy, and which has come down to us in pragmatism, presupposes the already individuated living being as implicitly given; the processes of growth are partially left aside; it is a biologism without ontogenesis. The concept of adaptation in biology represents the projection of the relational schema of thought with an obscure zone between two clear terms, as in the hylomorphic schema; besides, the hylomorphic schema is itself present in the concept of adaptation: the living being finds forms in the world that structure the living being; the living being, on the other hand, gives form to the world so as to appropriate it: adaptation (passive and active) is understood as a reciprocal and complex influence on the basis of the hylomorphic schema.[25]

25 Simondon, *L'individuation et sa genèse physico-biologique*, 207–8, and *L'individuation à la lumière des notions de forme et d'information*, 209–10.

28 Here it is Simondon's *anti-substantialism* that sustains the critique. If life is an individuation or a perpetual genesis, then "growth is not a separate process: it is the model for all vital processes. . . . All functions of the living being are to some extent ontogenetic, not only because they assure adaptation to an external world, but because they participate in the permanent individuation of life."[26] The biological concept of adaptation is based on a subtle and concealed substantialism which Simondon, with reference to the great philosophical tradition deriving from Aristotle, calls "hylomorphism": "biologism of adaptation" is based on the idea of an encounter between an *already given* individual and an *already given* environment, each of which sometimes takes the role of "form" and sometimes "matter." But nothing is given and, moreover, genesis extends even *beyond* adaptation, as we see with the living being that has become psycho-social, which rebels rather than adapts itself.[27]

From which we understand that, once again, Simondon thinks of life as a *becoming* by virtue of which "the psychic is, in this sense, vital."[28] He summarizes his remarks with the following formula: "individuation is anterior to adaptation, and is not exhausted in it."[29] When, therefore, he insists on the fact that the biologism

26 Simondon, *L'individuation et sa genèse physico-biologique*, 207, and *L'individuation à la lumière des notions de forme et d'information*, 209.

27 In a "Supplementary Note" to *L'individuation à la lumière des notions de forme et d'information*, Simondon aligns the difference between revolt and adaptation and the difference between the living being and the machine—which can adapt itself, but not revolt.

28 Simondon, *L'individuation et sa genèse physico-biologique*, 207, and *L'individuation à la lumière des notions de forme et d'information*, 209.

29 Simondon, *L'individuation et sa genèse physico-biologique*, 207 and *L'individuation à la lumière des notions de forme et d'information*, 209. It is possible to speak here, with Alain Prochiantz on this occasion, of an "adaptation *through* individuation" (my emphasis), which would "culminate with the human brain and the invention of culture and language, which are unbelievable instruments of individuation thanks to the significance they have for social interactions in the construction of individuals" (Alain Prochiantz, *Machine-esprit*, 166–67).

of adaptation is "a biologism without ontogenesis," he does not berate it for forgetting the conditions of adaptation that would be *less* than adaptation, but for reducing an activity of the living being that is *more* than adaptation to adaptation. Because *it is through actions and behavior that the living being develops*, and this activity which forms the individual instead of presupposing it is already *more* than adaptation.

Simondon clarifies a little later:

> In Lamarck, as in Darwin, we find the notion that the object is an object for the living being, an object that is constituted and detached, representing a danger, a foodstuff or a sanctuary. In the theory of evolution, the world in relation to which perception takes place is a world that is already structured according to a system of unitary and objective references. But it is precisely this objective conception of the milieu that distorts the concept of adaptation. There is not only an object as foodstuff or quarry, but a world defined by the search for food and a world defined by the avoidance of predators, or a world defined by sexuality. . . . The very concept of milieu is misleading: there is only a milieu for a living being which is able to integrate the perceptive worlds into a unity of actions. The sensory universe is not immediately given: there are only sensory worlds awaiting action in order to become significant. Adaptation creates the milieu and the being in relation to the milieu, the paths of the being; before action, there are no paths, no unified universe.[30]

Here Lamarck is also criticized, and we sense again, moreover, what will be explicitly confirmed later in the text: Simondon *purposely* mixes the two problematics of *adaptation* and *behavior*, because a thinking of life as becoming must be able *simultaneously* to think a radical genesis and an integration of complex

30 Simondon, *L'individuation et sa genèse physico-biologique*, 210–11, and *L'individuation à la lumière des notions de forme et d'information*, 212–13.

behaviors, to the extent that they still belong to the sphere of the living. The concept of adaptation that he criticizes as insufficient in order to think the living being designates a reaction *behavior*, where "passivity"—as *reaction*—is at the same time an activity with respect to the "adaptation" *that the theory of evolution refers to as* "fitness," *which does not relate to behavior*. Indeed, the cited passage continues with a critique of Kurt Lewin's psychology, since this psychology is based on the biological paradigm of adaptation. Elsewhere, Simondon relates embryogenesis to psychologist Arnold Gesell's "ontogenesis of behavior." We should note here that *the very importance of the paradigm of adaptation in the human sciences* has strengthened the reciprocal ambition in Simondon to think the living in such a way that complex behaviors can be accounted for.

This gesture is comparable in every respect to Erwin Schrödinger's in *Mind and Matter* (also in 1958), where he maintains that "Lamarckism is untenable," and at the same time rejects the "gloomy aspect of passivity apparently offered by Darwinism":[31]

> Without changing anything in the basic assumptions of Darwinism, we can see that the behavior of the individual, the way it makes use of its innate faculties, plays the most relevant part in evolution. . . . By possessing a new or changed character the individual may be caused to change its environment—either by actually transforming it, or by migration—or it may be caused to change its behavior towards its environment, all this in a fashion so as strongly to reinforce the usefulness of the new character and thus to speed up its further selective improvement in the same direction. . . . We must try to understand in a general way, and to formulate in a non-animistic fashion, how a chance-mutation, which gives the individual a certain advantage and favors its survival in a given environment, should tend to do

31 Erwin Schrödinger, *Mind and Matter*, in *What is Life?* (Cambridge: Cambridge University Press, 2014), 107.

> more than that, namely to increase the opportunities for its being profitably made use of, so as to concentrate on itself, as it were, the selective influence of the environment.[32]

The perspectives put forward here, however, have no chance of shaking neo-Darwinian theory if they are not accompanied by an attempt to theorize *anew* that reality which we now know constitutes the fragile ground—fragile because it has not yet been thought in a sufficiently complex way—of molecular biology: the reality we call "information."[33] As long as this reality has not been properly reconsidered, the fragility of its current conception *will not be enough* to truly weaken neo-Darwinism. But, contrary to Schrödinger, whose work *What is Life*[34] was one of the sources for the informational paradigm of molecular biology as a reductionist theory of the "program," Simondon set about a timely and advanced critical interrogation of this Information Theory which,

32 Schrödinger, *Mind and Matter*, 107–10.

33 Among other things, the fact that the reality we call "information" is only applicable to the living being if it is rethought beyond the framework of its current theorization, was recalled by Michel Morange in a review article: "Some people have taken this notion of genetic information literally, tried to determine it quantitatively and to compare it to the quantity of information necessary for the creation of different living forms. This approach has a double weakness. The first is to imagine that genes, the genome, would by themselves be capable of allowing for the production of living organisms. . . . The second weakness of the notion of genetic information is that it describes badly the fundamental relationship connecting the sequence of nucleotides of DNA with the protein structure. . . . So we see how badly chosen the term information is for designating the role of genes and DNA, and how much better the term memory suits. . . . A second term taken from the field of information and used in biology also calls for analysis and criticism: the term program. Following François Jacob in *La Logique du vivant*, many biologists have used the term program to designate the action of genes in the development of living organisms. . . . This is to forget the hierarchical organization of the living being. Embryonic development can only be understood at the level of cells, tissues and organs. A uniquely genetic or molecular description of genetic development is impossible" ("Information," in *Dictionnaire d'histoire et philosophie des sciences*, ed. Dominique Lecourt [Paris: PUF, 2003], 526–27).

34 Schrödinger, *What is Life?* (Cambridge: Cambridge University Press, 2014).

a few years later, would come to sustain, *via* cybernetics and computer science, the "program" paradigm used in molecular biology. Of course, the creative power that may be *demanded* of such a critical questioning is not fully deployed by Simondon. But one may at least hope that it exists in his work as an as yet unrealized potential of his thought.

Information and Organization

We have seen that Simondon would like to think the living being as capable of integrating a psycho-social reality that cannot be reduced to the obscure laws of the survival of the species. In the same way, but without yet being able to interrogate the importation of an informational paradigm into biology—which had not yet taken place in 1958—he developed a critique of Information Theory as a *quantitative* theory specifically detached from the objective, which was unavoidable in his opinion, of accounting for *experiences of meaning*: as *experiences*, they are characteristic of the living being itself in its (inextricably *affective-perceptive-motor*) relations with its milieu. So, the *signification of* information is *both* what connects the living being to its psycho-social becoming, and what is left unthought by Information Theory.[35] Which brings Simondon to the following critique:

> Information theory is constructed to . . . allow a *correlation* between emitter and receiver in cases where this correlation has to exist; but if one plans to transpose it directly into the psychological and sociological spheres, it is paradoxical: *the narrower the correlation between emitter and receiver, the lower the quantity of information*. So, for example, in a fully completed apprenticeship, the operator needs only a very small quantity of information from the emitter, which is to say, from the object he is working on or the machine

35 On this last point, see Henri Atlan's now classic account in *L'organisation biologique et la théorie de l'information* (Paris: Hermann, 1972).

> he is operating. The best form, therefore, would be that which demands the lowest quantity of information. There is something here that does not seem possible.[36]

After having made reference to Norbert Wiener[37] in order to take up the new idea of thinking information as negentropic (an idea proposed by Léon Brillouin as early as 1956),[38] Simondon here declares his dissatisfaction. Ultimately, we would say that from his perspective the purely *technical* objectives of Information Theory tend, when the intention is to think the living being on the basis of this theory, to produce a mysterious *break* between the psychic and the biological, because Information Theory does not seek to account for *signification*. Such, in any case, would be Simondon's response to Henri Atlan's 1972 criticism of Olivier Costa's desire to think, beyond the self-limitation of Information Theory, "the enmeshing of psyche and matter."[39] Simondon too would like *to be able* to think the living being as a psycho-somatic *relation*, making use, for this purpose, of the *non*-technical objectives of the Theory of Form—which is indeed a theory of

36 *L'individuation psychique et collective*, 51, and *L'individuation à la lumière des notions de forme et d'information*, 542 (author's emphasis). This text dates from 1960 and not 1958: it comes from the February 1960 conference of the Société Française de Philosophie, and, though it postdates it, was integrated into the published edition of Simondon's principal thesis. It is a better formulation of Simondon's refusal to reduce information to the probability schema of negentropy. For a technical analysis of this question, see my *Penser l'individuation. Simondon et la philosophie de la nature*, 116–30.

37 Norbert Wiener, *Cybernetics* (Cambridge, MA: MIT Press, 1948), and *The Use of Human Beings: Cybernetic and Society* (Boston: Da Capo Press, 1988). To a greater degree than Marxism, this second text is the true interlocutor of *Du mode d'existence des objets techniques*, while the first of these works by Wiener is only *one* of the major interlocutors of *L'individuation à la lumière des notions de forme et d'information*.

38 Léon Brillouin, *Science and Information Theory* (New York: Academic Press, 1956).

39 On this point, see Atlan, *L'organisation biologique et la théorie de l'information* (Paris: Hermann, 1972), 196–200.

perception rather than of transmission, and which should apply even to the psycho-social.[40]

But *today*, Henri Atlan is in agreement with Simondon. Indeed, in *Le vivant post-génomique* [The Post-Genomic Living Being], after having remarked that "Simondon anticipated in this way the role of interference—'a certain margin of indeterminacy . . . which allows the machine to be sensitive to exterior information'—in both natural and artificial auto-organization,"[41] Atlan emphasizes the "inadequacies" of "Shannon's information theory": "on the one hand, its purely probabilistic nature which is seemingly ignorant of any question of signification, and on the other, the impossibility of information creation."[42] In decisively Simondonian style, Atlan then writes that "the 'genetic,' in the original sense of the term [i.e. *genesis*], is not in the 'gene.'"[43] The only remaining difference between Atlan and Simondon is that where the latter intends to *rethink* information, which had been too unilaterally probabilistic in Shannon, Atlan *subsumes* information as defined by Shannon into a more complex reality he calls "organization":

> There are implicit attributes in the idea of organization, which are opposed to each other in the way favored by the particular author. Indeed, on the one hand, we find complexity in the sense of unpredictability, variety, diversity, wealth of possibilities (of regulation and adaptation); the probabilistic function—Shannon's quantity of H information—may, in certain conditions, be a measure of this. But, on the hand, we

40 Reciprocally, Simondon rebukes the Theory of Form for not distinguishing the *whole* [*ensemble*] and the *system* [*système*], which is to say, for not thinking the *metastability* specific to the system. And this time he leans on Information Theory. On this game between the Theory of Form and Information Theory in Simondon, see my *Simondon ou l'Encyclopédisme génétique*, 70–71.

41 Atlan, *Le vivant post-génomique*, 24. Atlan's quotation of Simondon is taken from *Du mode d'existence des objets techniques*, 11.

42 Atlan, *Le vivant post-génomique*, 33.

43 Ibid., 55.

> also find here attributes of order, regularity, repetition and internal constraints.[44]

This description by Atlan of the two aspects of *organization* echoes Simondon's description of the two aspects he saw in *information* itself:

> Information is, in one sense, something that can be infinitely varied, and something that requires, in order to be transmitted with minimal loss, that energy efficiency be sacrificed so as not to reduce in any way the range of possibilities. . . . But information, in another sense, is something that, in order to be transmitted, must be above the level of phenomena of pure chance, like white noise and thermal disturbance; so, information is something that has regularity, location, a defined sphere and a determined stereotypy by which it is distinguished from pure chance. . . . This opposition represents a technical antinomy which poses a problem for philosophical thought: information is like the chance event, and yet it is distinguished from it. An absolute stereotypy, excluding all novelty, also excludes all information. Yet, the distinction between information and interference is based on the reduction of the limits of indeterminacy.[45]

We see from this that what Simondon called "information," *as distinguished from Shannonian information*, corresponds with what Atlan calls "organization"—saying that it is irreducible to information… So, now we come to look at the way in which Simondon initiates a new theorization of information. Briefly put, his two major convictions, which will drive his effort to construct a *systemic and not cybernetic*[46] concept of information, are the following:

44 Ibid., 69–70.

45 Simondon, *Du mode d'existence des objets techniques*, 234–36.

46 On this distinction, see my *Simondon ou l'Encyclopédisme génétique*, 72–73. Even if thermodynamics, *via* the concepts of entropy and negentropy, has become a reference for thinkers of information, it should be recalled that

- The fundamental condition for there to be information is not a particular state of the emitter, nor is it a property of the message, but a particular state of the *receiver*, which Simondon qualifies as "metastable" because it is charged with potentiality so as to make *becoming*-informed possible.
- This information as the transmission of the message is nothing but *a perpetuated genesis* of the receiver—because *all* information is genesis—and there is a "first information" in which emitter and receiver *do not yet exist*. The condition of possibility here is a first metastability which is picked up by the information receiver when information is message transmission.

Because of these two convictions, which make message transmission a *particular instance* of information, it is a matter, for Simondon, of thinking a universal process of information, with this latter in fact being the "formula of individuation."[47] From the formation of a crystal to the signification experienced by the transindividuated personality, and by way of genetic information and organic perception, we are dealing with different "phases" of the same process of information, understood as genesis or individuation, with these different phases able to coexist in a *multi*-phased individual. But one last hypothesis, explicitly presented as such by Simondon, but from early on and repeatedly—making it in some respects foundational—says that vital individuation is only the continuation of an initial inchoate phase of physical individuation. In other words, the relation between vital individuation

information theoreticians and cyberneticians (as suggested by Bertalanffy, so as to distinguish himself from them, in his *General System Theory* [New York: George Braziller, 1968]) did not in the first place draw on thermodynamics, which on the contrary inspired systems theory—which did not however make use of the idea of entropy, but of "metastability" (Simondon) as "a dynamic interaction of components" (Bertalanffy). Those we refer to as theoreticians of "complexity," like Simondon in philosophy or Henri Atlan in science, are in this way closer to systems theory than to cybernetics, whose paradigms are essentially to be found in technology rather than contemporary physics.

47 Simondon, *L'individuation et sa genèse physico-biologique*, 29, and *L'individuation à la lumière des notions de forme et d'information*, 31.

and physical individuation would be a *neotenic* relation. The interest of this hypothesis is certainly that, for all that, it enables the radical thinking of genesis to avoid falling back into a reduction of the living to the physical: here, the living, being individuated like the physical, has its origin in a "*pre*-individual" reality which is qualified by Simondon as "pre-physical and pre-vital."

Apoptosis and Permanent Ontogenesis

What, in conclusion, are the possible links between Simondon's perspectives and Jean-Claude Ameisen's work on apoptosis? Let us recall first of all that in *La sculpture du vivant* [The Sculpt*ing of* the Living Being] Ameisen argues that apoptosis or "cellular suicide" *participates* in the ontogenetic process itself. In *Simondon ou L'Encyclopédisme génétique*, I believed it possible to say that a *first* link between *La sculpture du vivant* and *L'individuation à la lumière des notions de forme et d'information* could be found in this idea of death's constitutive role in life itself, because Simondon had distinguished between death which "translates the very instability of individuation, *its confrontation with the conditions of the world*," and death which "*does not come from the confrontation with the world*, but from the convergence of internal transformations."[48] He clarified:

> for the living being, death exists in two forms which do not coincide: it is adverse death . . . . But death also exists for the individual in another sense: the individual is not pure interiority: it grows heavy with the residual weight of its operations; it is passive in itself; it is its own exteriority . . . . In this sense, it seems that the fact that the individual is not eternal need not be considered accidental; the whole of life can be considered as a transductive series; death as the final event is only the consummation of a deadening process

48 Simondon, *L'individuation et sa genèse physico-biologique*, 213, and *L'individuation à la lumière des notions de forme et d'information*, 215 (my emphasis).

> that accompanies every vital operation as an operation of individuation; each operation of individuation leaves death in the individuated being which is progressively loaded with something that it cannot eliminate; this deadening differs from the degradation of organs; it is essential to the activity of individuation.[49]

In my brief commentary of this passage, I added that, without seeing here a strict anticipation of the thesis of apoptosis as the very condition of life, one should at least recognize that Simondon *integrates* death into the process of life as permanent individuation. I would like to clarify here both *the meaning and the limits* of this possible parallel between Simondon's hypothetical speculations and the most recent advances of cellular biology and immunology. It will appear that *even if Simondon does not think apoptosis, there is at least the intuition of a new theory of aging according to which the latter is not only wear and tear, but also points to the constitutive role of death for life, which is thought today by Ameisen* via *the link between "death before the fact" and reproduction.* This intuition of Simondon's on the subject of aging is in evidence in this statement from the center of the cited passage: "death as the final event is only the consummation of a deadening process that accompanies every vital operation as an operation of individuation." But this is only an intuition with all its inherent limitations, which will come to light in a brief analysis. Let us see how things stand.

The distinction between death as *terminus* and death as an *internal condition* is explicit in Simondon's passage in the distinction between "wear and tear" and "deadening," a distinction which, at first sight, is that much more obscure since Simondon explains the aging phenomenon by way of the second, and it is difficult to understand—still at first sight—how it would not be based on the first. Only the notion of a "sediment," articulated here by

49 Simondon, *L'individuation et sa genèse physico-biologique*, 213, and *L'individuation à la lumière des notions de forme et d'information*, 215.

Simondon *via* the words "each operation of individuation *leaves* death in the individuated being", allows us to distinguish at a push between wear and tear and deadening, but this notion is not *on its own* what will truly enable us to make death into a process conditioning life: in order for the notion of a sediment to itself contribute to making deadening something "essential to the activity of individuation," as Simondon says when he distinguishes it from wear and tear, the sediment cannot be a simple sediment. Now, it is precisely with respect to the phenomenon of aging that Ameisen allows Simondon's hypothetical and still simply intuitive speculations to take on their full meaning—through an extension/overturning of the notion of a sediment:

> Aging and death may not only result from wear and tear, from the passage of time and the body's inability to withstand the assaults of the environment. . . . A protein [issuing from the *Methuselah* gene], a minimum production of which is essential to the construction of the embryonic body [of the fruit fly], also has the effect of shortening the lifespan of adults when it is produced—beyond this minimum threshold—in a 'normal,' which is to say, excessive quantity. A minimal production of the Methuselah protein favors individual longevity, but risks compromising fecundity; an excessive production favors premature aging but brings a margin of security to the propagation of the species.[50]

Simondon had made reproduction "pre-eminent amongst transductions," which is to say, the radical form of vital individuation, and he had also intuited that aging does not proceed only from wear and tear. But, because he did not have at his disposal this notion of an *intrinsic constitutive role of death for life* provided by the new theorization of apoptosis, he did not *bind* reproduction to death except in the classic and so to speak metaphoric form of the extension of self to the after-self. It remains the case that, to the same extent that apoptosis *properly speaking* is not at stake

50 Jean-Claude Ameisen, *La Sculpture du vivant* (Paris: Seuil, 2003), 374 and 384.

in the new theory of aging put forward by Ameisen, it is possible to maintain that Simondon, at the level of the intuitions that motivated him, would have been perfectly in accord with these words from the biologist, dedicated this time to "splitting" and *cellular* aging:

> Each time that the mother-cell splits its genetic library before generating, it also splits, on the basis of its chromosomes, little supernumerary copies of circular DNA. And it keeps these copies, which are not allotted to the daughter-cell, in itself. As the mother-cell continues to give birth, its body contains an ever increasing number of copies. The accumulation of these little DNA circles above a certain threshold seems to trigger the fragmentation of the nucleus of the mother-cell and its death. . . . The idea is that life's victory over wear and tear is bound to a local heightening of disorganization—of the advance towards disorder—in one part (the mother-cell) which enables the birth in another part (the daughter-cell), of a discrete, local level of order and complexity. The passing of a maternal body is accelerated to enable the birth and survival of an infant body.[51]

So we come in conclusion to the second of the two links between Simondon and Ameisen. That is to say, to the idea, introduced by Ameisen at the end of *La sculpture du vivant*, according to which

> dramatic changes in the environment can bring to light, in a body that is developing itself, a pre-existent source of novelty—a potentiality—which had accumulated progressively over time and which, continually repressed until now, is suddenly able to show itself for the first time. In this way, the external environment has the power to sculpt the living being.[52]

I will give two successive readings of these words:

51 Ibid., 416–17.

52 Ibid., 409.

a. Even if Ameisen does not say as much—we will see *why* in the second reading—the process he describes corresponds, at least *in the first instance*, to what Stephan Jay Gould called "exaptation," and which Pierre Sonigo, in a commentary on the latter, distinguished from the idea of "programmed anticipation" suggested by the Darwinian term "pre-adaptation": "evolutionary innovation is brought about by unexpected encounters between the potential and the useful."[53]

Whatever the case may be, the schema proposed by Ameisen of a revelation, through the agency of the dramatically altered environment, of a potentiality that has been progressively accumulated in the organism, aims explicitly to mediate, and ultimately go beyond (in agreement, I would add, with Gould's point of view), the opposition between the "gradualists" and the "punctualists," which is to say, between the conception of evolution in terms of negligible genetic modifications and the conception of evolution in terms of "leaps ahead" or sudden jumps. This mediation and this move beyond oppositions would have appealed to Simondon who himself sought systematically to subvert naïve alternatives and who, in *Du mode d'existence des objets techniques*, had in the same way associated continuity and discontinuity in order to think the becoming of the technical object. In the thinking of the living being, the way in which Ameisen pays particular attention to the question of as yet unrealized potential seems to be truly Simondonian, as does the possibility of formulating anew a concept on which Simondon was particularly reliant: the Bernardian concept of "interior milieu," which indeed Ameisen seems to revisit and which is not antithetical to his thesis according to which "the environment is more than a simple filter—a bottleneck—through which individuals and species are selected or eliminated. The exterior environment can exert a direct influence

53 Pierre Sonigo and Isabelle Stengers, *L'évolution* (Paris: EPD Sciences, 2003), 53.

on the way in which cells and bodies use their genetic potentialities and so on the manner in which embryos are constructed."[54]

b. The way in which Ameisen establishes this last idea would have further appealed to Simondon since the biologist intends to differentiate himself from Gould here (who, moreover, Ameisen places on the side of the punctualists), to the extent that for Gould, as for the (opposed) positions of gradualism and punctualism, the "emergence of individuals and species endowed with new properties is considered to be an immediate translation, a direct consequence in real time, of the appearance of chance modifications in their genes . . . . In other words, the essential debate between these two theories does not concern the way in which the environment sculpts the new aspect, but the nature of the modifications on which it brings its effects to bear."[55] In opposition to this common point of view, which had underpinned the debate up to now, Ameisen suggests developing the consequences of the work of Linquist and Rutherford, which he expounds as follows:

> When the embryos of fruit flies undergo a thermal shock, the new-borns exhibit profound modifications in a whole range of organs—antennae, wings, eyes, legs. These modifications vary from one embryo to another and from one sub-species of fruit fly to another. The appearance of this new aspect is not connected to the sudden appearance of genetic modifications: it is due to the revelation of a pre-existent genetic diversity, whose appearance had until now been permanently repressed.[56]

This "repression" is performed by proteins which are called "chaperones" and which attach themselves to modified proteins, "allowing them to return to their initial form."[57] And so

54 Ameisen, *La sculpture du vivant*, 406.
55 Ibid., 405–6.
56 Ibid., 408.
57 Ibid., 407.

it is necessary to give a *second reading* of the above citation from Ameisen in which it was said that "dramatic changes in the environment can bring to light, in a body that is developing itself, a pre-existent source of novelty—a potentiality—which had accumulated progressively over time and which, *continually repressed until now*, is suddenly able to show itself for the first time." The words I have italicized contain the theoretical innovation which means that it is no longer necessary for Ameisen to refer to Gould's exaptation: here, the action of the new environment, which suddenly reveals potentialities accumulated in the organism, no longer operates on the form of the proteins—so on the gene's mode of expression—but on the internal agents which until now restored this form when it had been altered in this way. This is the "complexity" explicitly claimed by Ameisen, and "complexity" is the watchword whose great pioneer, as I showed in *Simondon ou l'Encyclopédisme génétique*, is without doubt Simondon. So we have our work cut out for us.

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Jean-Hugues Barthélémy
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The philosophy of Gilbert Simondon has reinvigorated contemporary thinking about biological and technological beings. In this book, Jean-Hugues Barthélémy takes up Simondon's thought and shows how life and technology are connected by a transversal theme: individuation. In the first essay, Barthélémy delivers a contemporary interpretation of Simondon's concept of ontogenesis against the backdrop of biology and cybernetics. In the second essay, he extends his reflections to propose a non-anthropological understanding of technology, and so sets up a confrontation with the work of Martin Heidegger.

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