

AION

Journal of Philosophy and Science



ISSUE 3. 2026

Aion. Journal of Philosophy & Science



3rd Number | Presentation

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As early as 1983, Gilbert Simondon argued that “a deepened technology must learn not only to invent the new, but also to reinsert the old and update it into the present under the call of the future.”^[1] One of the most striking characteristics of his work is the feedback relationship this philosopher, psychologist, and technologist establishes between the abstract and the concrete, the actual and the virtual, the present and the future. We may say that his work is devoted to activating the creative power of human thought when it takes a leap forward and reshapes itself. This relationship between thought and world unfolds through the identification of a problem, its reflection, the cycle of imagination, and the invention of a solution. And when this problematic, recursive relationship is established—already from the very first moment of consciousness—the material world around us also comes to bear meanings shaped by the full set of modes of cognition, emotion, valuation, and “phases” that define what Simondon calls Culture.

Some forty years later, everyone who reflects on the future of our civilization agrees that the technologies capable of addressing material, energy, informational, and environmental challenges do not necessarily match the futuristic promises of recent rapid innovations; rather, they are those that lay the foundation for a more sustainable future for both humans and machines within their intertwined environments. We may say that human beings can fully express themselves in the world—and truly communicate with nature—when they perceive the unified character of the relations between different regions of reality, despite the division already given to us by the community. The coupling of human beings’ internal and external worlds is rooted in the preindividual, which is more than one and the same, and from which emerge not only the individual but also its associated milieu, metastable and structured at different scales. But what about artificial beings? Do they also have a future of their own?

Contemporary thought must envision the common future of natural and artificial beings by drawing on the convergence of multiple disciplines and overcoming

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Aion Journal of Philosophy and Science

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the current disorientation resulting from the abandonment of linear conceptions of progress. Dominant technologies preempt the vision of the future even though they are “zombie technologies,” incompatible with the persistence of living conditions on Earth, while others—neglected, forgotten, or buried in local traditions—undoubtedly possess greater potential when considered on a long timescale. When we recognize the communicative characteristic of being subjects, we perceive our reality as more than our individuality: the subject is preindividual, individual, and transindividual, therefore relational. We, as individuating beings, can understand that we are part not only of the physical, biological, psychic, collective, and technical realms, but also of constant communication with one another and, of course, beings in becoming. Nobody can watch her or his own individuation, but this process becomes meaningful when considered as the “technical individuation”^[2] of the world.

“Where are the future technologies?” Human civilization, in its process of individuation—or rather of evolution, saturation, and sometimes disaggregation—needs to become culturally conscious of these layers of reality. That is why Vincent Bon-tems (philosopher at CEA), Christian Fauré (scientific director of Octo Technology), and Roland Lehoucq (astrophysicist at CEA and president of the science-fiction festival “Les Utopiales”) decided, in 2023, to hold a one-week symposium at the prestigious center of Cerisy-la-Salle^[3].

From philosophy to science fiction, via history, natural science, and design, this gathering explored—in both speculative and concrete terms—the redefinition of obsolescence across different timescales, the interplay between technologies and their associated milieus, the implications of “ecotechnology,” the actions on technological affects, the appropriateness of bifurcation strategies, and the technopolitical directions to prioritize. The full grasp of the present can only be achieved when the power of action is brought into the present moment by an encyclopedic convergence. Only in this way is it possible to project a becoming, a comingintobeing, a future.

These are the elements that the reader will find here, in these sixteen works, which seek not only to interpret the theory developed by Simondon, but also to apply and amplify it—together with other creations of the human imagination—in order to reinvent futures.

JeanHugues Barthélémy and Ludovic Duhem open this selection of texts with a reflection on the notion of ecotechnology. They approach the problem of future technologies as something that cannot be reduced to a purely technical or economic perspective. The authors’ aim is to reconcile, through three distinct approaches, the concepts of technology and ecology. Also addressing technical objects in relation to environmental issues is the text by Giovanni Carrozini, which develops a topic of great importance in the context of contemporary capitalism: planned obsolescence. Carrozini makes us aware of the impossibility of addressing the problems of disposal and waste without taking into account the symbolic, economic, and social domain in which advertising also plays a role in the preservation and reproducibility of the

objects we consume.

As we have already said, imagining a future requires that the present compel us to think about the current system of material and social organization. This is what Jim Schrub does in his article. Starting from a highly compelling reflection on the reality of workers in the Global South, the text addresses—by articulating Simondon’s theory, Morizot’s thought, and concepts such as the Capitalocene—the relations of exploitation affecting these workers within a capitalism increasingly marked by surveillance, as well as its social and psychological consequences. These issues lead us to reflect on the status of two fundamental concepts in contemporary thought: progress and growth. This is what Silvia de Cesare and Bontems do by philosophically engaging with the analogy that can be established between technical evolution and biological evolution, claiming that the simondonian concept of “negative progress”¹ should inspire our time. Still focusing on the highly important concept of progress—this idea that the present is better than the past and that the future can be better than the present—we have the work of Andrea Bardin and Marco Ferrari, developed on a Simondonian theoretical basis. The authors offer a wellgrounded critique of the category of metastability and its relationship to the concept of homeostasis, itself derived from cybernetics. They reflect on how cybernetics operates as a foundation for a neoliberal logic of governance.

Anne Alombert, in turn, develops an important analysis of the use of computational automata starting from Plato, also mobilizing philosophical concepts from Bernard Stiegler and Karl Marx in order to examine the double effect—both positive and negative—that this type of technology produces in the cognitive relations between subject and machine, and between subject and society. Conversely, Pierre-Marie Pouget analyzes the very idea of human progress on the basis of the development of the sciences and technologies. Pouget’s analysis moves toward an axiology grounded in a reflection on technoscientific development, while criticizing reductionist conceptions of nature. This leads us to ask: under what conditions are the technologies of the future produced? What different paths might the sciences take in the future? These questions are implicit in the development of Anne Querrien’s line of reasoning, as she reflects on the contemporary model of industrial research and comments on Bontems’ research about innovation.

Another perspective on the theme guiding this collection of philosophical articles is precisely the one that starts from bodies and the senses of the human individual. In her text, Catarina PomboNabais offers a stimulating analysis of techtattoos, showing how this ancestral tradition has been reconfigured by contemporary technologies, while never neglecting an analysis that takes into account the role of science fiction as well as its consequences within a society increasingly characterized by control and surveillance. Frédéric Pascal also begins from an analysis centered on

¹ See Vincent Bontems “Simondon’s ‘Right Technology’. Ecotechnology, Scalability and Negative Progress” in Jamil Alioui et al., *The Idea and Practice of Philosophy in Gilbert Simondon*, Basel, Schwabe Verlag, 2024, pp. 249-266.

the senses. By taking human hearing as his object of study, Pascal shows how this sense offers another meaning of information. Inspired by Simondon's philosophy, he demonstrates how information provided by technical objects can only be understood as such through the determinations of the organism. In a broader way, considering the body, space, play, and artistic expression, the only article not translated into English is that of Farah Khelil, which leads us toward an understanding of thought as a category traversed by these elements. As it is a text that deeply engages with aesthetics, we decided to keep it in the original language in which it was written.

It is not possible to think about science and an alternative future without engaging in a deep reflection on biology and technology. While Dominique Lestel's article puts forward an original philosophical proposal that he calls "zoofuturism", inviting us—through ten theses—to rethink the place of animals in culture. Jérôme Laforcade's text offers an analysis grounded in the soviet Theory of Inventive Problem Solving (TRIZ) in order to think about physical, technical and coupling contradictions. The strength of these two texts lies in their invitation for the reader to experiment, within philosophical analysis, with the distinctive concepts of both biology and engineering. Despite the fact that these texts are not referring to the simondonian corpus, both are deeply resonating with his work.

Finally, there are three texts that use science fiction as a central element for philosophical reflection. This is the case with the text by Alex and Veronica Calazans, who offer an analysis of the highly important work that coined the term "*robot*" in 1920, written by Karel Čapek, read in the light of Simondon's texts on the technical and industrial object. In a more exploratory vein, we have a novella by Émilie Querbalec, which can be regarded as a genuinely exploratory work in the way they use literary expression—in the form of a future expedition journal—as a means of thinking about ecology, politics, and philosophy. Querbalec reminds us that the first technological choice is to *not use* technology. Finally, the "science fiction prototype" by Roland Lehoucq and Vincent Bontems chooses to focus on energy as an object of philosophical reflection through fiction. Drawing on Frank Herbert's *Dune*, the authors lead the reader to immerse themselves in the environment of the planet Arrakis as a way of simulating extreme conditions that must be anticipated when we think about the development of new energy sources.

In an era marked by massive flows of information, energy crises, climate change, and a new phase in capitalism's self-destructive process—through a shift toward dual-use innovation (that is, technologies whose civilian and military applications have become inextricably linked)—technological thinking must develop new criteria for rethinking progress in all its dimensions, moving beyond our obsession with power, and inventing images, technologies, and forms of organization (utopias?) that will restore a less fleeting future for both technological and living individuations.

The editors

For Eco-Technology Thinking Beyond Techno-Solutionism and Technophobic Ecologism¹

Ludovic Duhem & Jean-Hugues Barthélémy

Résumé

L'article examine la notion d'écotechnologie comme une voie permettant de dépasser l'opposition stérile entre le technosolutionnisme naïf et l'écologisme technophobe, à partir d'un dialogue critique avec la philosophie de Gilbert Simondon. Les auteurs partent du constat que, dans le contexte de la crise écologique globale, la question des « technologies du futur » n'est pas seulement technique ou économique, mais avant tout une question de sens, liée à la possibilité même de croire en un avenir commun. L'écotechnologie est présentée comme un effort de réconciliation entre technologie et écologie, impliquant une redéfinition du progrès. Contre l'idée moderne du progrès comme accroissement illimité de la puissance, est proposé un « principe de moindre puissance », selon lequel la valeur d'avenir d'une technologie doit être évaluée en fonction de ses relations d'échelle, de ses effets entropiques globaux et de son intégration aux milieux naturels et sociaux. Le texte articule trois approches complémentaires de l'écotechnologie : comme étude régulatrice des échelles techniques, chez Vincent Bontems ; comme projet culturel de transformation des formes de vie, chez Ludovic Duhem ; et comme théorie philosophique systématique, intégrée à une « écologie humaine » incluant la question du Droit et des droits des nonhumains, chez Jean-Hugues Barthélémy. Cette perspective élargit l'héritage simondonien en insistant sur la nécessité d'un nouvel éclairage des Lumières, capable d'intégrer technique, culture et nature sans retomber dans le mythe du progrès linéaire. Enfin, l'article examine de manière critique des propositions historiques de technologies alternatives en montrant à la fois leur potentiel et leurs limites face aux exigences énergétiques, sociales et politiques contemporaines. La conclusion soutient que notre société n'est pas « excessivement technique », mais mal orientée tant du point de vue technique qu'écologique.

Mots-clés: Écotechnologie; Philosophie de la technique; Principe de moindre puissance; Crise écologique; Redéfinition du progrès

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Abstract

The article examines the notion of ecotechnology as a way of overcoming the sterile opposition between naïve technosolutionism and technophobic ecologism, through a critical dialogue with the philosophy of Gilbert Simondon. The authors start from the observation that, in the context of the global ecological crisis, the question of “technologies of the future” is not merely technical or economic, but above all a question of meaning, tied to the very possibility of believing in a shared future. Ecotechnology is presented as an effort to reconcile technology and ecology, implying a redefinition of progress. Against the modern idea of progress as an unlimited increase in power, a “principle of lesser power” is proposed, according to which the future value of a technology must be assessed in terms of its scalar relations, its global entropic effects, and its integration into natural and social environments. The text articulates three complementary approaches to ecotechnology: as a regulatory study of technical scales, in the work of Vincent Bontems; as a cultural project aimed at transforming ways of life, in the work of Ludovic Duhem; and as a systematic philosophical theory, integrated into an “human ecology” that includes the question of law and the rights of nonhumans, in the work of JeanHugues Barthélémy. This perspective extends the Simondonian legacy by emphasizing the need for a renewed Enlightenment capable of integrating technology, culture, and nature without falling back into the myth of linear progress. Finally, the article critically examines historical proposals for alternative technologies, highlighting both their potential and their limits in light of contemporary energy, social, and political demands. The conclusion argues that our society is not “excessively technical,” but rather poorly oriented both technically and ecologically.

Keywords: Ecotechnology; Philosophy of technology; Principle of minimal power; Ecological crisis; Redefinition of progress

Ludovic Duhem

The implicit meaning of the conference title

The title of this conference is surprising. The question it poses “Where have the technologies of the future gone?” seems to formulate a paradox. On one hand, it asserts that technologies of the future are, in a sense, untraceable: we no longer know where they are, we may no longer know how to conceive and implement them, or perhaps we can no longer even imagine them. On the other hand, such a question nevertheless suggests that we can already conduct an investigation to rediscover these “technologies of the future” and objectively question what happened to them (thus assuming that they once existed, if not as actual realities, at least as ideas, sketches, prototypes, and that we believed in their concrete and functional future).

But another paradox in such a question should be noted, one that is less explicit and deeper: technologies of the future are probably no longer those that make the future possible as a sense of what is to come and trust in what happens for the collective good, since, after the many catastrophes and disasters of the last two centuries, new technologies are suspected of embodying the threat of eliminating any future by destroying the fundamental conditions for the existence of the human species and the biosphere in general.

The question posed by the conference title is therefore less about knowing “where” the technologies of the future have gone, in the sense of a specific geographical location or historical moment, even though geographical and historical issues are important for such an investigation, nor simply about which technologies have a real chance of developing in the future according to the current state of science and technology, which technologies will be encouraged or hindered by the global capitalist network society, and which ones should be, according to various ethical, economic, or political positions. Rather, it is about what meaning to give to technologies of the future in a time of planetary ecological crisis. Thus, it is a matter of re-asking the question of the meaning of the future of technologies from the ecological perspective: not only questioning the criteria for evaluating the future value of technologies based on their simulatable, measurable, and controllable ecological impact, but also their capacity to carry a promise, a hope, a belief in the future that involves meaning, sensitivity, and direction irreducible to any calculation.

Re-asking the question of the meaning of the future of technologies, especially those that have a future because they are ecological, is therefore also and above all re-asking the question of the meaning to be given today to the promise, to the hope, to the belief that the future is possible, that the future is positive, that technologies can carry such meaning, such momentum, such values, without falling back into the “myth of progress” and without preparing a new “collapse of civilization into barbarism” through a misguided illusion of lucidity regarding the lessons to be learned from the past. This also requires questioning the conditions of compatibility between the sense of the future carried by technology and the sense of the future carried by ecology, which are most often presented as contradictory and irreconcilable.

According to a common schematic representation, the technological future would be essentially short-term, utilitarian, serving particular interests, while the ecological future would be long-term, anti-utilitarian, and serving the general interest beyond even human interests. The technological future would also be fundamentally optimistic, based on the idea that technology, through scientific knowledge and technical efficiency, can solve all human problems, including those posed by the functioning and use of technologies, made possible by a demand for rationality, freedom, and convergent means. The ecological future, on the other hand, would be fundamentally pessimistic, based above all on anticipating the long-term negative effects of any human technology, this anticipation itself relying on scientific knowl-

edge, historical records, and empirical observations of the consequences of industrial development since the 19th century. Moreover, ecologists would immediately denounce the illusion of radical technicians who believe that ecological problems could all be solved by technology without completely transforming our ways of living, thinking, and acting, and technicians would reciprocally denounce the illusion of radical ecologists who think they can live in a utopia of deprivation, discomfort, and vulnerability.

Overcoming these two opposing conceptions of the future, which clash especially in the false debate between technophobic ecologism and technological solutionism, is a major challenge for the eco-technology that Vincent, Jean-Hugues, and I advocate. This “eco-technology” certainly requires a profound cultural reform to emerge as a lasting and fruitful reconciliation of technology and ecology in practices uniting organic life, technical life, and symbolic life through long-term care (attention, prudence, temperance) for their uniqueness and interdependence. To be fulfilled, this requirement certainly calls for restoring the link to the Earth, to places, and to living beings through daily experience and in situ education, but it also requires “new Enlightenment” as Simondon asserted was necessary. However, such a theoretical gesture, which consists in returning to the Enlightenment and renewing them, is not self-evident, as it immediately questions what is considered today as a “bygone” era and an “outdated” way of thinking because of its anthropocentrism, scientism, technicism, and universalism, but above all because of its belief that the future can only be a linear, continuous, and necessarily positive progress if it is rationally defined and conducted. In other words, if new Enlightenment are essential for rethinking the meaning of the future after the modern disaster and in the time of the current planetary ecological crisis, they will undoubtedly have to integrate darkness and regression as much as the limits imposed by the awareness of human finitude: which is a true requirement for reflexivity and invention, decentering, and participation.

Jean-Hugues Barthélémy

In the argument for this conference, Vincent used the notion of eco-technology twice. He also made a reference to the question of progress. Now, the link between this notion and that question began to be explored last year in a book in which Vincent participated: the book *Écologie et technologie. Redéfinir le progrès après Simondon*, which Ludovic and I co-edited for Matériologiques. That is why my way of contributing to the conference will first consist in recalling this link in order to outline, from it, a theoretical framework for the question of new technologies as “technologies of the future.” Then, it will be necessary to more concretely discuss some technologies that could fit into this framework—and for that, I will hand the floor back to Ludovic.

Aspects of the Idea of Eco-Technology

The notion of eco-technology, then, arises quite naturally from the desire to reconcile technology with the ecological emergency, and that is why the book *Écologie et technologie* provided the opportunity for this notion of eco-technology to emerge—independently and without any prior coordination—among Ludovic, Vincent, and myself. Of course, the precise meanings we each gave to this notion may differ somewhat. What is important to emphasize, therefore, is the complementarity between the three conceptions of eco-technology that came to us respectively. Then I will also recall the link between, on the one hand, these three definitions of the notion thus unified, and, on the other hand, the question of progress.

For Vincent, first, eco-technology is defined as a study that updates Simondon's reflection because this study consists in "taking into account the implications of integrating technical reality within the natural environment and analyzing their joint evolutions." The starting point is the positive notion of scalability, which refers to "the capacity of a technology to adapt to changes in scale, whether in terms of operation or production." Vincent relates this to the more negative notion of exo-transcendence, defined by Bernard Stiegler as the emergence of a tendency toward increasing entropy within individuation processes due to the technical amplification of human activities. More precisely, Vincent seeks to develop the hypothesis that scalability, in its positivity, simultaneously constitutes an exo-transcendence in its negativity: "although the machine is organized matter and an organizer at its own scale, the combined effect of all machines' operations is undeniably the main cause of entropy at the scale of the global environment." The eco-technological study of the implications of integrating technical reality within the natural environment and their joint evolutions then leads him to formulate a "principle of least power": "a regulatory principle allowing us to estimate the future value of technologies based on the scale relations between their life cycles, their performance in their associated environment, and their overall entropic consequences." For Vincent, then, eco-technology is a study placed at the service of reducing the exo-transcendence that scalability always entails.

For Ludovic, eco-technology is defined as a problem of building a culture that is both "technological and ecological," because this culture, first, would have fully become aware that, as Simondon argued, technology "belongs as much to cultural reality as to an extension of natural reality." But Ludovic obviously does not stop at this idea, because:

first, this awareness, by culture, of its deep unity with nature as with technology must go further than Simondon himself regarding the link between the latter two: nature and technology, and by also relying for this purpose on an accentuation of the link between nature and culture, Simondon having for his part begun to unify the three by insisting more on the link between culture and technology than on the other two links. Ludovic particularly insists on the fact that within his thinking of the link

between nature and technology, Simondon thought of technical progress more as a process of “concretization” through integration of the techno-geographical environment as a condition for the functioning of the machine, or as a progressive “naturalization” of technical objects whose functioning relies on an increasing number of known and integrated natural laws, than as something that must have “an ecological meaning.”; - second, the awareness mentioned above, that is to say the awareness that technology belongs as much to cultural reality as to an extension of natural reality, will in fact be transformative for culture, since as Simondon already said our Western culture was until now in denial not only of the belonging of technology to the world of cultural meanings, but also of the continuity between nature and culture and of that between nature and technology – which precisely nourishes in an essential way the first continuity.

We can see that Ludovic conceives eco-technology more as a problematic and a cultural goal, whereas Vincent conceives it as a study and a means. But this study also defines for Vincent a “problematic,” and as a means it is indeed at the service of the same goal as in Ludovic: making possible what Ludovic calls “ways of living, thinking, and acting”—that is, a culture—that reconciles the idea of technical progress with the necessity of not destroying our natural environments and thus our own ecological conditions of existence. For Vincent, this redefinition of progress lies in the fact that the “future value” of technologies has as its regulatory principle a “principle of least power,” extending Simondon’s critique of “philosophies of human power through technologies.” The Simondonian nature of the approach is also revealed in the fact that its guiding thread is the passage where Simondon affirmed that «of all the transductive aspects of technology, the one that enables the change of scale, and consequently mobilization, timelessness, potentialization, is undoubtedly the most important. »¹ It should then be added that Vincent, starting from Simondon’s idea that “the machine” “is intended to maintain the homeostasis of the universe in an objective alliance with the living against entropy,” immediately notes a paradox between this idea and Simondon’s definition of technical progress, which indeed “does not integrate respect for ecosystems.” Vincent emphasizes the fact that in Simondon the process of concretization “constitutes an adaptation to nature as physical constraints and not as resources for living beings.” But he then adds, on the one hand, that Simondon’s reflection evolved somewhat after *MEOT*, and on the other hand, that “what explains the contradiction, in *MEOT*, between progress at the level of individuals (within technical lineages) [this refers to machines as ‘technical individuals’ in Simondon] and ecological considerations is above all the break in scale between the local associated milieu and the global environment.” If therefore Simondon’s philosophy “makes it possible to escape the tragic slope without, however, ignoring the danger toward which contemporary technological civilization

¹ Simondon, G., 2014, *Sur la technique (1953–1983)*, présentation de J.-Y. Château, Paris, Presses Universitaires de France. Op. cit. p. 136.

is moving ever faster,” it is because this philosophy “implies the analysis of scale relations” and thus of that exo-transcendence that scalability always is, Simondon having precisely systematized this analysis in the 1970s.

For Ludovic, the emphasis is on the capacity of Simondonian thought for the “subversion of oppositions,” on which I myself had insisted in my exegetical work on Simondon’s oeuvre. Ludovic focuses more particularly on the three oppositions nature/culture, culture/technology, and nature/technology, the critique of this last opposition being, like the critique of the nature/culture opposition, the occasion to go further than Simondon in order to truly make possible an eco-technological culture. This culture must consist in “giving another meaning to becoming, both as the significance of the relation of the human to the world and to itself, as a sensitivity shared symbolically across space and time, and as a direction collectively defined, developed, controlled, corrected.” Ludovic then makes the eco-technological problematics “that in which the main source of alienation is now negligence, as insensitivity to and ignorance of our relation of dependence and responsibility toward living beings, artificial beings, and their environments. Fighting against this negligence is a requirement of culture and reflexivity regarding the meaning of becoming, that is to say, a necessity to cultivate care for organic life, technical life, and symbolic life as an inseparable whole in its evolution. It is in this broadened and renewed sense that all the critiques formulated by Simondon to establish a new Enlightenment are useful.”

My own reflection on eco-technology does not seem to me to be in tension with the perspectives of Vincent and Ludovic. Like them, I proposed the notion of eco-technology driven by the need to reconcile technology with the ecological emergency, and by advocating for overcoming the opposition between naïve technological solutionism and technophobic environmentalism - which our book *Écologie et technologie* aimed to set against each other. Here again, it is our shared Simondonian heritage that inspires a double critique of what Simondon called “intemperate technicism” and its adversary, technophobia, and this in the name of what I have called, in my work on Simondon, a technophilia that is both learned and anti-technicist.

However, I would readily say that while in some respects Ludovic’s very definition of eco-technology was broader than Vincent’s, as it was directed toward the idea of an eco-technological culture, what is broader in my case is first the theoretical context, since this context is my human ecology as a philosophy that is immediately global by virtue of its very method. Without going here into these methodological foundations as they determine a layered philosophical architecture and as they were recalled in 2022 in Chapter 5 of my *Manifeste pour l’écologie humaine*, I would simply like to clarify the role of eco-technology within this philosophical structure defined by the new method that I began to establish in 2018 in the book entitled *La Société de l’invention. Pour une architectonique philosophique de l’âge écologique*. The actual definition, then, that I give of eco-technology makes it the theory of the

reconciliation between technical power, today devastating, and the protection of natural environments, now a priority. Like Vincent—and Ludovic—and in accordance with what Simondon undoubtedly said first, I conceive power as being neither the essence nor the ultimate *telos* of technology, true technical progress leading to informational ensembles whose higher vocations are, on the one hand, the scientific knowledge of nature, the very condition of its “mastery,” and on the other hand, the universal transmission of knowledge for the benefit of the “mastery of mastery,” that is, the mastery of the consequences of our power to act upon nature—this mastery of mastery which Hans Jonas was the first to say we lacked.

Now, there is here a specificity of the theoretical framework that is both very broad (or even “systematic” in the sense of global) and very systemic (in the sense of relational) brought by the philosophy I have called “human ecology.” This specificity is that eco-technology, as a theory of the reconciliation of technical power and ecological priority through the problem of “mastery of mastery,” can no longer be thought of independently of the question of the rights of non-humans, as these rights must today come to limit our freedom in the use of technical power. Political ecology is very concerned with the question “how can we avoid the ultimate catastrophe that is looming?” Now, to build a true “new Enlightenment” is to dare to pose the question of the refoundation of Law, and thus the question of “why?” in the sense of the norms and the goals that these norms define for human action. This is why the two major interlocutors of the system of human ecology and its internal political ecology are Bernard Stiegler and Corine Pelluchon. This is also why I write, for my part, “eco-techno-logy,” with two hyphens and not just one, the association of the two hyphens serving to give “eco” an etymological meaning that concerns not only political ecology but also political economy. And since the latter is not economic science but rather belongs to political philosophy, its fundamental problem is the foundations of Law as a normative framework for economic activity and the satisfaction of needs—which today more than ever must be distinguished from desires and their ecologically destructive spiral.

Relation of the Idea of Eco-Technology to the Question of Progress

To conclude this first part of our presentation, and thus the only but somewhat lengthy section that falls to me within our discussion, I had announced that after outlining the possible unity of our three definitions of eco-technology, I would come to the link between this unified definition and the question of progress. Now, we have already had along the way a first but very brief glimpse of this, when I said that for Ludovic, the purpose of eco-technology is to make possible what he calls “ways of living, thinking, and acting”—that is, a culture—that reconciles the idea of technical progress with the necessity of not destroying our natural environments and thus our own ecological conditions of existence. And I added that for Vincent, this redefi-

inition of progress lies in the fact that the “future value” of technologies has as its regulatory principle a “principle of least power,” extending Simondon’s critique of the “philosophies of human power through technologies.” In light, on the one hand, of our shared Simondonian heritage, and on the other hand, of the general theoretical framework of human ecology that I propose, it seems to me that three additional remarks are possible to prepare future developments on which we could work together as we have all three been doing for years:

First, our shared Simondonian heritage was expressed in the collective work *Ecology and Technology* through a conviction stated in its subtitle: the conviction that we must “redefine progress.” This means that the loss of credibility of the idea of progress that occurred since the Second World War opened a real highway for ideas that are in fact non-philosophical substitutes² for the very idea of progress that one wanted to discard: the ideas of “development” and “growth.” These ideas, non-philosophical but ideological in the pejorative sense of the term, ultimately led to that form of capitalist economy called consumerism, and to its political endorsement, which is the neoliberal ideology. These are substitutes for the old idea of progress insofar as our world, as it is dominated by economic motivations and desires for comfort and consumption, remains subject to a form of over-productive technical rationalization—perhaps less radically inhuman than the scarecrow that the famous “technical rationalization” implemented during the Second World War had become, but more ecologically devastating due to the globalization of over-productive consumerism. This is why we must redefine the idea of progress rather than hope to get rid of it. The substitutes that have occupied the empty space have moreover revealed over the past two decades their intimate and philosophically degrading link to the outdated idea of progress, since the technophile humanism of the Enlightenment has given way to a delirious and naïve technicist transhumanism that is the perfect techno-scientific ally of neoliberalism.

Next, it should be recalled that Simondon, in his learned and anti-technicist technophilia, had precisely prepared the ground for this redefinition of progress, he who at once attacked the “intemperate technicism” of certain cyberneticists of his time and sought to think the unity—still misunderstood—of technology with culture on the one hand, and with nature on the other. His “difficult humanism,” as I have called it in my works on him, was “difficult” both because it integrated technology into culture—against all technophobic humanism—and because it fought anthropocentrism and, more generally, any form of “anthropological divide,” or separation between humans and other species. He aimed in particular to reconcile technical progress both with the preservation of nature and with properly human progress. This is why *On the Mode of Existence of Technical Objects* distinguishes technical evolution from technical progress and rejects lines of technical evolution that are

² In the original french text : “(...) des idées qui sont en réalité des *ersatz*”. (T.N.)

overdetermined by socio-economic factors. The very subtle fundamental and founding paradox of his thought lies at this point: that technical normativity for social progress itself resides in what is least human in technology, that is, in functionings rather than in uses, and this progress of functionings leads to informational ensembles whose highest vocation does not correspond to the lines of technical evolution overdetermined by socio-economic factors arising from uses as defined by the “society of yield”—an expression by which he designated our over-productive and consumerist society, already emerging in his time.

Finally, redefining progress as being both technical and human obviously means raising the question of the “new Enlightenment” and of the refoundation of Law without which they cannot truly be a new Enlightenment. And at this point, it is therefore a matter of extending Simondon’s idea of technical normativity for social progress by showing that the age of informational ensembles is also that of scientific access to the subject-being of the non-human animal, as Simondon had already conceived it as a precursor strongly interested in ethology. This subject-being of the non-human animal is defined by a sensitivo-emotional affectivity, and the non-satisfaction of the needs of the non-human animal then generates suffering—physiological or even psychic. My own work for the refoundation of Law therefore consists in showing that Law, instead of being the system of compatibility of the “free wills” of “moral persons” alone, as it was for Kant and as it remains in our anthropocentric societies, must become the system of the greatest possible compatibility of the suffering needs of all beings, human and non-human, that have such needs. And it is within this future legal framework, to which Corine Pelluchon also aspires, that our uses of technical power will have to be conceived.

Ludovic Duhem

What technologies could fit into such a framework? Do future technologies exist today that we could consider as being fully eco-technological? It is obviously difficult to answer.

First, because future technologies do not necessarily follow from such a broad theoretical framework, unless it takes the form of a planning process that would set out its main guiding principles, define its development priorities, establish its goals, state its strategy, and determine its material, economic, and human resources. The idea of eco-technological planning should therefore be discussed, both in terms of its content and its modalities; but also regarding its necessity, since we all know the technical, economic, social, and political problems that planning has produced since the industrial revolution in Europe, the USA, and Russia.

It is difficult to answer next because the idea of eco-technology, even unified as Jean-Hugues has just mentioned, is still a concept under construction, which therefore requires further theoretical work to become fully understandable, publicly de-

batable, and above all connected to existing technologies or possible technologies for which we have sufficient indications to assess their relevance and potential.

It is difficult to answer finally because it would be necessary to develop a set of objective criteria to select technologies claiming to be technologies of the future. Eco-technology as formulated by Vincent through scalability and exo-transcendence provides at least a first fundamental criterion, that of “least power.” Other factual criteria could also be stated, such as: the amount of resources mobilized, the amount of energy required and its mode of production, land footprint, impact on biodiversity, quantity and quality of pollutant emissions, and more generally the integration into the functioning and evolution of technological lineages of negative effects on natural environments at different scales and throughout the entire life cycle of technologies—that is, their capacity to tend toward complete naturalization or even to contribute to the enrichment of the associated milieu. But it might be necessary to establish a new mechanological science to satisfactorily define all these criteria: an eco-technological mechanology that would be developed within the framework of a general ecological organology, at once multidimensional, relational, processual, and scalar.

In any case, for the moment, future technologies that meet the requirement of a coherent eco-technology lie between two extremes: on one side, integral geo-engineering, which is a totalitarian technicism on a planetary scale, and on the other, technological primitivism, which is a radically techno-critical environmentalism. The former claims to be able to control natural cycles such as the carbon cycle (machines to store CO₂), the water cycle (rain control, desalination, artificial snow), the reproductive cycle of plants and animals (genetic biotechnologies: GMOs, CRISPR-Cas2, etc.), the evolutionary cycle of living beings (paleogenomics, pre-Neolithic rewilding), and even the cycle of the universe (terraforming of terrestrial planets, control of stellar radiation). The latter claims to be able to eliminate all technological dependencies by returning to a pre-industrial state based on an artisanal and ascetic model, or even, in its most mystical form, by returning to a pre-technical or archaic state in the manner of a return to a magical-technical era of the Paleolithic, to the mythical golden age of abundance under the benevolent gaze of the gods, to the Edenic time before the fall, or even to a supposedly purely animal, wild state, uncorrupted by civilization.

Between these two extremes (of which not everything should necessarily be rejected in principle despite their sometimes utopian and fanciful aspects), there is nevertheless a wide spectrum of technologies that could meet the eco-technological requirement. As early as the 1970s, some ecological thinkers proposed future technologies, such as Schumacher with “intermediate technologies,” Illich with “convivial technologies,” Bookchin with “liberatory technologies,” or more recently Bihouix with “low technologies” (or Low Tech). Despite their differences (which should not be overlooked), these proposals had in common: the fundamental critique

of the capitalist industrial system and consumer society, the preservation of nature as an absolute priority without any sanctuarization, the integration of technology into culture and nature, the reappropriation of alienated knowledge, the privilege given to the local scale for production and distribution, the reduction of mobilized energy and generated waste, the limitation of human needs, the recognition of vernacular cultures, and the pursuit of individual autonomy and collective emancipation.

The future technologies corresponding to their proposals were mostly derived from the pre-industrial artisanal model and clever tinkering, renewable energy production technologies (especially wind and solar), and networked informational technologies for the dissemination of knowledge. All modes of industrial production based on large-scale machinery were prohibited, as well as fossil energies such as coal, oil, and nuclear power. In this respect, the idea that nuclear energy could be conceived as an “ecological” energy or “more acceptable” than others was in no way acceptable to these thinkers, nor to the majority of environmental activists. Few, if any, of them would have subscribed at that time to the idea defended by Simondon in his texts of the 1970s: namely, that in the future, nuclear fusion reactors would be operational and could be used to reintegrate and eliminate all previously produced nuclear waste. This eco-technophile optimism of Simondon is still not on the agenda 50 years later, despite the very recent progress of this technology (within the international ITER program); and it is by no means certain, moreover, that it would be technically possible, economically viable, ecologically sustainable, and socially acceptable to use it in parallel with electricity production to eliminate nuclear waste buried underground and sealed.

In the same way, wind, solar, hydraulic, and tidal power technologies, which Simondon studied with enthusiasm, have experienced for some a limited development, such as tidal energy, and for others significant growth, such as solar and wind power. However, these technologies still fail to reach sufficient load and efficiency levels to meet the electricity needs of a society based on continuous industrial production, permanent connectivity, automatic processing of massive data, electric-powered transportation, and widespread air conditioning. Furthermore, as we know, these technologies require, in order to exist and function, a technical environment, technical ensembles, technical networks—that is, a large quantity of machines, metals, and rare earths, and considerable energy, which at every stage of the process and at every level of the system recalls the dependence on what is not eco-technological, particularly the dependence on oil.

Eco-technological coherence is therefore a requirement that should go far beyond the development of this or that eco-technology materialized, for example, in a household appliance, an electric car, a wind turbine, or a solar network (smart grids). The integration of life cycle analysis of the product coupled with the ecological assessment certainly constitutes an interesting normative framework for defining a set of specifications to develop future technologies aiming at eco-technological co-

herence, but this rather demanding framework does not allow for a qualitative leap producing the necessary bifurcation to respond to the ecological emergency. The current enthusiasm around “Low Tech” is in this respect revealing both of a promise of a positive future, an aspiration to autonomy, and above all a capacity for designing and developing credible and sustainable alternatives to digital technologies and industrial machinery, whether for producing energy and food, or for housing, transportation, healthcare, clothing, adornment, and entertainment. But the advent of the “age of Low Tech,” to use Bihouix’s phrase, is also not for tomorrow, as much for technical reasons as for economic, social, and political ones. It is not possible to develop these reasons here, but such a generalization of Low Tech to society as a whole raises numerous problems, particularly for so-called “sensitive” and “strategic” sectors such as research in fundamental and applied science, military defense, human health, telecommunications, and space exploration; but also in its relation to the industrial scale, which seems unavoidable to meet the energy and food needs, housing, and equipment of a global population that is predominantly urban and metropolitan.

I will conclude by saying, following Simondon, that today’s society is not “too technical” but “poorly technical,” not only because it expresses resentment toward technology, and machines in particular, in the name of an easy humanism based on a misunderstanding of its meaning and its intrinsic relations with nature and humanity, but also because it fails to reform itself culturally to integrate technology and ecology by making them compatible at the level of values as well as norms. Today’s society is therefore both poorly technical and poorly ecological, because it still cannot materialize eco-technology according to a mix based on openness that is at once artisanal and industrial, low tech and high tech, in the right place and at the right scale, intense here and light there, dismantled elsewhere. But all this will only make sense for the future if the economy, finance, and law are redefined according to the principles of degrowth and long-term care for the Earth system where organic life, technical life, and symbolic life sustain each other. We are faced here with a political choice.

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Is the Object Obsolescent ? On Reuse Beyond Simondon

Giovanni Carrozzini

Résumé

L'article analyse de manière critique le statut de l'obsolescence des objets techniques dans le contexte de la société contemporaine de consommation, en prenant pour axe théorique central la philosophie de la technique de Gilbert Simondon. L'auteur soutient que l'obsolescence n'est pas principalement un phénomène technique, mais un phénomène social, symbolique et économique, produit par les dynamiques du marché, par la publicité et par la logique de l'innovation permanente, qui dissocient l'objet de sa durabilité structurelle. À partir de ce constat, le texte propose la réutilisation comme un geste technique, éthique et politique, distinct de la simple pratique du recyclage ou de la restauration. Réutiliser signifie réinvestir l'objet de nouveaux schèmes fonctionnels, inaugurant ainsi un nouveau cycle inventif qui préserve le noyau technique de l'artefact et réinscrit l'humain dans la relation à la technique. Cette pratique est présentée comme une forme de résistance à la déshumanisation de la consommation et à la réduction des objets à de simples marchandises jetables. L'article examine également les liens entre réutilisation, écoconception et économie circulaire, en soulignant la nécessité de repenser le design à partir de la durabilité, de la démontabilité et de l'ouverture fonctionnelle des objets. Des exemples issus du design, de l'art contemporain et de pratiques éducatives illustrent la manière dont des objets obsolètes peuvent acquérir de nouvelles fonctions, des valeurs symboliques et une pertinence sociale renouvelée. Enfin, le texte défend l'idée que la culture de la réutilisation implique une transformation plus large de la société, fondée sur des principes de responsabilité, d'imagination technique et d'éducation, capables de promouvoir une relation plus éthique, durable et solidaire aux objets techniques.

Mots-clés : Obsolescence des objets techniques; Philosophie de la technique; Réutilisation; Économie circulaire; Design durable.

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Abstract

The article critically examines the status of the obsolescence of technical objects within the context of contemporary consumer society, taking Gilbert Simondon's philosophy of technology as its central theoretical framework. The author argues that obsolescence is not primarily a technical phenomenon, but rather a social, symbolic, and economic one, produced by market dynamics, advertising, and the logic of permanent innovation, which detach the object from its structural durability. On the basis of this observation, the text proposes reuse as a technical, ethical, and political gesture, distinct from the simple practices of recycling or restoration. To reuse means to reinvest the object with new functional schemata, thereby inaugurating a new inventive cycle that preserves the technical core of the artefact and reinscribes the human within the relationship to technology. This practice is presented as a form of resistance to the dehumanization of consumption and to the reduction of objects to mere disposable commodities. The article further examines the connections between reuse, ecodesign, and the circular economy, emphasizing the need to rethink design in terms of durability, dismantlability, and the functional openness of objects. Examples drawn from design, contemporary art, and educational practices illustrate how obsolete objects can acquire new functions, symbolic values, and renewed social relevance. Finally, the text argues that a culture of reuse entails a broader transformation of society, grounded in principles of responsibility, technical imagination, and education, capable of fostering a more ethical, sustainable, and solidaristic relationship with technical objects.

Keywords: Obsolescence of technical objects; Philosophy of technology; Reuse; Circular economy; Sustainable design.

Laissez-moi ainsi
comme une
chose
déposée
dans un
coin
et oubliée¹

Giuseppe Ungaretti, *Natale* [1918]

¹ "Leave me like this / like a / thing / laid down / in a / corner / and forgotten"(T.N.)

Je suis allé au marché à la ferraille
Et j'ai acheté des chaînes
De lourdes chaînes
Pour toi mon amour²

Jacques Prévert, *Pour toi mon amour* [1946]

1. Reinventing a Technical Object.

The current world demands a reversal of our attitude toward objects. Consumption and the frenzy for novelty have led us to become true executioners of objects. We must save them at all costs—and not only for environmental reasons. To save them from the fate that reduces them to waste, we must give them the chance to extend their life—that is, recycle or restore them—or to have another life, that is, reuse them, which is perhaps the best gesture to oppose the constraints of the global market. Now, the reuse of technical objects is not merely an ecological requirement; it is above all a question of a purely technical nature, as Gilbert Simondon—the only philosopher of the 20th century who analyzed techniques as such—noted. In 1983, during a very dense interview with Anita Ketchichian for the journal *Esprit*, the philosopher from Saint-Étienne observed: “[t]he true technology is a reinvention. [...] We must preserve the material of the past because it represents a possibility of revival, and not only to constitute an archaeology. [...] Techniques are never completely and forever in the past. They contain an inalienable schematic power that deserves to be preserved and safeguarded.”³

Thus, reuse, as reinvention, is strictly linked to the obsolescence of objects, and the idea of technical obsolescence fits into Simondon's overall perspective regarding the evolutionary process of objects; he indeed writes on this subject: “one must consider as an aspect of consumption the fact of social obsolescence: an automobile, just like a hat, is out of fashion before it is worn out or technically outdated.”⁴ Reused objects—that is, objects that have already passed their phase of obsolescence—trigger a new inventive cycle, and invention, for Simondon, is precisely the human part of the object that must be recognized, protected, and ‘saved,’ to oppose “the loss of passion of the individual toward the object, a kind of depersonalization of the human/object relationship.”⁵ Simondon himself was a practitioner of reuse, if it is true that, as Jean-Marie Charpentier recounts, in Poitiers, in his Psychology Laboratory, he had used decommissioned American radars to make oscilloscopes⁶.

² “I went to the scrap market / And I bought chains / Heavy chains / For you, my love” (T.N.)

³ Simondon, G., 1983, “Sauver l'objet technique”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, Presses Universitaires de France (PUF), pp. 450–454.

⁴ Simondon, G., 1962, “Objet économique et objet technique”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, pp. 374–375.

⁵ Appiano, A., 1999, *Eстетica del rottame. Consumo del mito e miti del consumo nell'arte*, Roma, Meltemi, p. 150.

⁶ Charpentier, J.-M., 2018, “Un contadino del Danubio. Gilbert Simondon à Poitiers. Entretien réalisé par Giovanni Carrozzini”, in *Il Protagonista*, vol. XLV, 6e série, no. 29–30, pp. 223–227.

To return to the general question, we can say that to reuse is not only to restore or recycle an object; it is rather to reinvent it, to give it a chance to begin a new adventure, free in relation to its inventor—an adventure that is quasi-autonomous, but not independent. A requirement, that of reuse, is becoming ever more urgent in the contemporary world, since it is true that today “the entire production/consumption mechanism inexorably aims to configure the product in a one-way sense, for a programmed use, oriented toward ever-increasing thresholds of innovation, but not always necessary, and in fact functionalized by the logics of profit and the market.”

⁷ Now, the “art” of reusing objects is not a skill acquired by digital natives; as Pulvirenti observes on this point: “We’ll keep this... it might come in handy!” That was the philosophy of our grandmothers, who never threw anything away because maybe, one day, that thing could become useful again.”⁸ But it must be added that the reuse of objects varies according to cultures and geographic areas. Reuse can indeed arise from the need to address the problem of accumulation, as is the case in developed countries, but it can also arise for other reasons, “in developing countries [where] the problem is linked to the lack of means, the lack of goods and advanced resources, rather than to their overabundance as in rich countries.”⁹ The question that arises in any case regarding the reuse of objects is precisely: what is a technical object to be reused? The answer comes to us from Simondon: an object is not only the coherent technical organism, but also its components—the elements—and its organizational ensembles—the systems. Reuse therefore demands from us a true rediscovery of technical thought, softened by the constraints of the global, globalized, and globalizing economy—that is, the economy that dominates a society that “scraps, throws away, eliminates, forgets, loses, recycles everything that is no longer new, no longer efficient, no longer perfect and youthful, lucid and taut, whole and integrable into a system.”¹⁰ As Simondon writes:

“[T]he object, as an object of use, is subject to a process of progressive degradation through wear, corrosion, deformation. In certain objects, such as a microscope, this process is almost inoperative if the object is well maintained. However, a certain halo effect spreads, starting from objects that deteriorate, to all technical objects, and leads one to think that they lose their quality of use over time. [...] [O]ne can consider this process of invisible but presumable degradation as one of the bases of the depreciation of objects of use over time.”¹¹

⁷ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 34.

⁸ Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Jonio (Cosenza), La Mongolfiera, p. 7.

⁹ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 18.

¹⁰ Appiano, A., 1999, *Eстетica del rottame. Consumo del mito e miti del consumo nell'arte*, Roma, Meltemi, p. 148.

¹¹ Simondon, G., 1960–1961, “Psychosociologie de la technicité”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, pp. 53–54.

2. Is the Object Obsolete?

However, before analyzing the civility of reuse, to use Guido Viale's expression, we must study the process that contributes to the obsolescence of an object. It is true, as Viale notes, that: "the current productive world, in fact, because of and according to its ever-increasing implications, conditions the existence of objects to a kind of relativity that is all the more significant as their functional and meaningful complexity is high, and more variable as their placement is taken within the structures of the market."¹² From this point of view, advertising and fashion are two determining factors: they contribute to the arrival of the 'new' and the eclipse of the 'old,' independently of authentically technical evaluation criteria. So here we are talking about the fashion for the 'new' and not about that which rediscovers the old object—the 'retro' style that Simondon tells us in 1983 reinserts the object "into the present."¹³ Now, the technical object possesses at least three types of values: exchange or economic value, technical or structural value, and symbolic value. Advertising and fashion work mainly on the first and the third, and—as Simondon puts it—thus contribute to the exaltation of the over-historicity of the object, that is, to its overdetermination "as a psycho-social symbol"¹⁴; over-historicity is not neutral with respect to the object, because it "creates barriers, of which an example can be given in the fact that an automobile goes out of fashion faster than it wears out."¹⁵ Fashion and advertising focus on the object's contemporaneity; on the contrary, we should focus, technically, on its durability and permanence, because it is true that "the life cycle of an object could be as long as the technical, functional, and representative conditions that characterize it remain and endure."¹⁶ On this point, it is also true that Simondon had thought of a new advertising strategy respectful of the technical identity of objects: "at the level of a true advertising strategy, the handling of motivations gives way to a positive task of information intended to form archetypes from which cognitive structures will emerge. [...] [T]he point is not to sell, but to invent the object that will be manufactured so that it can be sold without advertising."¹⁷ But it is his dreamer's spirit that suggests this conclusion: for advertising, from its birth to today, things have worked very differently. Returning now to durability, it is the principle of ecodesign, whose promises aim "not only at the use of recycled materials in their production and at saving resources and energy during their manufacture, use, and handling; but also all operations of identifying

¹² Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 20.

¹³ Simondon, G., 1983, "Trois perspectives pour une réflexion sur l'éthique et la technique", in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 345.

¹⁴ Simondon, G., 1960–1961, "Psychosociologie de la technicité", in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 29.

¹⁵ Simondon, G., 1960–1961, "Psychosociologie de la technicité", in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 58.

¹⁶ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 21.

¹⁷ Simondon, G., 1960, "L'effet de halo en matière technique : vers une stratégie de la publicité", in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 293.

and reassembling disused products and the recovery and recycling of their materials and components”¹⁸; more generally, it is “the imaginative capacity to seek alternative systems, technologies, and strategies.”¹⁹ To return to the question we asked ourselves: how does an object become obsolescent? Viale suggests on this point that: “the entry of a thing into the world of the used is a complex passage, composed of at least two distinct moments; the decision to get rid of an object because it no longer serves, we no longer like it, we no longer want it, or we can no longer stand it; and the operation of removing it, giving it away, consigning it, or taking it away; because it may serve or please someone other than the one who used it.”²⁰

It is the moment when we part with an object that its “meaning” is revealed: its obsolescence as an everyday object of use gives way to its persistence in the realm of existence, of affectivity. It is then that the necessity arises to think about the destiny of the object as such, once it has lost its immediate utility but not yet its existence. It is indeed true that an object, as an object,

“can suggest an idea of material permanence and continuity of uses and meanings; in every domain, each material thing presents aspects of permanence, in constant contradiction with the impulses of continual innovation and transformation typical of contemporary reality; reasons and motives of affection, representativeness, and memory make this same idea of permanence appear as a kind of added value to that already implicit, which is contained in its material structure and in its capacities to endure beyond the conventional limits often imposed by contextual circumstances.”²¹

The object thus becomes the protagonist of a series of possible human actions: inventory, give, throw away, sell, or reuse. Now, reuse is, according to Viale, “the second life of the thing,”²² and therefore, in this series of possible actions, reuse is the only truly technical act: it is a gesture made to the object for the object, which consists in reinventing it, as we have already said. But the universe of reuse is a complex universe. There are at least three types of possible reuse: “a) the reuse of an artifact for the same function, by working to restore it. b) the reuse of an artifact for similar functions by making the necessary modifications. c) the recovery of the components of an artifact to reproduce a similar type or another type, depending on the shape and availability of the parts.”²³ In any case, reuse involves a first common moment, which I would dare to define as an *epoché* with respect to its over-historicity: that is, the detachment from the affective-emotional meaning it may have previously

¹⁸ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 17.

¹⁹ Barbero, S., Cozzo, B., 2009, *Ecodesign*, Milano, Gribaudo, p. 13.

²⁰ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 20.

²¹ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 22.

²² Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 26.

²³ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 25.

possessed, in order to rediscover its structure, its functioning, and thus be able to reinvent it—that is, apply new schemas to the object. But a society that reinvents, a technical society—that is, a society that thinks and works in a technical way—is above all a human society, all too human. The society of reuse is a transindividual society, where the transindividual can be conceived as the foundation of solidarity: “a solidary and convivial society is also a human consortium where things ‘ask’ to be used by many people, to have a new master if they have lost the previous one.”²⁴ This society would be founded on a vaguely Kantian imperative, adapted in Simondon’s manner: “always treat the object as an end, never as a means,” or again, “do not do to the object what you would not want done to you,” thus opposing the...

“the dis-humanity that loses the sense of the past, of roots, the archetypal bond with the object, the sense of the beauty of a gaze, of a face, of a figure marked by life [...] or lowered and immersed in its thoughts [...]; the system that revolves around an alienating, frantic, exaggerated consumerism and eyes maddened by the money-god is killing the soul, is erasing the time to observe, to appreciate, to think, to meditate—the time of the essence of man.”²⁵

It is indeed true that “the overcoming of the utilitarian approach in the cognitive domain—and of the utilitarian ethics that is consubstantial with it—is a revolution of thought and conduct that removes man from his position as center and master of the world, to place works and activities within broader cycles of which they represent a segment, but which it is dangerous to interrupt.”²⁶ This approach is therefore driven not only by the need to rethink the object, but above all by the need to redesign society. If, as Pagliero observes, renewal and innovation are the watchwords of the contemporary product industry and “the frenzy for novelty (...) is a true monstrosity,”²⁷ as Simondon asserts, the philosophy of Redesign primarily raises environmental questions: “the principles and philosophies of Redesign extend their rationale by referring to environmental issues, as hypotheses for reconfiguring products and services based on durability and compatibility.”²⁸ This is precisely a reversal of the constraints of capital, which transform us into serial destroyers who unleash their repressed rage on their objects, against this “kind of violence, of disorder,”²⁹ as Simondon precisely says: for example, in the case of truck shows where vehicles crash into each other like gladiators in the arena—“this fight against

²⁴ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 36.

²⁵ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell'arte*, Roma, Meltemi, p. 149.

²⁶ Viale, G., 1994, *Un mondo usa e getta. La civiltà dei rifiuti e i rifiuti della civiltà*, Milano, Feltrinelli, pp. 168–169.

²⁷ Simondon, G., 1983, “Sauver l’objet technique”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 449.

²⁸ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 57.

²⁹ Simondon, G., 1965, “Entretien sur la technologie avec Yves Deforge”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 403.

a false enemy seems to us to be harmful [...]. The technical object is too easily taken as a scapegoat. If all our sufferings came from technical objects, it would suffice to drown them in the sea, after ritually charging them with our faults.”³⁰

It is indeed true that—as Pagliero says, directly quoting Simondon:

“in the contemporary world, the meaning of a product is determined by reasons external to its nature as a ‘technical object,’ according to Simondon’s definitions; which refer to those forms, structures, and functions that define its technological-material status; in other words, its logical meaning, independently of the reasons for hypertrophies of production and market.”³¹

3. *Throw away objects?*

Now, before addressing reuse as such, it is necessary to analyze it in relation to another possible action toward the object as an obsolete component: namely, the action of “throwing away.” The technical culture of reuse does not imply that everything must or can be saved: “there are sets of objects [...] which, due to their technical and constructive structure, can be difficult to rehabilitate, as is the case for those that exhaust themselves in the exercise of their function: for example, a battery, a light bulb, or a garment after a certain limit of use.”³² We must therefore learn to throw away. But what should be done with all the discarded objects that can be reused? The first way to reuse discarded objects is to look for them in the trash, in large landfills. There are people who have made this activity a way to save objects. But it is a rather uninventive way: it is limited to prolonging the life of objects without reinventing them, except in cases where waste becomes components for the creation of new subsistence objects, as in *Robinson Crusoe*. Waste, moreover, is also a figure of human activity and existence; it is “the ‘repression’ of this systematic activity of theft and waste of the Earth’s ‘resources.’”³³ As Pagliero observes, via Scanlan: “human history has continually produced waste which, in different ways, is and represents history itself.”³⁴ Cultures develop as networks of meanings, and waste also possesses its meaning within these cultures. It is not necessary to cite Bataille and his economy of expenditure to understand this. As Viale says: “once thrown away, things—certain things, or even many things—can still be recovered.”³⁵ Objects, components discarded because they are obsolescent, can well, for example, become the *raison d’être* of collectors who, thanks to their inventiveness, become true visionary artists: “those who, with the materials collected, engage in tinkering,

³⁰ Simondon, G., 1960–1961, “Psychosociologie de la technicité”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 75.

³¹ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, pp. 33–34.

³² Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 28.

³³ Viale, G., 1994, *Un mondo usa e getta. La civiltà dei rifiuti e i rifiuti della civiltà*, Milano, Feltrinelli, p. 7.

³⁴ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 5.

³⁵ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma–Bari, Laterza, p. 42.

including installations and works of art.”³⁶ This is a way of recognizing the openness of an object to new possible destinations, and even to new social identities. A discarded technical object, a useless component, becomes the engine of artistic invention and can well lead to the production and creation of a work of art or an aesthetic object in general. This type of reuse I will address in the last part of this article, by discussing the case of Rondella, a mysterious artist who sells online his small “peaceful robots” made from real technical waste.

For now, let us follow the object “that begins its path toward final disposal.”³⁷ A whole new way of rethinking the object must be introduced. A new life begins. The privileged place of this new existence of the object is the flea market, where the object awaits a new owner and, hopefully, its new inventor. Flea markets are the cradles of objects to be reused: they can be purchased to continue their existence in other hands, or they can become something else. In any case, this is where the object most often (re)is born. Now, as we know, the object that (re)is born on the stalls of a market can indeed be bought, as mentioned, without changing its function: this is the case when it is purchased by recognizing its structure and functioning. But this way of buying an obsolete object also has a technical character. In most cases, the purchased object is also an object to be repaired. There is an entire culture of tinkering, which Simondon understood. To restore, to repair is above all to learn how to do. The first step toward recovery through restoration is contemplative in nature; it is precisely the expression of that sensitivity toward the object that Simondon spoke of: technical beauty. Contemplation is therefore not separate from knowledge of the object: repairing to reuse is part of (technical) culture. At the base of this culture lies a true love for the object, the same feeling that Fordist culture, in order to justify mass production, emptied of meaning, even erased. Extending the life of an object, as in the case of restoration, means moving from an economy of waste and consumption to a circular economy of recovery, which also has its own way of reinventing objects. It happened to me, while restoring an old phonograph from the 1930s with a friend, that we had to replace missing and irrecoverable parts with elements from other objects, whose function and use we rethought. This was the case with the support arm of the amplifier, which lacked the connector: to repair it, we reused (and rethought) a plastic part from a tube that was used to extend a faucet and diffuse the water flow. In the society of reuse and reinvention, there is no such thing as waste. Everything can serve. This is the principle of ecodesign, that is, design that:

“minimizes the presence of toxic substances in products, incorporates recyclable/recycled materials, reduces the quantity and types used, employs materials that are compatible with each other during the recycling phase, reduces the amount of work-related waste, minimizes

³⁶ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 48.

³⁷ Viale, G., 2011, *La civiltà del riuso. Riparare, riutilizzare, ridurre*, Roma-Bari, Laterza, p. 59.

packaging, uses a reusable packaging system, increases the energy efficiency of electrically powered products, simplifies access to parts for replacement or maintenance, and enables the recovery of components for recycling.”³⁸

It is from this ecodesign based on durability that the conception and realization of the Phoenix chair, produced by Offecet and designed by Luca Nichetto and Francesco Dompieri, derives. This chair is entirely recoverable; it is an “open” object in Simondon’s sense, that is, “an object that presents itself as fully real, that does not conceal itself.”³⁹ Easy to assemble, each part of the chair can be recycled once worn out and replaced by new parts which, in turn, can be recycled and replaced: here are the principles of the circular economy at work—an economy that no longer relies on simple linear causality, but on a complex causality that reacts in a controlled way upon itself. Here we find a way of reusing the object that Pagliero summarized as follows: “intervening on an already existing objectual reality by means of operations that could be defined as exogenous because they act on a constructed body defined by structural additions or functional modifications,”⁴⁰ which contrasts with the approach that consists in “conceptually defining the structure of any objectual reality to program its possible modifications and changes according to a principle that could be defined as endogenous, or internal, because it is the structure of the object that is modified, according to circumstances, by means of determined transformations.”⁴¹ This is how Nichetto and Dompieri respond to a critical observation by Appiano regarding recycling, which deserves to be quoted in full:

“Why don’t large, medium, and small industries think about using less polluting procedures and materials for the production and manufacturing of products, and instead we, the consumers, who have already wasted our money on illusionistic and exaggerated designs and pay taxes for garbage collection, must waste our time subdividing our excessive waste, preparing bulky items, bags of plastic bottles, and others of glass bottles, etc., and go through the endless ritual of unloading one piece at a time into the ‘bells’ for separate collection [...]?”⁴²

Now, when we said that everything is reusable, we did not tell the whole truth: there are, in fact, objects “born to die.” This is the case, among others, with

³⁸ Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Jonio (Cosenza), La Mongolfiera, p. 7.

³⁹ Simondon, G., 1965, “Entretien sur la technologie avec Yves Deforge”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 402.

⁴⁰ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 37.

⁴¹ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 37.

⁴² Appiano, A., 1999, *Eстетica del rottame. Consumo del mito e miti del consumo nell’arte*, Roma, Meltemi, p. 152.

batteries; and this is where the reconceptualization of ecodesign comes into play. Batteries are, in fact, objects to be used and thrown away once exhausted. Could new technologies help to rethink them? Moixa Energy Limited thought of solving the problem as follows: “[t]hanks to the USB interface, the battery uses the computer’s current to avoid problems related to the disposal of alkaline batteries or to make the production of elements such as the transformer—necessary for rechargeable batteries—superfluous.”⁴³ When recycling is no longer possible, we must reinvent!

Up to now, the discussion has mainly been about restoring, recycling, and recovering: in other words, about the possible continuation of the life of the object as such, that is, respecting its materials, its structure, its functioning, and its function. To restore, recycle, and recover is to continue the life of the same object. But the true technical gesture toward the worn object, the obsolescent object, consists in reinventing it, or even reusing it—that is, in making one object into another object.

4. Saving the Technical Object: Reuse.

Reuse is a transitional practice, to use Pascal Chabot’s expression.⁴⁴ But to *trans-ire*, to go through and beyond, one must first invent—that is, *in-venire*, to go inside. This requires changing our perspective on things, on the world. It is another way of being-in-the-world. This approach can be traced back to Bruno Munari and his Falkland lamp, a modular lamp made with a tube of elastic fabric used for repurposing garments. It is not exactly reuse, but it is nonetheless a way of looking at an object differently, even creatively. But reuse is not only a good practice; it is above all a “European directive”: “[t]he formula of the ‘four Rs’ (Reduction, Reuse, Recycling, Recovery) was born in the 1970s as an environmental slogan and became a European directive in 1991 [Directive 91/156/EEC] [...]. The formula designates an order of priorities established on the basis of hygienic, sanitary, and environmental criteria and identifies as the first option the upstream Reduction of waste; the second option (but in reality the first of the ‘downstream’ options) is Reuse, that is, the extension of the life of a good by maintaining the function of the object.”⁴⁵

Now, the market has already captured the taste for the worn object and is exploiting it for commercial purposes:

“Levi’s recently adopted an advertising campaign where the product—a pair of jeans—is not new but overused and thrown as it is: worn out, dirty, and faded, on a pile of work scrap metal. [...] [O]ne must ask what the real purpose of the company is, since it neither

⁴³ Barbero, S., Cozzo, B., 2009, *Ecodesign*, Milano, Gribaudo, p. 159.

⁴⁴ Chabot, P., 2015, *L’âge des transitions*, Paris, Presses Universitaires de France (PUF).

⁴⁵ Centro di Ricerca Economica e Sociale dell’Occhio del Riciclone (ed.), 2009, *La seconda vita delle cose. Il riutilizzo, nuova frontiera per la gestione dei rifiuti*, Milano, Edizioni Ambiente, p. 17.

produces nor markets worn jeans and advertising, ultimately, aims to encourage purchase; beyond the fact that the jeans are presented as an indestructible ‘work tool,’ Levi’s seeks with this ad to assert itself with a counter-current jeans clothing style, in an anti-conformist trash aesthetic (and perhaps also a little snobbish).”⁴⁶

What, then, is the meaning of reuse? It seems to me that Pulvirenti summarizes its nature and purpose in a way that I would dare to call incisive:

“It is a practice that everyone can put into action [...]; it is an approach that sparks creativity; it is an action that fosters responsibility regarding the use of our planet’s resources; it is an aesthetic based on simplicity and economy; it is an ethics that recovers values such as respect and care for the things around us; it is an opportunity to move toward sustainable development.”⁴⁷

Reuse is therefore a practice to be applied to all those obsolescent objects that were not conceptualized according to the principles of ecodesign and Life Cycle Design—that is, design that extends its territories of “complete and organic conceptualization of the product’s life cycle toward a necessary reorganization of all processes of growth and economic and social development of planetary ecosystems.”⁴⁸ Before reusing, it is necessary to analyze the potentialities of the object to be reused; Appiano summarizes them as follows: the motive, that is, “the idea that starts the subject’s imagination, which develops externally in relation to it”⁴⁹; imagined feelings; the logical form community between “its symbolic level and the morphology of the subject’s feeling”; the displacement of meaning; the sensations and associations that the object stimulates in the subject; continuity of thought; the zone of passion in the subject; the appearance of feeling; the awareness of the object’s degraded level⁵⁰. Now, as Pagliero says, reuse proceeds by addition, subtraction, and substitution—that is, modification “to different degrees [of] structure, form, dimensions, and relative characteristics.” Obsolescent objects are everywhere. They risk increasing the mass of waste: they must therefore be saved by rethinking them.

Reuse is above all a technical practice, but technology is objectified humanity, and therefore it has authentically ethical dimensions. Reusing to help is a first form of reuse. Most of the objects produced are designed for rich countries. And what about the Third World? Reuse can intervene to support it, as in the project to reuse

⁴⁶ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell’arte*, Roma, Meltemi, p. 155.

⁴⁷ Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Jonio (Cosenza), La Mongolfiera, p. 10.

⁴⁸ Pagliero, A., 2007, *Redesign. L’oggetto ritrovato*, Pescara, Sala, p. 52.

⁴⁹ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell’arte*, Roma, Meltemi, p. 157.

⁵⁰ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell’arte*, Roma, Meltemi, pp. 158–159.

car tires as circular bins that can be rolled on the ground: the Roto-tanque. In this case, the physical properties of the tire—its resistance—were considered and applied to a new object, a rolling container to improve water supply in developing countries. There is also Evan Gant's Rain Drop project, which, thanks to a system of plastic bottles mounted on house gutters, transforms them into small rainwater reservoirs, usable for many purposes. In this case, nothing is thrown away: neither the bottle, which is reborn to a new life, nor the rainwater, which becomes a renewable source. There is yet another way to practice ethical reuse: producing unique pieces from waste. Artetecnica, with its Design with Conscience project, creates flower vases, glasses, and chandeliers from glass bottles that are cut, sandblasted, and assembled.

A second way to reuse is the production of design objects manufactured in series from other objects: a now-historic example is the lamp by Livio Castiglioni and Gianfranco Frattini, the *Toio*, created in 1962 from a vacuum cleaner plastic tube with small fluorescent lamps placed inside. There is an entire set of actions that can be conceived as the operative principles of reuse design. As Pulvirenti further observes, it is true that, very often, this kind of design does not stem from a traditional project. It is enough to come into contact with the object to be reinvented to receive from its form all the useful information to rethink it. It is a design where the conception process is immediately tied to the hand. The first principle of this type of design is the manipulation of the object: “[v]ery often this type of design does not require traditional conceptualization with drawings, sketches, or other, but direct manipulation of the objects to be reused, a manual observation turning and flipping the object in the hands.”⁵¹ A second principle is decontextualization, that is, the way of changing the intended use of an object to create another. To give just one example, think of bottles used to make lamps. The last principle is fragmentation, that is, dividing objects into parts to make a new object.

Up to now, we have mentioned cases where an object changes its intended use to acquire another, but reuse design can very well be done while keeping the object's function. If its context changes, that does not mean its function ceases. Take the case of fruit crates: they are containers that, once emptied, can become shelves! The same conceptualization process is found at the basis of making chairs and armchairs from car seats: they keep their function but change context. But it is precisely when an object's function changes that reinvention becomes exciting. As we said: to reinvent is to look at the object differently. It is imagination in power—or the power of imagination—which, as Munari says, is “the means to visualize, to make visible what fantasy, invention, and creativity think.”⁵²

To change the way we look at an object, we can focus on its shape, its

⁵¹ Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Ionio (Cosenza), La Mongolfiera, p. 32.

⁵² Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Ionio (Cosenza), La Mongolfiera, p. 45.

transparency, its modularity, its resistance, its malleability, its rigidity, the presence of holes, etc.: these are all properties of the object that can trigger an inventive cycle of images, to use Simondon's expression from *Imagination and Invention*⁵³.

These properties can be combined with one another to reuse objects. There is, moreover, an entire history of design that is an alternative to innovation—a design that, however, does not oppose the industrial logic of design but stands alongside it with new ways of creating design objects. For example, Victor Papanek proposes “an anti-consumerist rather than anti-industrial vision, which takes a strongly ideological stance as it postulates a design culture as the representation of a social and economic model alternative to current standards.”⁵⁴ In this context, Bruno Munari must also be mentioned, who, in *Le macchine di Munari*⁵⁵, proposes the logic of play as the basis for creative conceptualization founded on the assembly of parts, as a possible principle of redesign. Charles Eames also designed his house-studio using components already existing and available in commercial circuits. To quote Cinzia Picchioni⁵⁶, these are all tips for not buying but for reusing. They can be applied by organizing ideas starting from the objects to be reused. First of all, the plastic bottle—our omnipresent waste. It has a changeable shape and transparency, two elements to exploit from the perspective of reuse. If you press bottles and place them side by side on a metal bar, you get a very original and ethical coat rack. If you exploit its resistance, you can create partition walls or even economical and exceptionally transparent houses. The most widespread use remains that of employing them to make lamps: cut, frayed, assembled, they become sources of light to reinvent space. In this case, the object may lose not only its function but also its integrity and shape to exploit one property of its material—transparency. The lamp becomes the best object of inspiration for reuse: it inspires containers of all kinds. All you need is a low-voltage light source to have efficient and decorative objects.

The second object—or rather, material—that we will analyze is fabric. There is an entire long-standing tradition of fabric reuse: patchwork is the best object-based result that can be obtained from joining old pieces of fabric taken from worn or unused clothing. In this case, the color of the fabrics is exploited and explored to create new objects. Reuse design truly began with fabrics: clothing, bags, lamps, ottomans, armchairs, and a whole series of objects born from textile industry waste. Like fabric, cardboard lends itself to many uses: there is an entire series of armchairs and seats made from rethought and reused cardboard.

Another property to exploit is the sound an object can produce. The Italian musical group *Capone e i Bungt Bangt* reuses plastic bands, wrenches, curtain rods,

⁵³ Simondon, G., 2008, *Imagination et invention (1965–1966)*, N. Simondon (ed.), J.-Y. Chateau (intro.), Chatou, La Transparence.

⁵⁴ Pagliero, A., 2007, *Redesign. L'oggetto ritrovato*, Pescara, Sala, p. 60.

⁵⁵ Munari, B., 2001, *Le macchine di Munari*, Mantova, Corraini.

⁵⁶ Picchioni, C., 2013, *Consigli contro gli acquisti. Consumare meno e vivere meglio con la semplicità volontaria*, Torino, Edizioni L'Età dell'Acquario.

a vacuum cleaner tube, and the cup of a shock absorber to produce sounds like those of the double bass, xylophone, transverse flute, and tubular bells. Now, in the contemporary world, the omnipresent waste is electronic. The Economic and Social Research Center *Occhio del Riciclone* notes that “the life of computers has shortened significantly in a very short time [...]. How can we get rid of computers? How can we recycle their parts? [...] It is in this context that [...] trashware is born, a neologism that designates a reuse practice that can take two options: the reuse of discarded hardware or the elimination of old PCs as special waste. Trashware fruitfully reuses decommissioned computers destined for disposal: they are practically computers recovered from the trash that are reassembled for socio-cultural utility purposes.”⁵⁷ But reuse, as we have seen, is not only an economic and ethical practice to follow in the field of design. It has also been employed in art: one can cite the case of Dada, Surrealism, and later Manzoni and Burri.

Let us finish by looking at a contemporary case, straddling design and pure art.

5. Reusing the Object and Its Components: The Case of Rondella

The reuse of objects and components of objects became a common practice starting in the 20th century. The obsolescent object or its parts become works of art in several ways:

“Assemblage is its use as a material element to be composed from abstract or natural patterns; insertion is its connection to other materials according to the artist’s free choices; camouflage and/or transformation is its hidden use so as not to appear as what it is; and finally, reproduction is its representation as the object of a different creative operation”⁵⁸.

The artists of the time (Picasso, Manzoni, Duchamp...) used waste or objects deprived of their function to create unique pieces. But this uniqueness is not the same as that of objects produced by Artecnic, which share a common project, the same concept: they are unique because the idea embodied in them cannot be reproduced, and that is why they are works of art. It is the same process as in ‘poor art,’ minimal and trash art—that is, the art ‘of reversing the meaning of the word wreck; by closely observing the shapes, colors, and materials of our waste, it may be possible to consider and measure the behaviors of individuals and society, to reflect on the mountains of polluting garbage that grow exponentially and suffocate our planet’⁵⁹.

⁵⁷ Centro di Ricerca Economica e Sociale dell’Occhio del Riciclone (ed.), 2009, *La seconda vita delle cose. Il riutilizzo, nuova frontiera per la gestione dei rifiuti*, Milano, Edizioni Ambiente, p. 133.

⁵⁸ Pulvirenti, E., 2009, *Design del riuso. Quando un problema diventa una soluzione*, Doria di Cassano allo Jonio (Cosenza), La Mongolfiera, p. 24.

⁵⁹ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell’arte*, Roma, Meltemi, pp. 158–159.

Thus, straddling art and design, an Italian artist, Rondella⁶⁰, creates little robots that do nothing—that is, with the sole function of decoration—using components from worn-out, broken, dismantled, discarded technical objects. Rondella is a mysterious artist, as they do not reveal their given name. After losing their job due to the economic consequences of the Covid-19 syndemic, they reinvented themselves by exploiting their qualities as a multifaceted artist. Their passion for old, worn, obsolescent objects, which they found everywhere (at home, on flea market stalls, in the trash), led them to invent a true profession: rescuing technical objects or at least their components, which, reimagined and manipulated, become the eyes, arms, legs, bodies, heads, and accessories of their robots. Rondella thus rediscovers an ancient art: that of our grandparents who, during the war, made real toys out of metal boxes, cardboard, etc.—a practice still widespread among children in the Third World. Here, these objects do not serve as toys but as decorative pieces, although the principle remains the same: playing with waste, which, as Appiano says, is ‘the testimony of the traces of time and space.’⁶¹ Moreover, around their robots, Rondella builds a true fantastical world: the little robot is indeed ‘endowed with speech,’ as Rondella invents a story for each one, which may well be accompanied by photos (a photo-novel), sending amusing yet deeply ethical messages. Furthermore, Rondella is a committed artist who collaborates with the association AI.MCTO, which supports children affected by a rare genetic pathology, Multicentric Carp Tarsal Osteolysis. On this subject, on their Facebook page, Rondella recounts the story of a child from Geneva whose dream they fulfilled: a little robot resembling them, that is, with some small joint problems. In addition, Rondella stimulates their own inventiveness and that of the youngest by sending a personalized, ethically sustainable little robot in response to the drawings they receive. With Rondella’s enterprise, as Appiano notes, ‘we glimpse the aesthetic and creative potential of an art that, like a dreamlike X-ray, exorcises decay through wreckage [...] and illuminates the intimate desire not to start from scratch every day, but to rediscover daily space with the instruments of a primitive demiurge—the pieces of wood, the remnants, the waste and debris forgotten by history—for the construction of a personal cabinet of curiosities.’⁶²

6. The principles of reuse

Now, to return to the general discourse, there is a whole series of actions to undertake in order to ethically reinvent an object, to make it reborn or give it another life. Simondon [MOU1.1] considers that an object is a human invention that embodies in its functioning a mental schema. To reinvent through reuse, one must rethink this schema, which means rethinking a functioning according to a new circular economy of invention. Thus emerges a true method of reinvention with its rules and stages:

⁶⁰ Site officiel, <https://www.rondella.it> (last consultation).

⁶¹ Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell'arte*, Roma, Meltemi, p. 10.

⁶² Appiano, A., 1999, *Estetica del rottame. Consumo del mito e miti del consumo nell'arte*, Roma, Meltemi, p. 161.

relearn to observe—that is, disrupt the traditional way of apprehending the object; rethink it—that is, develop a new hypothesis about its potential function; manipulate it, make contact with it, get hands-on; and finally realize it, bring it back to life, the final stage of this new discourse of method. To look again, to rethink, to manipulate above all, to realize—these are matters for artisans, artists, designers, but above all they are human matters, those of a human rediscovering the world, coming to be reborn, rediscovering themselves as a child. Indeed, children are often the best reusers of waste. Our future hope.

7. Educating for Reuse: the Example of the ‘Angelo Fortunato Formiggini’ High School in Sassuolo

It is precisely to the new generations that the project of a group of art history teachers from the ‘Angelo Fortunato Formiggini’ High School in Sassuolo, near Modena in Italy, is addressed. In ... the Italian Ministry of University and Research established the requirement of school-work alternation in secondary schools. Within the framework of this law, this group of dedicated teachers put their skills as architects, engineers, and artists at the service of a restoration project for their school building, with the support of students and using recycled or discarded materials. Thus, pallets were transformed into public benches installed in the school gardens, which host during breaks all those who want to rest, but especially students with disabilities who spend their time doing outdoor activities; a satellite dish became the support for the logo of an association for abandoned animals managed by one of the teachers coordinating the project; colorful fabric scraps were used to decorate a bench and the wall above a school window, creating a cheerful and informal effect.

As Simondon rightly foresaw, the advent of a technical culture is a matter for the young, who must be educated—and educate themselves—in techniques, in their understanding, in respect for objects, in a benevolent contemplation followed by action, namely their maintenance and recovery to prevent obsolescence. This is democratic education, lessons drawn from an object that radiates wherever it is found; it is the education of a society aware of its finitude but not based on ‘the heuristic of fear’ in Jonas’s sense to apply the principle of responsibility, rather on the active and thus informed construction of new cognitive frameworks regarding technology and its objects—our allies in building a better future world: ‘deepened technology must learn not only to invent the new, but to reinsert the old and to update it so as to make it a present under the call of the future. [...] World is rich.’⁶³

⁶³ Simondon, G., 1983, “Trois perspectives pour une réflexion sur l’éthique et la technique”, in *Sur la technique (1953–1983)*, J.-Y. Chateau (ed.), Paris, PUF, p. 75.

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How to define the normativity of techniques in the era of the Capitalocene and surveillance?

Jim Schrub

Résumé

L'article examine la manière de définir la normativité des techniques à l'ère du capitalocène et du capitalisme de surveillance, en partant du constat que l'économie capitaliste est responsable d'une destruction systématique des espaces de vie — économiques, mentaux, sociaux et politiques. Pour nommer ce processus, l'auteur mobilise le concept d'écofragmentation, inspiré de Baptiste Morizot, et propose de repenser la technologie à partir de ce que Gilbert Simondon appelle l'alimentation, entendue comme l'articulation entre moyens, fins, énergie, matériaux et motifs humains. Le texte analyse le capitalisme de surveillance comme un système sociotechnique qui dépend structurellement du travail humain invisibilisé, en particulier de la modération commerciale des contenus. À partir du cas des travailleuses et travailleurs du Sud global, l'auteur soutient que ce travail consiste à assumer des traumatismes psychiques « pour les autres », déplaçant les normes de vie et instaurant une division du travail affectif et perceptif. À cette dimension s'ajoute la matérialité du numérique, marquée par l'extractivisme minier et l'exploitation des populations humaines et non humaines. En s'appuyant sur le concept simondonien de transindividuel, l'article affirme que penser des technologies d'avenir suppose de faire collectif avec celles et ceux qui produisent matériellement et symboliquement le monde technique.

Mots-clés : Normativité des techniques; Capitalocène; Capitalisme de surveillance; Écofragmentation; Transindividuel.

Abstract

The article examines how to define the normativity of technologies in the era of the Capitalocene and surveillance capitalism, starting from the observation that the capitalist economy is responsible for a systematic destruction of living spaces—economic, mental, social, and political. To name this process, the author mobilizes the concept of ecofragmentation,

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Aion Journal of Philosophy and Science

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inspired by Baptiste Morizot, and proposes rethinking technology on the basis of what Gilbert Simondon calls *alimentation*, understood as the articulation between means, ends, energy, materials, and human motives. The text analyzes surveillance capitalism as a sociotechnical system that structurally depends on invisibilized human labor, particularly commercial content moderation. Drawing on the case of women and men workers in the Global South, the author argues that this labor consists in assuming psychological trauma “for others,” thereby displacing norms of life and instituting a division of affective and perceptual labor. Added to this is the materiality of the digital, marked by extractivist mining practices and the exploitation of human and nonhuman populations. Building on the Simondonian concept of the transindividual, the article argues that thinking about “technologies of the future” requires forming collectives with those who materially and symbolically produce the technical world.

Keywords : Technological normativity; Capitalocene; Surveillance capitalism; Ecofragmentation; Transindividual.

Surveillance and eco-fragmentation

The capitalist economy is the main agent of the unprecedented destruction of living spaces currently underway, both in the North and the South. We propose to use B. Morizot’s term, *eco-fragmentation*, to name this systematic mode of destruction. By living spaces, we mean not only the spaces of economic life, but also the destruction of spaces of mental life, social life, and political life.

This has methodological consequences: today, we are seeking new norms for political, legal, social, environmental, and economic life... All these areas of normative reflection can be brought together in what Simondon calls *alimentation*. By *alimentation*, we should understand both the supply of energy and materials, as well as the motives and purposes of human groups. In other words, in *alimentation*, we encounter the collusion between means and ends. Accepting this starting point allows us to formalize the requirements carried by the notion of “future technology”, insofar as these will not be conceivable merely as means, but must be considered as integrating the human as one of their parts¹. They must therefore take into account human normativity, that is, not damaging the future potential carried by living beings

Let’s take an example: surveillance capitalism, extensively described by S. Zuboff (2019), first corresponds to a large socio-technical system. It is produced through a four-step process of creating dependency on a service, initiated by an initial capture in an undefended zone and over the long term (in contrast to the instantaneity glorified for consumers). According to Zuboff, these steps are incursion, habituation, adaptation, and redirection; but each stage of the cycle is a gamble, an

¹ Simondon, G., 2012, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 97.

objective whose success depends on a power relation where temporality is decisive². This power relation justifies Anna Tsing's characterization of capitalism as a 'joyful mess,' always chasing after itself and its own success. To operate the technical environment of this economic order, which synthesizes various technical ensembles (cables, satellites, antennas, software, and computers, for example) resulting from historical competition, the human operator is always required. A social network functions thanks to human labor, such as commercial content moderation practices, which contribute to the conditions of possibility for the proper functioning of the object. At this first level, we must add a second: the material condition of possibility of the object, namely, at the starting point, mining.

Let's start with content moderation. The Kenyan workers at Sama, who need no introduction. What is the role of these workers? What does it concretely mean to recruit "web cleaners"? I propose the following definition: the function of Sama workers, and of all the people who do this job³, is to traumatize themselves for others. Commercial content moderation consists of taking care of someone else's perceptions, but at one's own expense. In this sense, philosopher J. Dean is right to criticize the illusory space of universal communication that Web 2.0 would represent: it is mainly about organizing the division of perceptual labor (of violence). Yet such a "division of perceptual labor" is not a matter of perception: the division of the experience of violence is indeed a matter of norms of alimentation because the experience of violence shifts the norms of life. One could even speak of this job as affective rather than perceptual work (without, however, providing the salary, psychological support, or the necessary equipment and health apparatus for these activities). The shift in life norms is this: intrusive thoughts, nightmares, increased propensity to consume drugs or alcohol, increased risky behaviors, desocialization. What consequences does this have for what we are trying to think about, the definition of a "technology of the future"?

First, that a *technology* of the future must be a normative philosophy that does not separate technical reflexivity, environmental reflexivity, and the lessons of the sociology of work. Technical networks and contemporary digital objects rely, for their continued proper functioning, on permanent human participation. The gigantic private digital platforms have their underpaid staff.

Thus, anyone who builds a technology that ignores its *human conditions of possibility*, which are just as material, would be on the wrong track. What is at stake here are our conceptions of technology *and* the future. The future is what carries another: this is the real compatibility (defined negatively by a non-destructive relationship) with a living environment, of which "nature" and humans are part.

² Here, the legal timeframe *for responding to the incursion* is incompatible with combating the cycle of dispossession, unless its outcomes make it possible to lock in adaptation and redirection.

³ Roberts, S. T.; Casilli, A. A.; Renaut, S., 2020, *Derrière les écrans: Les nettoyeurs du Web à l'ombre des réseaux sociaux*, Paris, La Découverte.

The transindividual, the possible, and the required

Let us now turn to the material conditions of existence of the technical network serving surveillance capitalism, which begin with the mining sector. Systext reports inform us about the (disastrous) ecological impact of mining—but we still need to integrate the human “into the loop”. Pascal suggested conceiving the human species as a single old man. Today, this old man is the one whose story Simondon tells elsewhere: a man who would have sold an eye to benefit from a restorative operation on his leg. The leg? The non-negotiable lifestyle of rich countries. The eye? The miners whose rights are trampled—as documented by S. Kara in *Cobalt Red*. The eye? The workers of the Crolles Valley, where STMicroelectronics sustains residents through wages while draining the valley, depriving humans and other living animals of water. The eye? The populations of the Atacama Desert, whose way of life and millennia-old tradition of transhumance are gravely endangered by Western desires for electric cars (Chile does not extract its resources for itself nor to equip its own populations, who risk displacement)⁴. In short: eco-fragmentation, the destruction of living spaces, is the destruction of life.

It so happens that Simondon developed a (rather famous) concept to think about the constitution of a living space⁵, both individual and collective: the transindividual. It consists of the encounter between affective-emotional experience and action. Every meeting between affective-emotivity and action produces a Collective, not necessarily composed of humans, but of which humans are a part. Do we today form a collective with those who manufacture and handle *our* world? This is not a matter of representations or visibility, but of acts and axiology: to say that this collective is missing is to say that *we do not begin by thinking or acting with them*. Nor do we begin by thinking with technical reality, for that matter. Overwhelmingly in the social field, none of these realities of world production are taken into account in our relationship to technical objects. Yet this is a condition for distinguishing what is merely possible from what is required, from what can be considered as “future-oriented”.

For *all this is possible* without being required. What is required is axiological, and its open determination involves mobilizing political economy and the sociology of work to rethink the redefinition of collectives that exist materially without existing symbolically or politically, and which are technical and human collectives. This is

⁴ Blair, J. J. A.; Balcázar, R. M.; Barandiarán, J., *et al.*, 2023, “The ‘Alterlives’ of Green Extractivism: Lithium Mining and Exhausted Ecologies in the Atacama Desert”, *International Development Policy – Revue internationale de politique de développement*, no. 16, <https://journals.openedition.org/poldev/5284#quotation> (last consultation: 26 February 2024).

⁵ In this sense, the living space is a broader notion than that of a territory to be defended.

something akin to an extension of class consciousness at play here, and it justifies—borrowing A. Monnin’s expression—the need to politicize renunciation.

Dismiss infinity

Defining our time through the search for norms of alimentation means questioning the link between the technical and the human in terms of the requirement for reciprocal compatibility, extended to the entire biosphere. Simondon saw in the atomic bomb a matter-energy relationship that could only lead to destruction: at this level, the use and functioning of the object converge in a pathological relationship to existence. If convergence is possible in destruction, we can imagine compatibility in openness. This compatibility implies a temporal axis, corresponding to a requirement for durability that allows us to move beyond a spatial, synchronic imaginary of communication between machines and with humans in the technical domain.

But what does this collective mean on the individual level, and what are the consequences of these proposals for the relationship between the transindividual and the future?

For Simondon, anxiety is affectivity without action—a polarity that leads nowhere. Does the reverse exist? Action without affective-emotivity, without individuation of a collective. In 2022, *Everything Everywhere All at Once* by D. Kan and D. Scheinert illustrates this with a character: Jobu Tupaki. Without recounting the film: Tupaki is omnipotent, navigating an infinity of possible worlds and versions of herself. She loses all sense of meaning. Classic problem: if everything is possible, then nothing makes sense. Infinite capacity faced with infinite possibilities deprives Tupaki of anxiety and the possibility of meaning, but not of distress. She objectifies this in the “bagel”, which absorbs all worlds so that they exist simultaneously in the same place: a full version of chaos. How to escape? One must choose the finite. In this case, the character’s mother, Evelyn, prevents the absorption of everything into the chaos-bagel by restoring her relationship with her daughter and choosing her own world.

This is the transindividual. “Forming a Collective” is a necessary condition for the individualization of the subject; it is the *metaxu*⁶ of its affectivity within emotion-action:

Affective universes, or rather emerging affective universes, only lead to distinct and uncoordinated subsets as long as action—or the analogue of action in its aspect of interiority—does not intervene. The coordination of primary affective dimensions cannot be accomplished within the subject without the intervention of the collective, because the col-

⁶ The link.

lective is necessary for emotion to be actualized⁷

In the transindividual, the encounter between action and affective-emotivity corresponds to the collusion between causality and finality—between alimentation (including motives, “the analogue of action in its aspect of interiority,” which is decision) and action, as they produce a collective. This collective is a passage from the infinite to the finite: the collective cuts through the infinity of possible relations with the world—this is incompatible with the promises of capitalism. And for us, forming a collective with these technical and human agents in this way means refusing the morbid delegation of psychic traumas associated with life on Web 2.0, and refusing the exploitation of living humans in the mode of contemporary slavery to guarantee the continuity of our services “while we look for something better than the electric car”.

15. Our double eco-fragmentation—the destruction of living spaces (biological, social-mental)—first seemed to challenge our perception (destruction of perceptual experience by hot media) and action (imprisonment in a mechanistic-behaviorist conception of humans and capture by the attention hunt for which capitalists compete). Yet thinking about future technologies requires moving beyond this prism in favor of questions of alimentation—these invite us to transform the contours of our own conception of technical objects and networks, and with them, of ourselves and human groups. It is an invitation to form a collective with those who *make* our world, human and technical beings we mostly ignore. This completely redraws the map of our social relations and makes much more evident and bearable—indeed absolutely desirable—the renunciations and struggles that accompany the fight against the Capitalocene and its drive toward infinity. For infinity is not the future, and the future is not a technical category, even though it demands compatibility among the ensembles formed by humans, technical objects, and their networks. Thus, accepting finitude is an urgent cultural task, which will transform our relationship to technology and our consumption practices. And we can also say that redefining the possible through what is required, which shapes and limits it, is just as urgent, however painful the consequences of such a proposal may be *for us*.

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⁷ Gilbert SIMONDON, 2005. *L'individuation à la lumière des notions de forme et d'information*, Grenoble, Jérôme Millon, coll. « Krisis », p. 252.

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Progress and Growth. A Comparison between Technical and Biological Evolution

Silvia de Cesare & Vincent Bontems

Résumé

Dans cet article, De Cesare et Bontems comparent les concepts de progrès et de croissance dans l'évolution technique et dans l'évolution biologique, en proposant une analyse critique des analogies entre ces deux domaines. En s'appuyant sur la philosophie de la technique de Gilbert Simondon et sur la théorie évolutionniste contemporaine, en particulier telle qu'elle est développée par Silvia De Cesare, les auteurs distinguent le progrès purement performatif du progrès authentique. Au niveau technique, Simondon définit le progrès comme un processus de concrétisation, par lequel les objets deviennent plus cohérents, autosoutenables et mieux couplés à leur milieu, évitant ainsi les évolutions hypertéliques marquées par une spécialisation excessive. Au niveau biologique, l'article montre qu'il est possible de parler de progrès local comme amélioration fonctionnelle adaptative sans recourir à des valeurs morales, tout en soulignant les limites liées à la fragilité associée à la suradaptation. À des échelles de temps plus longues, l'évolutivité est proposée comme critère d'un progrès organique global, entendu comme la capacité à générer de la diversité face à l'instabilité environnementale. Enfin, le texte dissocie le progrès de la croissance (démographique ou économique), en soutenant que la situation écologique contemporaine exige de repenser le progrès technique indépendamment de l'augmentation quantitative, ouvrant même la voie à l'idée d'un « progrès négatif » orienté vers la soutenabilité, la réduction de la puissance et la préservation de l'évolutivité des systèmes vivants.

Mots-clés : Progrès technique et biologique; Philosophie de la technique; Concrétisation; Évolutivité; Progrès et croissance.

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Abstract

De Cesare and Bontems compare, in the article, the concepts of progress and growth in technical evolution and biological evolution, offering a critical analysis of the analogies between these two domains. Drawing on Gilbert Simondon's philosophy of technology and contemporary evolutionary theory, especially as developed by Silvia De Cesare, the authors distinguish merely performative progress from genuine progress. On the technical level, Simondon defines progress as a process of concretization, through which objects become more coherent, selfsustaining, and better coupled to their milieu, thereby avoiding hypertelic evolutions marked by excessive specialization. On the biological level, the article shows that it is possible to speak of local progress as adaptive functional improvement without appealing to moral values, while emphasizing its limits due to the fragility associated with overadaptation. At longer timescales, evolvability is proposed as a criterion of global organic progress, understood as the capacity to generate diversity in the face of environmental instability. Finally, the text dissociates progress from growth (demographic or economic), arguing that the contemporary ecological situation requires rethinking technical progress independently of quantitative increase, even opening the way for the idea of "negative progress" oriented toward sustainability, the reduction of power, and the preservation of the evolvability of living systems.

Keywords: Technical and biological progress; Philosophy of technology; Concretization; Evolvability; Progress and growth.

Introduction

Technical objects and living beings are connected by a very strong and long-standing analogy, which can already be traced back to Aristotle¹. Today, from an evolutionary perspective that has asserted itself since the publication of *On the Origin of Species* by Charles Darwin², one can easily identify a common point between technical objects and living beings: both have an evolutionary history. Indeed, one can speak of biological evolution just as one can speak of technical evolution. In the biological case, it is possible to identify lineages, that is, organisms that represent the same "branch" of the evolutionary tree. In the technical case, one can analogously refer to technical lineages, a concept developed within the framework of French mechanology by Jacques Lafitte³.

In both domains, the technical and the organic, a central question can be posed

¹ Canguilhem, G., 2008, *Knowledge of Life*, New York, Fordham University Press.

² Darwin, C., 1859, *On the Origin of Species by Means of Natural Selection*, London, John Murray.

³ Lafitte, J., 1932, *Réflexions sur la science des machines*, Paris, Vrin.

in the same terms: does it make sense to say that evolutionary change proceeds “toward the better”? The question amounts to asking whether the concept of progress, including an axiological component and a descriptive component⁴, can legitimately be employed to describe these two types of evolution. The notion of progress as meliorative evolution was introduced by Francis Bacon in the domain of the sciences and the arts⁵. Technical progress proceeds through artifacts that are increasingly efficient according to criteria that remain to be determined. By analogy, in the organic case, the idea of progress designates the fact that the evolution of living beings would imply, in part or in its entirety, a change toward the better⁶.

Alongside the term progress, another term can be used in relation to both domains: that of *growth*. The term growth is used in biology to describe the increases (in size and in number of cells) that occur during the life history of an organism⁷. By extension, it can be used in reference to a population of organisms. Thus, with respect to human beings, the term growth describes the demographic increase of the human population, but also designates, by analogy, economic growth as measured through various indicators. These two types of growth (demographic and economic) are often associated, in one way or another, with technical evolution.

In the case of both living beings and technical objects, it is therefore possible to speak of *progress* and *growth*. However, it is important to avoid presupposing the validity of the analogies suggested by the use of the same vocabulary. In this contribution, our aim is to clarify the way in which these terms can be understood in their respective domains and thus to assess the validity of the analogies. On the biological side, we will refer to evolutionary theory as it originates in the thought of Charles Darwin, by adopting the conceptual framework recently presented in De Cesare⁸. On the technical side, we will rely on the analysis of the mode of existence of technical objects developed by the French philosopher Gilbert Simondon⁹, whose relevance is increasingly recognized in the field of philosophy of technology¹⁰, drawing in particular on the recent synthesis proposed by Bontems¹¹. We will address the following questions:

- a) What does “progress” mean in relation to technical evolution as understood within the perspective of Gilbert Simondon?

⁴ Guffroy, Y., Bontems, V., 2018, “La mécanologie : une lignée technologique francophone ?”, *Artefact*, 8, pp. 255–280.

⁵ Bacon, F., 1605, *The Advancement of Learning*, London, Thomas Huggins.

⁶ Ruse, M., 1996, *Monad to Man. The Concept of Progress in Evolutionary Biology*, Cambridge (MA), Harvard University Press.

⁷ Wilt, F. H., 2025, “Growth”, *Encyclopedia Britannica*, <https://www.britannica.com/science/growth-biology> (last consultation).

⁸ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁹ Simondon, G., 2013, *Du mode d'existence des objets techniques*, Paris, Aubier.

¹⁰ Bontems, V., 2018, “On the Current Uses of Simondon’s Philosophy of Technology”, in *French Philosophy of Technology: Classical Readings and Contemporary Approaches*, Loeve, S., Guchet, X., Bensaude Vincent, B. (eds.), Cham, Springer.

¹¹ Bontems, V., 2023, *Au Nom de l’Innovation. Finalités et modalités de la recherche au XXI^e siècle*, Paris, Les Belles Lettres.

- b) What does “progress” mean in the context of evolutionary theory?
- c) In what way is this organic progress analogous to technical progress *sensu* Simondon?
- d) Given that the Simondonian notion of technical progress is detached from that of growth, what can be said of an analogical notion that would apply to both technology and living beings?

Before addressing these questions, it will be necessary to begin by highlighting the differences and the common points between technical evolution and biological evolution, which will make it possible to keep in mind the respective specificities of these two domains

1. Differences and common points between technical evolution and biological evolution

In her classic study, the philosopher Mary Hesse¹² considers analogy to be a system of relations linking an object or a system of objects (called the source) to another object or system of objects (called the target). Hesse takes from the inductivist epistemology of J. M. Keynes the distinction between the positive and negative contents of analogy. Positive analogy consists in the properties and relations that are common to both objects (or systems), whereas negative analogy consists in the dissimilarities between the two¹³. Beyond an attempt at formalization, her personal contribution was to define the *neutral* content of analogy, namely the set of properties or relations shared by the two systems, but also by many others that do not validate the analogy.

Hesse was the first to point out the difficulties encountered by this framework for analyzing analogies: in order to evaluate the positive, neutral, and negative contents, it is necessary to resort to a weighting of the different properties or relations being compared. However, a distinction must be made between material and formal analogies. Material analogies concern properties or relations that depend on concrete resemblances between objects or systems of objects, whereas formal analogies are established between mathematical formulas that model these properties and relations independently of any material resemblance. Even when it is specified that formal analogies are the ones relevant to science, the oversimplification of the procedure for evaluating analogies has been noted by many epistemologists, among them Leatherdale¹⁴, who emphasizes that formal analogies are established between models of objects rather than the objects themselves. Leatherdale further insists on the fact that an analogy is always established between relations within models. Simondon adopts

¹² Hesse, M., 1963, *Models and Analogies in Science*, London, Sheed and Ward.

¹³ Frigg, R., Hartmann, S., 2024, “Models in Science”, in *The Stanford Encyclopedia of Philosophy*, Zalta, E. N., Nodelman, U. (eds.).

¹⁴ Leatherdale, W. H., 1973, *The Role of Models, Metaphors and Analogies in Science*, New York, Elsevier.

an equivalent definition (“an analogy is a resemblance of relations and not a relation of resemblance”)¹⁵ and distinguishes between structural analogies, which concern properties and spatial relations, and operational analogies, which concern processes and which alone are valid¹⁶. The respective validity of material, formal, structural, and operational analogies as applied to the technical domain has been examined in Bontems¹⁷.

In the case that concerns us, the comparison between technical and organic evolutions also leads to privileging operational analogies and to emphasizing from the outset the importance of the negative content of any possible analogy between biological evolution (as described by Darwinian theory) and technical evolution as analyzed by the “mechanologists.” A first difference is that technical objects, unlike organisms, lack the capacity to reproduce themselves and to generate variability. Seals can produce seal offspring, but forks cannot produce baby forks¹⁸. Genetic drift is a mechanism that can lead to significant consequences in biological evolution, whereas there is no equivalent on the technical side. The industrial “reproduction” of objects is relatively constant and weakly variable. Certainly, technical evolution exhibits many cases in which a fortuitous or deliberate modification improving the performance of an object is carried over into subsequent “generations,” but this means that such a modification has been incorporated through a modification of production processes. Technical evolution therefore does not present operational analogies with the processes of spontaneous mutation, genetic recombination, or reproduction rates.

A second difference is that organic forms are subject to natural selection, which is a mechanical and “blind” process, whereas technical objects can be intentionally selected by human beings. Although some economists¹⁹ draw a parallel between the economic selection of innovations and natural selection, it is necessary to keep in mind the significant differences between the two selection mechanisms. Certainly, biological evolution and technical evolution may display a similar pattern of alternation between phases of diversification and selection, as well as between phases of stability or oriented or divergent evolution according to a succession of “punctuated equilibria.”²⁰ However, the two types of evolution operate on disparate time scales and through radically different mechanisms²¹.

There is then a third operational difference: unlike what occurs in technical evo-

¹⁵ Simondon, G., 2005, *L'Individuation à la lumière des notions de forme et d'information*, Grenoble, Millon.

¹⁶ Simondon, G., 2005, *L'Individuation à la lumière des notions de forme et d'information*, Grenoble, Millon.

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¹⁸ Lewens, T., 2024, *Quatre questions à Tim Lewens*, O. Morin.

¹⁹ Zuscovitch, E., 1990, “Progrès technique, évolution économique et sélection naturelle”, *Revue française d'économie*, 5, pp. 105–134.

²⁰ Gould, S. J., Eldredge, N., 1977, “Punctuated equilibria: the tempo and mode of evolution reconsidered”, *Paleobiology*, 3, pp. 115–151.

²¹ Mokyr, J., 1990, *The Lever of Riches: Technological Creativity and Economic Progress*, Oxford, Oxford University Press.

lution, change is irreversible in organic lineages. If an organic form has become entirely extinct (or if another form has succeeded it within a lineage), it cannot naturally reappear²². By contrast, if a technical object is abandoned at a given moment in human history, it may later be rediscovered and reused according to what has been called the “Lazarus effect.”²³ Nothing prevents the reinvention of a vanished object or the reuse of an abandoned process. In other words, the irreversibility of biological evolutions stands in contrast to the omnitemporality of technical possibilities.

When Gilbert Simondon applies to technology concepts drawn from the life sciences (“lineage,” “hypertely,” “milieu”), this in no way implies that he neglects the negative components of the analogy. In a comparison made by Simondon between technical and biological lineages in *On the Mode of Existence of Technical Objects*, the philosopher emphasizes the difference between *the produced* and *the generated*: “Transposed into biological terms, technical evolution would consist in the fact that a species would produce an organ that would be given to an individual, thereby becoming the first term of a specific lineage which would in turn produce a new organ.”²⁴ This possibility, which is specific to technical evolution, stands in contrast to the constraints of biological evolution, in which the transmission of organs between individual lineages does not exist in the natural state.

By contrast, without ignoring the differences, Simondon highlights a common point between technical objects and living beings: both oppose disorder and, ultimately, death. In *Individuation in the Light of the Notions of Form and Information*, Simondon²⁵ advances the hypothesis that “vital individuation would come to be inserted into physical individuation by suspending its course, slowing it down, and rendering it capable of propagation in an inchoate state.”²⁶ He defines the machine as a negentropic organization of matter: “the machine, as a work of organization, is, like life and together with life, that which opposes disorder, the leveling of all things that tends to deprive the universe of powers of change.”²⁷ Thus, vital individuation as well as technical invention are two becomings of physical individuation that *slow down* its dissipative process. The machine, like the living being, resists the dissipation of its potentials and maintains, through its exchanges of matter, energy, and information with its milieu, a metastability. In this respect, the machine and the living being do not share the same status as stable and inert inorganic matter.

This common point represents, in Simondon’s view, the most important positive component of the analogy. In the case of human living beings, technical evolution

²² We will not discuss here human attempts to counter such irreversibility, notably through so-called “deextinction” efforts involving species such as the woolly mammoth (on this topic, see for example Paganeli, B., Galetti, M., 2025, “DeExtinction at a Crossroads: Ecology, Ethics, and the Future of Conservation in the Biotech Age”, *Ecology Letters*, 28(9)).

²³ Eldredge, N., 2011, “Paleontology and Cornets: Thoughts on Material Cultural Evolution”, *Evolution: Education and Outreach*, 4, pp. 364–373.

²⁴ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 82

²⁵ Simondon, G., 2005, *L’Individuation à la lumière des notions de forme et d’information*, Grenoble, Millon.

²⁶ Simondon, G., 2005, *L’Individuation à la lumière des notions de forme et d’information*, Grenoble, Millon, p. 152.

²⁷ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 18.

constitutes an attempt to obstinately oppose disorder. In both cases, there would therefore be progress when evolution produces individuals that resist entropy more strongly, even though they are produced through very different mechanisms (fabrication and generation). In both cases, while keeping the dissimilarities in mind, it is possible to speak of lineages. The question that now remains to be analyzed is whether (and in what sense) these two types of evolution involve a progress that can be measured by analogous criteria.

2. Technical Progress in Simondon

This brings us to address question (a) mentioned above: what does progress mean in relation to technical evolution as understood within the perspective of Gilbert Simondon? To answer this, we will first discuss technical progress within the lineage and the associated milieu; we will then specify what the criteria of technical performance are and in what sense genuine technical progress is not hypertelic. Finally, we will address the question of progress *beyond* the lineage and the associated milieu.

2.1. “Concretization” and its relativity to “associated milieus”

In Simondon²⁸, technical progress is defined as a process of concretization. A lineage begins with the invention of an “abstract individual.” The object is abstract in the sense that its elements are recruited in order to each fulfill a function contributing to the realization of the technical operation, without the totality of the effects of their interactions being anticipated, in particular certain undesirable effects (heating, friction, etc.). The technical individual then “evolves,” that is, its genesis is modified by agents (the restriction of these agents to human beings being open to discussion: animals or artificial intelligences may also intervene). This evolution takes place through a succession of minor advances (partial modifications) and major advances (global reconfigurations).

Minor advances consist in modifying a subsystem or an interface in order to attenuate the residual incompatibilities between the different elements that make up the technical system, until its organization becomes “saturated,” that is, until no further modification can improve its functioning in one respect without degrading it in another. At the time when Simondon produced this analysis, the Soviet engineer Genrich Altshuller arrived at similar conclusions, but by distinguishing more precisely between three types of “contradictions” encountered in technical evolution: the “physical contradiction,” when achieving an improvement would require a parameter to evolve in two opposite directions; the “technical contradiction,” when the improvement of one parameter leads to the degradation of another; and the “coupling contradiction,” when an improvement entails a degradation of the relation to the

²⁸ Simondon, G., 2013, *Du mode d'existence des objets techniques*, Paris, Aubier.

associated milieu²⁹.

Saturation results from the accumulation of minor advances and requires a major advance in order to be overcome, that is, a reinvention of the global organization of the technical object. This operation consists in redistributing the various functions assigned to the elements, either through a convergence of functions, leading to an increased multifunctionality of the new elements, or through the dissociation of functions previously assigned to a single element. The result is always a more synergistic functioning of the individual, *but also* of the system constituted by this functioning together with its associated milieu. And it is in this respect that the crucial distinction lies between genuine progress, which potentially resolves all three types of contradictions, including the coupling contradiction, and a mere improvement in performance.

It is necessary to emphasize that the technical individual does not find its conditions of existence solely in the internal coherence of its structure with respect to the operation it performs (that is, in becoming progressively less selfdestructive), *but also in the relations that this operation maintains with its milieu*. This milieu is both natural and artificial. The technical individual inserts itself into this milieu and, through its functioning, contributes to bringing it into existence. The process of concretization thus constitutes a progress both toward *autocorrelation* and toward *self-regulation*, which amounts to a tendential naturalization of the artificial individual, becoming increasingly similar to a living individual (which is perfectly “concrete”). In Simondon’s words, “the concrete technical object, that is, the evolved technical object, approaches the mode of existence of natural objects: it tends toward internal coherence, toward the closure of the system of causes and effects that operate circularly within its enclosure; moreover, it incorporates a part of the natural world that intervenes as a condition of functioning and thus becomes part of the system of causes and effects.”³⁰

The progress of technology thus presupposes, in its very definition, an adaptation relative to natural conditions that the object transforms—through its own functioning or through ancillary dispositifs—so that these conditions constitute its associated milieu. Now, this circular causality between the technical individual and its associated milieu is not static, since it consists in the coordination between variations in the regime of functioning of technical objects *and* variations in the associated milieu. Thus, as early as 1958, Simondon arrives at the following precise definition of technical progress: “The necessity of adaptation not to a milieu defined in an exclusive way, but to the function of establishing a relation between two milieus, both of which are themselves evolving, limits adaptation and gives it precision in

²⁹ Altshuller, G., 1999, *The Innovation Algorithm. TRIZ, Systemic Invention and Technical Creativity*, Worcester, Technical Invention Center.

³⁰ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 56.

the direction of autonomy and concretization. There lies true technical progress”³¹.

2.2 Two kinds of improvement in technical performance

Let us now try to understand by what criteria one can measure the degree of concretization of the technical individual. Within a technical lineage, the transition between two successive generations of individuals constitutes progress if the coupling of the new individuals with their associated milieu is more *durable*, in the sense that, on the one hand, their functioning is less selfdestructive and, on the other hand, the homeostasis of their associated milieu is maintained. This implies that technical functioning consumes the material and energetic resources of the milieu more sparingly and ingeniously extracts information from it, thereby enabling the regulation of its functioning. One then observes that the progress of concretization coincides with the pursuit of efficiency. Abstract individuals make inefficient use of matter, energy, and information; this is why they are both selfdestructive and destructive. This becomes progressively less the case with increasingly concrete individuals. Concretization is accompanied by *measurable* improvements in performance: the technical individual wears out more slowly, achieves higher efficiency, and integrates information from the milieu more extensively and more effectively.

However, it must be emphasized that Simondon insists on the distinction between evolutions that constitute such progress and other evolutions that are also accompanied by improvements in performance but which he designates as “hypertelies.” This term, borrowed from biological vocabulary, designates the development of a morphological trait that may become counterproductive—for example, the antlers of deer, whose large size provides advantages (notably in competition for sexual reproduction) but can eventually hinder the animal’s movement. Analogously, technical individuals may be adapted to a given milieu and a particular function in such a way as to achieve superior performance, but at the cost of losing their “genericity”³²: they become more vulnerable to variations in the milieu and less effective for other functions.

How can one distinguish between evolutions that are genuinely progressive (processes of concretization) and hypertelic ones? This is not easy to establish on the basis of measuring the performance criteria of the privileged function (*key performance indicators*) within a given milieu. Indeed, in both cases there is an improvement in specific performance. By contrast, one may assume that the difference becomes manifest as soon as one measures the full *set of generic performances of the technical individual*. In his course on “*Invention and the Development of Techniques*,” Simondon³³ develops a rational classification of machines according to their

³¹ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 65.

³² Shinn, T., 2008, *Research Technology and Cultural Change: Instrumentation, Genericity, Transversality*, Oxford, Bardwell Press.

³³ Simondon, G., 2005b, *L’Invention dans le développement des techniques*, Paris, Le Seuil.

type of functioning (passive, active, and informational) and their degree—that is, according to the relations between their functioning and the scales within the object and the associated milieu (structure, microstructure, higherlevel scales). Thus, the solidity of a tool’s handle fitting is a “passive performance of the first degree,” the energetic efficiency of an internal combustion engine is an “active performance of the second degree,” and a computer’s capacity to produce meaning is an informational performance of the third degree. This classification constitutes a universal analytical framework for the generic performances of a technical object³⁴. It can be represented in the following table:

Type / Degree	Minor	Intermediate	Superior
Passive	1 Structural qualities <i>E.g.: solidity</i>	2 Material qualities <i>E.g.: resistance</i>	3 Environmental qualities <i>E.g.: stability</i>
Active	4 Qualities of internal Mobility <i>E.g.: mechanical efficiency</i>	5 Qualities of energy conversion <i>E.g.: thermal efficiency</i>	6 Qualities of external mobility <i>E.g.: range and amount of work performed (load/distance)</i>
Informational	7 Qualities of transmission <i>E.g.: speed and fidelity</i>	8 Qualities of amplification <i>E.g.: sensitivity and resolution</i>	9 Qualities of meaning <i>E.g.: processing of complexity through autocorrelation (AI)</i>

The work carried out by Guy³⁵, Guy, Bontems & Minier³⁶, and by Minier & Bontems³⁷ confirms that hypertelic evolutions are characterized by the improvement of a single privileged function, often at the expense of other performances, whereas major advances lead to the improvement of several performances, or even of all of them simultaneously.

Let us take the example of two cases of hypertelic evolution. The customization of the ultrashortpulse laser (LIBS) of the spectroscopy instrument onboard *Curiosity*, a Martian rover, was overadapted to its extraterrestrial environment and, above all, to the conditions of its journey (strong vibrations during launch and landing

³⁴ Bontems, V., 2016, “Sur la classification des objets techniques selon Simondon”, *Artefact*, 3.

³⁵ Guy, T., 2019, “Relecture mécanologique de la lignée des télescopes”, *Artefact*, 10, pp. 99–118.

³⁶ Guy, T., Bontems, V., Minier, V., 2019, “Quel laser pour Mars ? Analyse mécanologique d’une innovation extraterrestre”, in *Gilbert Simondon et l’Invention du futur*, Bontems, V. (ed.), Paris, Les Belles Lettres.

³⁷ Minier, V., Bontems, V., 2016, “Simondon et l’innovation dans les machines spatiales de l’astronomie”, *Nacelles*, 6, online.

on Mars). The main improvement concerned a passive criterion of major degree (stability through the damping of disturbances at higher scales), at the expense of its energy efficiency and the fineness of its operations. Conversely, the laser used to study paintings at the Louvre is extremely delicate but not very robust. Whether in the case of the laser onboard *Curiosity* or in the case of the Louvre laser, both constitute hypertelic innovations.

Unlike hypertelic evolutions, which represent evolutionary dead ends insofar as the object becomes overadapted to a single function in a single environment, major technical advances (or concretizations) are characterized by an increase in all performances and by greater functional diversity. In Maunoury's terms³⁸, the progress of a technical lineage is manifested by a simultaneous improvement of the 'horizon of feasibility' and the 'horizon of creativity.' Thus, the invention of the maser, followed by that of the laser, and finally of LIBS, represent the crossing of thresholds of concretization, with the invention of LIBS making possible both the laser on *Curiosity* and that of the Louvre.

2.3 Technical progress beyond the lineage and the associated milieu

Since the measurement of performance is always relative to the associated environment, and since comparison of the degree of concretization only makes sense within a lineage, it is tempting to conclude that the notion of technical progress has meaning only within a lineage³⁹ and within a specific cultural context of application⁴⁰.

However, Simondon is not satisfied with this restriction: technical progress cannot be reduced to the improvement of a technical scheme; *it also involves the invention of new schemes that replace previous ones*. He thus indicates that the transition from the lineage of electronic tubes to that of semiconductors constitutes a progress in the 'pure operational scheme' of 'asymmetric conductance.'⁴¹ This broadens the assessment of progress to an entire family of lineages stemming from the initial invention: 'one could say that the technical object evolves by generating a family: the original object is the ancestor of this family. One could call such an evolution *a natural technical evolution*.'⁴²

If a technical lineage corresponds to the succession of individuals possessing a technical scheme that carries out the same operation and is subordinated to the same function, the family corresponds to the set of lineages that possess the same 'pure' technical scheme—that is, that carry out operations which are certainly different

³⁸ Maunoury, J.L., 1968, *La Genèse des innovations : la création technique dans l'activité de la firme*, Paris, Presses Universitaires de France.

³⁹ Guchet, X., 2005, *Les Sens de l'évolution technique*, Paris, Léo Scheer.

⁴⁰ Basalla, G., 1988, *The Evolution of Technology*, Cambridge, Cambridge University Press.

⁴¹ Simondon, G., 2013, *Du mode d'existence des objets techniques*, Paris, Aubier, p. 42.

⁴² Simondon, G., 2013, *Du mode d'existence des objets techniques*, Paris, Aubier, p. 43.

but are based on the same physical principle of operation. Following Maunoury⁴³, it should also be specified that this pure scheme must be subordinated to analogous functions; otherwise, the comparison may lose its relevance⁴⁴. It remains to be determined to what extent the previous analyses concerning the measurement of technical progress can be transposed to this broadened framework (beyond the lineage and the associated environment)

Electronic tubes and semiconductors belong to the same technical family because, even though they do not perform the same operations, they use asymmetric conduction to form chains of ‘logic gates.’ When the first transistor was invented, it performed this function less well than highly perfected electronic tubes, yet it already represented a form of progress. To extend the notion of technical progress to a ‘substitution after saturation’⁴⁵ between lineages within the same family, it must be shown that the new technical scheme offers superior *potential* performance according to most criteria. Although the highly concretized object of the first lineage possesses performances superior to those of the abstract object of the new lineage, it also exhibits signs of ‘saturation,’ that is, it can evolve only in a hypertelic manner: any improvement in one type of performance comes at the cost of the degradation of another. Thus, the semiconductor transistor displays a greater potential for evolution than electron tubes, and its lineage did not take long to supplant them⁴⁶. Sometimes, the two lineages can coexist and even be combined within the same technical system. Thus, in the Herschel satellite one finds two different lineages of bolometers: the historical lineage of horn bolometers—robust, perfectly mastered, but saturated—and the innovative lineage of pixel-matrix bolometers⁴⁷.

In the case of comparing lineages that do not belong to the same family—that is, whose principles of operation are radically different but which nonetheless fulfill the same function (such as a computer and a Babbage machine, in which gears play the role of logic gates)—the difficulty is of a different order. Mere comparison of performance can sometimes be misleading, since hypertelic evolutions also increase certain performances. Simondon is cautious about the ‘selfevidence’ of progress in this type of comparison. Common sense readily accepts that the computer represents a form of progress compared to the Babbage machine; but ultimately, one should not be content with observing performance gains alone, and should also consider the relation to the associated milieu: is it more sustainable? In the ‘Interview on Mechanology,’ Simondon even asserts the relative superiority of steam locomotives over electric locomotives under very particular historical circumstances (those of the

⁴³ Maunoury, J.L., 1968, *La Genèse des innovations : la création technique dans l’activité de la firme*, Paris, Presses Universitaires de France.

⁴⁴ See the example of the “wheel” in Simondon, G., 2014, *Sur la Technique*, Paris, Presses Universitaires de France.

⁴⁵ AïtelHadj, S., 2000, *Systèmes technologiques et Innovation*, Paris, L’Harmattan.

⁴⁶ Chevignard, E., 2025, *Du transistor à l’intelligence artificielle*, PhD dissertation, Université ParisSaclay.

⁴⁷ Minier, V., Bontems, V., Minier, V., 2016, “Simondon et l’innovation dans les machines spatiales de l’astronomie”, *Nacelles*, 6.

Liberation), emphasizing their autonomy with respect to the power supply network⁴⁸. This dependence on the associated milieu is not, however, absolute. Simondon could not have accepted the supposition of an absolute incommensurability of contexts⁴⁹.

Simondon could have agreed with Basalla that the wheel constituted a technical family that was little exploited by the Incas because of the specific conditions of their geographical environment (movement across rugged mountainous terrain), biological conditions (the absence of draft animals), and social conditions (the abundance of servile labor), without this implying any technical inferiority of their civilization. However, Simondon emphasizes, in ‘Culture and Technique,’⁵⁰ that machinic industrialization represents a technical progress insofar as it draws its energy from sources other than the bodies of living beings, makes possible the standardization of spare parts—which improves the durability of objects—and tends to free technology from cultural limitations. This does not mean that he defends the myth of progress, deconstructed by Basalla, as a justification for Western imperialism and capitalist exploitation. On the contrary, he denounces the ravages of the overexploitation of natural resources as a ‘rape of Nature.’⁵¹ Moreover, in the 1970s and 1980s, he insists that the growth of industrial activities threatens the homeostasis of the global environment⁵². In Simondon’s definition of technical progress at the level of the individual—as autocorrelation and self-regulation—one already finds a criterion of sustainability in the relationship between the technical system and the associated milieu. This criterion retains its full significance when the horizon of measurement is extended beyond the limits of a single technical lineage or a defined associated milieu. The complexity of translating it into performance metrics, however, becomes extreme because of the diversity of types (passive, active, and informational) and degrees (scale relations with the milieu). Life Cycle Assessment (LCA) procedures give an indication of this complexity.

3. Organic Progress and Evolutionary Theory

Now that the notion of technical progress in Simondon has been clarified, we can move on to questions (b) and (c) mentioned above: what can ‘progress’ mean in the context of evolutionary theory, and in what sense is this organic progress analogous to technical progress *sensu* Simondon? To answer these questions, drawing on the contribution of De Cesare⁵³, we will discuss the issue of organic progress, each time highlighting, by way of contrast, the positive content of the analogies with technical progress as conceived by Simondon. We will begin by examining local organic progress, showing in what sense adaptive change within a lineage can be described

⁴⁸ Simondon, G., 2014, *Sur la Technique*, Paris, Presses Universitaires de France.

⁴⁹ Bontems, V., 2023, *Au Nom de l’Innovation*, Paris, Les Belles Lettres.

⁵⁰ Simondon, G., 2014, *Sur la Technique*, Paris, Presses Universitaires de France.

⁵¹ Simondon, G., 2014, *Sur la Technique*, Paris, Presses Universitaires de France, p. 15.

⁵² on this point, see the contributions in Barthélémy, J.H., Duhem, L. (eds.), 2022, *Écologie et Technologie. Redéfinir le progrès après Simondon*, Paris, Matériologiques.

⁵³ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

as progressive. This will also make it possible, by analogy with Simondon's analysis, to clarify the difference between hypertelic and nonhypertelic adaptations. Finally, we will address the question of the possibility of an organic progress that goes beyond mere improvements in performance.

3.1. Context of the Debate and the Conceptual Framework Proposed by De Cesare (2026)

The idea of organic progress is intricately entangled with the history of biological thought. Ruse⁵⁴ is well known for having shown that in Darwin, as well as in many twentieth-century evolutionary biologists, one can observe the persistence of the idea that evolution entails a change for the better. The American paleontologist Stephen Jay Gould⁵⁵ argued that this idea is not at all implied by the very framework (the '*bare bones*') of evolutionary theory: it persists within biology for extrascientific reasons (such as *Homo sapiens*' desire to conceive of itself as superior to other organisms), rather than for reasons internal to the theory itself.

Recently, the work *Organic Progress and Evolutionary Theory*⁵⁶ has sought to shed light on this issue, which remains a source of controversy to this day. Starting from the observation that a change for the better presupposes an axiological opposition between good and bad, the author examines the meaning of these normative terms and clarifies that, within evolutionary theory, it is possible to assert 'x is good' in the sense that 'x has instrumental value for z.' This analysis, drawing on the work of Rosenberg and McShea⁵⁷, makes it possible to rule out any appeal to value in the sense of final value, in which x would be intrinsically good as an end in itself. This reference to instrumental value allows any notion of good/better in the moral sense to be excluded. De Cesare⁵⁸ thus proposes to speak of organic value, according to which it makes sense to formulate statements such as 'an organ is good for a biological function' or 'a biological function is good for the survival and reproduction of organisms.' Such statements, indeed, make sense in relation to organic performance in a given environment. For example, one can assert that 'a shell is good for the function of defense in gastropods, in such-and-such an environment,' and in turn that 'this function is good with a view to the survival and reproduction of the organism, in such-and-such an environment.' De Cesare⁵⁹ therefore proposes speaking of good/better in this very specific sense, which describes the relationship between organic entities and their environments.

3.2 Local organic progress: the adaptive process within a lineage

⁵⁴ Ruse, M., 1996, *Monad to Man*, Cambridge (MA), Harvard University Press.

⁵⁵ Gould, S. J., 1985, "The paradox of the first Tier", *Paleobiology*, 11(1), pp. 2–12; Gould, S. J., 2002, *The Structure of Evolutionary Theory*, Cambridge (MA), Belknap Press.

⁵⁶ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁵⁷ Rosenberg, A., McShea, D., 2008, *Philosophy of Biology. A Contemporary Introduction*, New York, Routledge.

⁵⁸ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁵⁹ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

On the basis of this notion of organic value, De Cesare⁶⁰ examines the notion of local progress, that is, improvements in performance that concern short and medium scales in evolutionary time. The author follows Dawkins's⁶¹ proposal, according to which the very concept of adaptation already involves a reference to a 'change for the better': namely, the fact that equipment for survival can improve within a lineage in certain evolutionary situations. According to Dawkins, the comparison concerns ancestors and descendants within a lineage⁶². Taking the example of gastropods again, and adopting Dawkins's criterion, it would be possible to argue in favor of an improvement of the shell (from a biomechanical point of view) within the lineage. This kind of empirical work has been carried out, for example, by the paleontologist Geerat Vermeij, who has shown such improvements in marine gastropods through the fossil record⁶³. One may also cite observations of improved performance in experimental evolution studies, such as Richard Lenski's *LongTerm Evolutionary Experiment* (LTEE)⁶⁴.

De Cesare⁶⁵ proposes that when this kind of adaptive process occurs, it is possible to speak (with reference to the notion of organic value) of a functional improvement of organic traits (*Functional Improvement of Organic Traits*). In other words, adaptation can be understood as an improvement in performance, within a lineage, in a local environment. The author also emphasizes, following Lewontin⁶⁶, that this requires considering organic traits 'in isolation,' that is, decomposing organic traits and the environmental problems organisms face. As noted by Lewontin⁶⁷, this requires assuming a *ceteris paribus* clause (all other things being equal) with regard to the other traits. For example, when we say that more recent gastropods exhibit shells that are more resistant to breakage compared to those of past gastropods, we assume a *ceteris paribus* clause with respect to the ways organisms respond to other environmental challenges (resource acquisition, reproduction, etc.).

This analysis presents noteworthy similarities with the technical progress within a lineage as described by Simondon. We have seen that, for the philosopher, the improvement of a technical object presupposes an adaptation to the *associated milieu* (which the object itself helps to create) through selfregulation, that is, also in relation to variations in that milieu. In the organic case, during an adaptive process, there is likewise a relation between two terms: organisms (which can be decomposed into organic traits) and a more or less variable local environment. One would therefore have an analogy of the following kind:

⁶⁰ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁶¹ Dawkins, R., 1997, "Human chauvinism", *Evolution*, 51(3), pp. 1015–1020.

⁶² Dawkins, R., 1997, "Human chauvinism", *Evolution*, 51(3), pp. 1015–1020.

⁶³ Vermeij, G. J., 1987, *Evolution and Escalation: An Ecological History of Life*, Princeton, Princeton University Press.

⁶⁴ See the discussion in De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, section 7.

⁶⁵ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁶⁶ Lewontin, R. C., 1978, "Adaptation", *Scientific American*, 239(3), pp. 212–218.

⁶⁷ Lewontin, R. C., 1978, "Adaptation", *Scientific American*, 239(3), pp. 212–218.

- The technical object (T) is in relation to its associated milieu (more or less variable).
- The organism (O) is in relation to its local environment (more or less variable).

In both cases, there can be improvement over time in the sense that one can observe, within the lineage of T or within the lineage of O, better performances in descendants, in contexts comparable to those of their predecessors. In both cases, it is possible to focus attention on a specific performance criterion. One would therefore have an analogy of the following kind:

- Within the lineage of T, the T‘descendants’ display better performance than the T‘ancestors’ with respect to a given criterion (e.g. parsimonious consumption of resources) in an analogous environmental context.
- Within the lineage of O, the O‘descendants’ display better performance than the O‘ancestors’ with respect to a given criterion (e.g. parsimonious consumption of resources) in an analogous environmental context⁶⁸.

In the same way as in the technical case, it is possible to evaluate an organism with respect to multiple performance criteria. In the case of adaptations, the strategy borrowed from Lewontin⁶⁹ consists in saying that one observes an improvement in performance with respect to a specific criterion, while assuming a *ceteris paribus* clause for the other performances. We have also seen above that, in the technical case, performance improvement can take two forms: hypertelic and nonhypertelic. Is there something similar in the organic case? For a technical object, Simondon argues that it is not viable to have an ‘exaggerated specialization,’ to be adapted ‘to a milieu exclusively.’⁷⁰ For example, Simondon considers that early airplanes, ‘which could land in open countryside, were less functionally overadapted than modern airplanes.’⁷¹

This would thus be a case of hypertelic adaptation. Simondon suggests that, in the organic case, this would correspond to specialized interspecific interactions, ranging from symbiosis to parasitism. One might think of the case of the tambalocoque (*Sid-eroxylon grandiflorum*), a tree endemic to Mauritius and threatened with extinction⁷². The seed of this tree is surrounded by an extremely hard endocarp, which must be broken for the seed to germinate. One hypothesis is that, in the past, the function of

⁶⁸ Here one can point to a negative analogy between the technical and the organic cases (see De Cesare, S., 2019, “Disentangling organic and technological progress...”, *Studies in History and Philosophy of Biological and Biomedical Sciences*, 73).

⁶⁹ Lewontin, R. C., 1978, “Adaptation”, *Scientific American*, 239(3), pp. 212–218.

⁷⁰ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, pp. 61 and 65.

⁷¹ Simondon, G., 2013, *Du mode d’existence des objets techniques*, Paris, Aubier, p. 61.

⁷² De Cesare, S., 2022, “L’idée de progrès chez Simondon”, in *Écologie et Technologie*, Barthélémy, J.H., Duhem, L. (eds.), Paris, Matériologiques, pp. 31–48.

enabling germination was ensured by passage through the digestive system of the dodo⁷³. The extinction of the dodo, which occurred at the end of the seventeenth century with the arrival of Europeans, would have put an end to this possibility of germination. If this hypothesis is correct, it would mean that the tambalocoque was overadapted: its exaggerated specialization would have placed it in a position of fragility with respect to changes in environmental conditions.

The existence of hypertelic adaptations nevertheless remains compatible with the criterion of local organic progress proposed by Dawkins⁷⁴ and revisited by De Cesare⁷⁵: it is entirely possible for an improvement in organic performance to occur within a lineage and for this to later result in the extinction of that lineage following a change in the environment (because of overadaptation). The notion of local progress therefore does not allow one to distinguish as clearly as Simondon would wish between adaptation and overadaptation, since progress can be accompanied by a form of ‘organic fragility.’ It may thus appear somewhat disappointing. To determine whether, in the biological case, one might hope to find a more robust notion of progress, it is necessary—just as Simondon also recommends when evaluating technical objects—to focus on the question of organic progress over long time scales, that is, on the question of global progress.

3.3 Long-term organic progress: evolvability

When it comes to global progress, the issue is no longer one of identifying small local improvements relative to a specific environmental context, but rather of identifying something that would be good for organisms ‘in general,’ that is, tendentially in any environmental context. Ideally, one should be able to observe that such a beneficial property shows an increase in its spread across different environments over the course of evolutionary history, and that this increase is caused by the mechanism of natural selection. Several criteria of global progress have been proposed in the literature and have been summarized by Rosslenbroich⁷⁶. A nonexhaustive list includes: complexity (morphological or hierarchical), energy intensiveness, autonomy from the environment, exploitation of environmental heterogeneity, and evolvability⁷⁷.

The strategy adopted by De Cesare⁷⁸ is to first explain why complexity cannot be a good criterion of global progress. The next step is to reflect theoretically by posing the following question: what would be an environmental problem that presents itself to all kinds of organisms, from microorganisms living in hydrothermal vents to elephants? Drawing on an idea from Georges Canguilhem, De Cesare proposes

⁷³ Temple, S., 1977, “Plantanimal mutualism”, *Science*, 197.

⁷⁴ Dawkins, R., 1997, “Human chauvinism”, *Evolution*, 51(3), pp. 1015–1020.

⁷⁵ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁷⁶ Rosslenbroich, B., 2006, “The notion of progress in evolutionary biology”, *Biology and Philosophy*, 21, pp. 41–70.

⁷⁷ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press, pp. 64–66.

⁷⁸ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

that this problem consists in environmental instability itself. In the long term, what is ‘better’ for organisms is to be prepared for the potential ‘infidelity of the milieu.’ This property is discussed in contemporary biological literature under the name of ‘evolvability.’

Evolvability applies to different biological systems and at different scales: microevolution, macroevolution, genomes, and clades⁷⁹. It is a dispositional concept, since it does not refer to characteristics that are currently in place, but rather to a general disposition to evolve. Evolvability is also necessarily linked to the notion of variability, that is, the disposition to vary. Despite the difficulty of empirically testing whether evolvability does indeed increase over the course of evolution, De Cesare⁸⁰ suggests that it can be considered a criterion of global progress, by reference to the conceptual framework proposed by Bourrat, Daeven, and others⁸¹.

Without going into the details of this framework, the important point to retain is that the evolutionary success of an organism (which we may call a Type1 organism) in an environment cannot be reduced to the notion of adaptation to a given local environment (the reference environment). A second characteristic that must be taken into account is the robustness of the adaptation, defined as the probability that the Type1 organism will leave descendants (of the same type) in an environment different from the reference one. But it is also necessary to take evolvability *stricto sensu* into account: the probability that this organism will generate daughter populations of a different type (Type2), whether in the reference environment or in another one. In short, when these two characteristics are taken into account, it would be reductive to evaluate the evolutionary success of an organism solely by looking at its local adaptation to a given environment. On the contrary, it is essential to consider the robustness of this adaptation and the evolvability potential of the organic form in question.

In what sense would this global progress be analogous to technical progress *sensu* Simondon? This is undoubtedly a positive content of the analogy that must be handled with caution. We have seen that, for Simondon, technical progress cannot be reduced to the improvement of a technical scheme; it also involves the invention of new schemes that replace previous ones. Technical progress beyond a single lineage would therefore also consist in the fact that each stage of concretization brings about an increase in genericity, that is, in the diversification of the functions that can be assigned to the lineage. In this sense, Maunoury⁸² defines the ‘flourishing of the technical lineage’: the ‘ancestor’ technical object evolves by engendering a family of lineages stemming from the initial invention, and the progress of each lineage gives rise to increasingly diversified potential uses.

In the biological case, when one is concerned with global progress, attention

⁷⁹ Bourrat, P., Daeven, K., Villegas, C., 2024, “Evolvability”, *Biology & Philosophy*, 39(4), pp. 1–24.

⁸⁰ De Cesare, S., 2026, *Organic Progress and Evolutionary Theory*, Cambridge, Cambridge University Press.

⁸¹ Bourrat, P., Daeven, K., Villegas, C., 2024, “Evolvability”, *Biology & Philosophy*, 39(4), pp. 1–24.

⁸² Maunoury, J.L., 1968, *La Genèse des innovations*, Paris, Presses Universitaires de France.

is also given to what becomes, over the long term, of an organic form, without restricting the search for improvement to within a single lineage. There is probably a positive content to the analogy: evolvability *stricto sensu*⁸³ would indeed translate into diversification, since it would involve the production of daughter populations of a different type from the initial type. By contrast, it is very important to recall the negative analogies highlighted in Section 1. In particular, the notion of variability that characterizes an organic population—central to the notion of evolvability—has little in the way of an equivalent in the technical case⁸⁴.

4. Progress et Croissance

We have now clarified, on the one hand, the notion of technical progress in Simondon, and on the other hand, the notion of organic progress, while highlighting the positive content of the analogies with technical evolution. In light of these elements, let us now try to address the remaining question: what is the status of the notion of growth in relation to that of progress?

As mentioned in the introduction, the term *growth* is used in biology to describe increases (in size and in number of cells) that occur during the life history of an organism⁸⁵, and by extension in reference to a population of organisms. If one sets aside increases in size during development, *growth would thus refer to an increase in numbers*, whether of cells (for example in the process of cell division) or of individuals that make up a population. We have also seen that this application to populations appears when one speaks of growth in reference to the species *Homo sapiens*, since the term can describe the demographic increase of the human population. With reference to human beings, an even more specific use of the term is found in economic growth. This can be defined as the process by which the wealth of a nation increases over time⁸⁶, the most commonly used indicator to measure it being Gross Domestic Product (GDP). It should be noted that there is not necessarily a correlation between demographic growth and economic growth: a rapidly growing human population may constitute either an advantage or a disadvantage for economic growth⁸⁷. The question that concerns us, however, is the following: *what is the relationship between progress and growth?*

Let us first consider the biological case. We have seen that organic progress can

⁸³ As defined by Bourrat, Daeven et al., 2024.

⁸⁴ Among the technical objects catalogued in the history of technology, one finds few examples of random variations that clearly degrade the performance of an object. Nevertheless, the analogy with biological variability was once defended (Kiesler 1939), by considering “consumerist” objects (designed to be sold according to nontechnical criteria) or simulated objects that are not necessarily realized. However, Bontems (2023) observes that the main French theorists of technology (Lafitte, LeroiGourhan, Simondon, Deforge) conceived technical evolution according to a model that does not require random variability analogous to that of neoDarwinian evolutionary theory (Lafitte even proposing an evolution analogous to Lamarckian theory).

⁸⁵ Wilt, F. H., 2025, “Growth”, *Encyclopedia Britannica*.

⁸⁶ Cornwall, J. L., 2026, “Economic growth”, *Encyclopedia Britannica*, <https://www.britannica.com/money/economic-growth>.

⁸⁷ Cornwall, J. L., 2026, “Economic growth”, *Encyclopedia Britannica*.

refer to two things. First, to an improvement in organic performance with respect to a local environment. Second, to the notion of evolvability: the dispositional capacity of an organic form to exhibit robustness in the face of environmental change and a potential ability to generate new organic forms. While the first notion can prove ambivalent, or even counterproductive when environmental conditions change, the second is more robust and concerns longer time scales. What is the relationship between these two notions and that of growth (in terms of the number of individuals in a population)? It certainly seems possible to envisage that an improvement in performance (through adaptation) might confer an advantage on a population over others, giving it the capacity to increase more rapidly in numbers. By contrast, the more robust notion of progress as evolvability does not necessarily go hand in hand with growth, but rather with the production of daughter populations of a different type from the initial one. One might of course think that in a very large population there is more variability, and therefore more potential for evolvability. But one might also envisage a population whose numbers increase very rapidly (at a time t), yet whose longterm evolutionary persistence is threatened by its overadaptation to particular conditions. Conversely, one can imagine an organic form that gives rise to various populations limited in number but that persist over the long term.

Let us now consider the case of the species *Homo sapiens*, whose specificity lies in having extended organic evolution through the evolution of technologies. Here, one must take into account the relations among several terms: the evolvability of *Homo sapiens* as a species, technical progress, and growth (both demographic and economic). It is not easy to identify a strict relationship among these terms, but the current situation strongly suggests that an increase in one of these elements does not necessarily coincide with an increase in another. Certainly, in the past, technical progress coincided with phases of demographic and economic growth, and this occurred without concern for the consequences in terms of the evolvability of *Homo sapiens*. The present situation is different, however, since we have become aware of the finitude of resources, of problems linked to climate disruption, and of the consequences for biodiversity. Demographic and economic growth has clearly been achieved at the expense of the evolvability of many other species, and given the importance of interspecific interactions, one can consider that this degradation potentially threatens the human species itself. As Simondon puts it, the changes brought about in the milieu have exposed *Homo sapiens* to a danger of ‘maladaptation.’⁸⁸ Rather than stubbornly seeking to return to a past situation, it would now be necessary, in order to reverse the trend, to reinvent the notion of progress so that it can accompany the technical system toward degrowth. This seems to be what Simondon suggests when he speaks of ‘regress,’ asserting that ‘the essence of progress can be present within processes

⁸⁸ see De Cesare 2022 on this point

of degradation.’⁸⁹ The idea would be to dissociate technical progress from growth, to lower the threshold of overall power employed, and to proceed with a reduction of human activity.⁹⁰ Such new ecotechnological regulations could make it possible to maintain a viable relationship between *Homo sapiens* and its milieu, thereby preserving the conditions of vital individuation for other species. The assessment of such progress would retain the same orientation—namely, the struggle against entropy and the establishment of a sustainable relationship with a milieu that is now irreversibly affected—but it would no longer rely on local measurements of the performance of organic or technical individuals. To prioritize the evolvability of *Homo sapiens* would require refocusing reflection on the question: with which living beings and technical systems does humanity envision its future?

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⁸⁹ Simondon, G., 2015, “Le progrès, rythmes et modalités”, *Critique*, 816; see also Bontems, V., 2022, “Écotechnologie : entre exotranscendance et rétroscalabilité”, in *Écologie et Technologie*, pp. 83–105.

⁹⁰ Bontems, V., 2022, “Écotechnologie : entre exotranscendance et rétroscalabilité”, in *Écologie et Technologie*, Paris, Matériologiques.

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Pharmacology of computational automata: from generative AI to contributive recommendation, toward future technologies

Anne Alombert¹

Résumé

L'article propose une analyse pharmacologique des automates computationnels contemporains, en mobilisant le concept platonicien de *pharmakon* — à la fois remède et poison — afin de penser les effets ambivalents des technologies numériques actuelles. À partir du mythe de l'écriture dans le *Phèdre* de Platon, l'autrice montre que toute technique d'extériorisation de la mémoire implique à la fois une amplification et un risque d'appauvrissement des capacités humaines. Cette ambivalence est reprise pour analyser les dites intelligences artificielles génératives, qui accroissent la productivité textuelle et iconographique au prix d'une délégation des capacités expressives, interprétatives et imaginatives des sujets. Le texte soutient que ces systèmes ne constituent pas des formes de conscience artificielle, mais de nouveaux *pharmaka* numériques, responsables de processus de prolétarianisation de l'esprit, au sens de Bernard Stiegler, analogues à la prolétarianisation du travail décrite par Marx. En outre, l'autrice critique la notion d'« IA générative » et propose le concept d'IA extractive, dans la mesure où ces systèmes se nourrissent de l'exploitation non rémunérée des productions culturelles collectives, transformant la mémoire sociale en capital. L'article met également en évidence les risques d'homogénéisation culturelle, d'appauvrissement linguistique et de désinformation, aggravés par la circulation massive de contenus générés automatiquement et par les algorithmes de recommandation opaques des grandes plateformes numériques.

Mots-clés : Pharmakon numérique; Automates computationnels; Intelligence artificielle générative; Prolétarianisation de l'esprit; Extractivisme numérique.

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Aion Journal of Philosophy and Science

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Abstract

The article proposes a pharmacological analysis of contemporary computational automata, mobilizing the Platonic concept of *pharmakon*—at once remedy and poison—in order to think through the ambivalent effects of current digital technologies. Drawing on the myth of writing in Plato's *Phaedrus*, the author shows that every technique of exteriorizing memory entails both an amplification and a risk of impoverishment of human capacities. This ambivalence is taken up to analyze so-called generative artificial intelligences, which increase textual and visual productivity at the cost of delegating subjects' expressive, interpretative, and imaginative capacities. The text argues that these systems do not constitute forms of artificial consciousness, but rather new digital *pharmaka*, responsible for processes of proletarianization of the mind, in Bernard Stiegler's sense, analogous to the proletarianization of labor described by Marx. Moreover, the author criticizes the notion of "generative AI" and proposes the concept of extractive AI, insofar as these systems feed on the unpaid exploitation of collective cultural productions, transforming social memory into capital. The article also highlights the risks of cultural homogenization, linguistic impoverishment, and disinformation, exacerbated by the massive circulation of automatically generated content and by the opaque recommendation algorithms of major digital platforms.

Keywords: Digital *pharmakon*; Computational automata; Generative artificial intelligence; Proletarianization of the mind; Digital extractivism.

At the end of the dialogue titled Phaedrus¹, Plato recalls the Egyptian myth of the origin of writing. In this myth, the Egyptian god Theuth, inventor of writing as well as the science of numbers, calculation, geometry, and astronomy, presents his invention to the king of the Egyptians, Thamus. Theuth claims to have found a remedy for memory and learning: writing will allow knowledge to be preserved on a material support and remedy the flaws of individual memories. Not only do individuals never remember perfectly, but they also always end up disappearing, their memories falling into oblivion. Artificial memory through writing thus promises potential immortality. But King Thamus, for his part, distrusts the true effects of this new technique, which he sees as a danger: it risks making citizens' souls forgetful, because they will stop exercising their memory, rely on written traces, and merely repeat speeches without making the effort to understand them. The king worries about the ambivalent nature of the increase promised by Theuth, which risks causing a

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decrease by weakening the mnemonic and interpretative capacities of the population. This is why the technique of writing is described by Plato as a *pharmakon*, a Greek term that means both remedy and poison: while the dead support is essential to assist the flaws of memory capacities, artificial memory always risks substituting for psychic memory—the auxiliary always risks destroying what it was meant to support.

The dangers of computational automata: toward a proletarianization of thought?

In *Schizophrénie numérique (Numerical schizophrenia)*², I tried to show that, however distant they may seem, these reflections of Plato can help us think about the challenges posed by the new writing and calculation machines we face today. Contrary to transhumanist ideologies that fuel promotional discourse about digital innovations, the pharmacological perspective requires abandoning the idea of pure technological “augmentation”: on the contrary, it suggests that technological augmentation always involves a risk of loss or reduction of capacities, against which we must fight. In the case of so-called “generative artificial intelligences” that are developing and spreading today, enabling the massive production of texts and images, the increase in productivity also goes hand in hand with a decrease in capacities. This time, it is no longer only mnemonic capacities that are threatened: when we ask ChatGPT to automatically generate a text, we also delegate our expressive capacities. Instead of forming and expressing our own thoughts, based on our experiences, memories, expectations, and desires, we place an order with a set of algorithmic automata that perform statistical calculations on massive amounts of data and generate probable sequences of signs, while reinforcing averages and majorities, thus amplifying biases. We thereby abandon our faculties of memory, synthesis, interpretation, and singular imagination, which are replaced by standardized mathematical procedures. Consequently, contrary to transhumanist speculations, these so-called “generative artificial intelligences” do not constitute new forms of algorithmic consciousness but new types of digital *pharmaka*, which profoundly affect mental, psychic, and cognitive capacities.

Just as know-how was externalized into machine tools in the form of mechanical automatisms, leading to what Karl Marx described as a process of proletarianization of workers³, so too, the know-how of writing or speaking now seems to be externalized into digital machines in the form of algorithmic automatisms, leading to what philosopher Bernard Stiegler described as a process of “generalized proletarianization”⁴ affecting not only know-how but also know-think (which is based on the practice of oral and written language). If machinic industrialization made it possible to

² Plato, 2006, *Phaedrus*, Paris, GF Flammarion.

³ Alombert, A., 2023, *Schizophrénie numérique*, Paris, Allia.

⁴ Marx, K., 1986, *Le Manifeste du parti communiste*, Paris, Éditions sociales [Original work: *Manifest der Kommunistischen Partei*, 1848].

produce many more objects much faster, this increase could only occur at the cost of uniformizing workers gestures, standardizing the objects produced, and exhausting the natural resources needed to operate industrial machines. Similarly, it now seems necessary to question the hidden costs of algorithmic industrialization, which will undoubtedly allow the production of many more texts and images at a much faster pace, but at what price? Probably at the cost of uniformizing our thinking capacities, standardizing the content produced, and progressively exhausting the linguistic and cultural resources available to operate algorithmic machines.

The limits of “extractive AI”: toward a capitalization of collective culture?

It indeed seems that the functioning of the computational automata developing today relies on the exploitation of collective symbolic resources sedimented on the digital network, which feed the databases on which the algorithms of large language models or image generators are trained. If “generative AIs” can produce highly plausible texts and images, it is because they draw on all the content shared on the Web: for example, on a collaborative encyclopedia like Wikipedia, to which individuals contribute voluntarily, or on various social networks through which individuals communicate daily. Yet content creators are not compensated for the content exploited; only the companies that own the automatic generation systems profit from it. The fascination with machine intelligence thus masks the dispossession of human contributors and the predation of intellectual works. Noam Chomsky has even referred to this as «the greatest theft of intellectual property since the arrival of European settlers on Native American lands»⁵, while Naomi Klein calls it «the greatest plunder in human history».⁶ For the same reasons, Jean Cattan and Célia Zolinski, specialists in digital law, propose speaking of “extractive AI” rather than ‘generative AI.’ In *The Capital That I Am Not! Putting Economy and Digital Technology at the Service of the Future*, we describe this phenomenon as an operation of capitalizing collective memory, which thus becomes a capitalizable stock or an available fund, from which a few hegemonic actors (such as OpenAI, Microsoft, Google, Meta, etc.) seek to profit by subjecting it to fully calculable criteria of selection and exploitation aimed at immediate profitability.

Not only do the designers of LLMs decide, in an opaque manner, the criteria by which certain content will be processed, but above all, these actors, primarily driven by the desire to accumulate capital, attract investments, and increase their market value, do nothing to renew the symbolic resources they exploit. Such renewal of collective culture would require not only compensating those who produce it but also valuing singular and minority expressions: whether artistic creation, technical innovation, theoretical invention, linguistic style, or scientific discovery, the new

⁵ Stiegler, B., 2015, *La société automatique*, t. 1, *L’avenir du travail*, Paris, Fayard.

⁶ Chomsky, N., 2023, “The False Promises of ChatGPT”, in *The New York Times*, March 8, <https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html> (last accessed February 26, 2024).

always emerges against common sense, dominant habits, and majority opinions. Yet algorithmic operations based on probabilistic calculations do not account for original content, which is drowned and rendered invisible in the mass of analyzed material. Algorithms therefore only predict what is most likely to occur. By systematically eliminating any seed of novelty, computational automata tend to threaten linguistic and cultural renewal. Moreover, automatically generated content will soon become dominant on the Web: it will inevitably feed into the training data of algorithms, which will then perform probabilistic calculations on texts that have already been automatically produced. This squared probability can only lead to a progressive homogenization and uniformity of content generated online: what kinds of texts or images will we encounter when chatbots start quoting each other in self-referential loops, endlessly repeating their own artificial nonsense?

The risk of digital disinformation: toward generalized distrust?

This points to a considerable impoverishment of linguistic and expressive diversity, already largely reduced due to the dominance of English on the web and the automatic content recommendations that tend to amplify the most “liked” or “followed” content to keep users engaged on digital platforms, even when these clicks are automatically generated by fake accounts serving disinformation industries. In the context of the post-truth era, characterized by the viral circulation of false information, the rapid development of “extractive artificial intelligences” seems all the more risky. While automatically generated texts may appear well-constructed in terms of grammar, syntax, or spelling, their relationship to truth remains problematic, since they are produced based on statistical calculations. No process of interpretation, reflection, verification, deliberation, or certification governs the creation of these textual products: they therefore constitute neither reliable information nor certified knowledge, but probable sequences of signs (often based on nonexistent citations or references generated by the machine to fulfill a request). Similarly, automatically produced images are not viewpoints on the world, however fictional, but random pixel combinations that may nonetheless appear just as “real” as the photographs that feed their databases.

Automatically generated content can therefore convey all kinds of false information in a highly convincing way, making it indistinguishable from certified information. As a result, it may become difficult for individuals to trust what they read or see: soon everyone will know, through an implicit knowledge that will become common sense, that images may have been produced either by humans or automatically generated by algorithms. Everyone will also know that they cannot immediately distinguish between these two types of “manipulations”. Consequently, every piece of content received will have to be questioned: a generalized distrust is likely to develop, aggravated by disinformation industries that will exploit these new systems to create misleading content or fake profiles. In this context, it becomes

essential to rebuild trust in the digital information environment, notably by acting on recommendation systems, as proposed in a note published by the National Digital Council⁷. Currently, these systems are generally controlled by large private companies that own the most widely used platforms or social networks: tech giants deploy recommendation algorithms that automatically suggest the most viewed, sensational, and shocking content. Moreover, recommendation is made invisible: the user does not know that the recommendation algorithm was designed by a company seeking to capture and sell their attention time, and that the content they access is not representative of all the content circulating on the web.

Conclusion: toward hermeneutic and contributive digital technologies

As dangerous as this situation may be, it is not inevitable: it could be transformed if tech giants were forced to relinquish their monopoly over recommendation functions. Other companies, media outlets, associations, and citizens could then create and deploy their own unique recommendation systems. Indeed, if GAFAM refuse to be considered content publishers like print newspapers, why should they be allowed to impose an editorial line through their algorithms? Conversely, a true digital democracy requires that users of social networks like Facebook or TikTok have the choice between different recommendation systems: they could choose to receive recommendations from Facebook or TikTok if they wish, but also from other actors who would become new trusted third parties, insofar as their algorithms would rely on human evaluations and judgments, not just on quantitative algorithmic criteria. This is the goal of “unbundling” social networks, which many civil society actors advocate today, including the NGO Article 19⁸ and the National Digital Council, by proposing to require companies that own these networks to open up to other recommendation or moderation systems. Furthermore, projects like that of the Tournesol association⁹ demonstrate the possibility of developing collaborative and contributive recommendation systems, offering an algorithm based on citizen votes, inviting them to evaluate content according to explicit criteria (pedagogy, clarity, reliability, relevance, etc.) to recommend content of public utility. We can imagine a multiplicity of such recommendation systems, suggesting content according to diverse specific criteria, by combining algorithms with human evaluations. Such projects reconnect with Stiegler’s perspective of a “hermeneutic web” which proposed to « design and implement tools for (...) polemical communities that reintroduce non-automatic interpretation criteria »¹⁰ into algorithmic functioning, thereby transforming digital technologies into “spiritual instruments” that enable the exercise of judgment and

⁷ Klein, N., 2023, “AI Machines Aren’t ‘Hallucinating’. But Their Makers Are”, in *The Guardian*, May 8, <https://www.theguardian.com/commentisfree/2023/may/08/ai-machines-hallucinating-naomi-klein> (last accessed February 26, 2024).

⁸ Alombert, A., 2024, « Assurer nos libertés à l’ère de l’intelligence artificielle », *Conseil National du Numérique*, March 28, <https://cnnumerique.fr/assurer-nos-libertes-lere-de-lintelligence-artificielle>.

⁹ Article 19, n.d., *Website*, <https://www.article19.org/>.

¹⁰ Tournesol, n.d., *About*, <https://tournesol.app/about>.

deliberation. Instead of fearing supposed “digital minds” threatening humanity, as mentioned in the letter published by the Future of Life Institute co-signed by Elon Musk and many other experts following the release of ChatGPT¹¹, the goal should be to put computational automata at the service of collective intelligence, turning them into hermeneutic and contributive technologies - that is, technologies that carry a future.

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¹¹ Stiegler, B., 2014, “Pharmacologie de l'épistémè numérique”, in *Organologie des savoirs et technologies de la connaissance*, Stiegler, B. (ed.), Paris, FYP, p./pp.

Governing Metastability: Reopening the Question of Progress with Gilbert Simondon

Andrea Bardin & Marco Ferrari

Résumé

L'article propose une réouverture critique de la question du progrès à partir de la philosophie de Gilbert Simondon, en opposant la catégorie de la métastabilité à la notion de homeostase issue de la cybernétique. Les auteurs soutiennent que l'idée moderne de progrès, héritée du déterminisme mécanique et réitérée par les sciences cybernétiques, est « mythique » en ce qu'elle réduit des processus dynamiques à des états fixes et occulte la dimension inventive et contingente du devenir. Cette conception repose sur une double réduction onto-épistémologique : la réduction de la réalité à des structures calculables et de la science à des opérations de calcul, soutenant ainsi une vision téléologique et déterministe du développement historique. Dans ce cadre, la cybernétique apparaît comme le paradigme de la condition (hyper-)moderne et comme le fondement épistémologique de formes contemporaines de gouvernement, en particulier de la gouvernamentalité néolibérale, qui privilégie des mécanismes d'autorégulation, de gestion des risques et de préservation d'équilibres homéostatiques. Un tel modèle transforme le progrès en une adaptation continue à l'« éternel présent » du marché, neutralisant le conflit, la subjectivité et l'invention sociale. À l'inverse, la notion simondonienne de métastabilité conçoit les systèmes sociaux comme traversés par des tensions productives et par une marge structurelle d'indétermination. Le progrès cesse alors d'être compris comme une marche vers une fin prédéterminée pour devenir l'invention de nouveaux objectifs, médiée par la relation entre les humains, le monde et les objets techniques. Gouverner le progrès, en ce sens, implique d'assumer le risque de l'invention normative, d'accepter la possibilité de l'échec et d'ouvrir les systèmes à des futurs qui excèdent leur propre existence.

Mots-clés : Métastabilité; Progrès technique; Philosophie de Gilbert Simondon; Cybernétique et homeostase; Gouvernamentalité néolibérale.

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Aion Journal of Philosophy and Science

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Abstract

The article proposes a critical reopening of the question of progress based on the philosophy of Gilbert Simondon, by opposing the category of metastability to the notion of homeostasis derived from cybernetics. The authors argue that the modern idea of progress, inherited from mechanical determinism and reiterated by the cybernetic sciences, is “mythical” insofar as it reduces dynamic processes to fixed states and obscures the inventive and contingent dimension of becoming. This conception rests on a double ontoepistemological reduction: the reduction of reality to calculable structures and of science to operations of calculation, thereby sustaining a teleological and deterministic vision of historical development. Within this framework, cybernetics appears as the paradigm of the (hyper)modern condition and as the epistemological foundation of contemporary forms of government, in particular neoliberal governmentality, which privileges mechanisms of selfregulation, risk management, and the preservation of homeostatic equilibria. Such a model transforms progress into a continuous adaptation to the market’s “eternal present,” neutralizing conflict, subjectivity, and social invention. By contrast, the Simondonian notion of metastability conceives social systems as traversed by productive tensions and by a structural margin of indeterminacy. Progress then ceases to be understood as a march toward a predetermined end and comes to signify the invention of new goals, mediated by the relationship between humans, the world, and technical objects. Governing progress, in this sense, entails assuming the risk of normative invention, accepting the possibility of failure, and opening systems to futures that exceed their own existence.

Keywords: Metastability; Technical progress; Gilbert Simondon’s philosophy; Cybernetics and homeostasis; Neoliberal governmentality.

The question of progress plays a crucial role in the critique of the cybernetic notion of dynamic stability (“homeostasis”) and in the development of the category of “metastability,” as well as in the questioning of the very “mythical” idea of progress, born at the beginning of modernity from an «illusion of simultaneity» that reduces every apparent development to a fixed state: it «mistakes for a state what is only a stage». ¹ For Simondon, this idea of progress is “mythical” for two reasons. First, because it implies a «false entelechy» that conceals all alternative futures which, although never actualized, were potentially present at each “stage” of development («for [each] stage is still rich in virtualities»). Second, because it rests on an errone-

¹ Simondon, G., 2012, *Du mode d’existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 150.

ous conception of a universal chain of causes and effects that «masks the very reality of invention».² The idea of progress is, in short, teleological and deterministic, like the mechanical worldview to which it is anchored: it depicts development as a fixed movement toward a prescribed final state that excludes the possibility of any radical change and of any invention. Simondon suggests that this mistaken understanding of progress—rooted in the imaginary representation of the natural order as «constant, necessary, universal, and analytic», first elaborated in the «deterministic era»³—was always present in the cybernetic sciences of his time, along with the renewed attempt to combine determinism and teleology.

Emphasizing a substantial continuity between these positions, we will refer—beyond Lyotard—to a “(hyper)modern condition,” thus preferring the prefix *hyper-* to *post-* and using parentheses to underscore the link between the beginning of modernity and the contemporary “condition.”⁴ What we see at work in the (hyper) modern condition is the same double ontoepistemological reduction that operated at the beginning of modernity: the reduction of reality to calculable structures (conceived in deterministic or probabilistic terms) and the reduction of science to an operation of calculation (algebraic or statistical).⁵ On the one hand, reality is conceived deterministically in terms of structured elements that develop continuously according to fixed “laws” that predetermine the outcome of this development. On the other hand, this entire process is conceived as, in principle, fully describable in terms of combinations of elements within a preestablished syntax, such that the production of scientific knowledge becomes a process of verification and decision carried out within a field of research that is entirely mapped in advance on the basis of a set of preestablished “principles of proof.”⁶

This double ontoepistemological reduction creates a fully formalizable system, whether in logical or mathematical terms, which reflects the uninterrupted chains of causes and effects linking each element or event to the deterministic whole to which it belongs. The idea of progress as the continuous development of knowledge and human society ultimately rests on an imagination of nature, including human nature, as a geometrical world that assumes the “primacy of being over becoming.”⁷ The kind of scientific knowledge that supports such a vision can only be formalized on

² Simondon, G., 2012, *Du mode d'existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 150.

³ Simondon, G., 2012, *Du mode d'existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 150.

⁴ Simondon, G., 2015, [título/edição não informado no documento], [local], [editora], p. 274. (Inserir dados bibliográficos completos.)

⁵ Bardin, A.; Ferrari, M., 2023, “We Have Never Been Modern (Enough)”, in *Method & Theory in the Study of Religion*, [vol.], [n.], pp. [xx–xx], DOI: <https://doi.org/10.1163/15700682-bja10122>. (Inserir volume/número/páginas se aplicável.)

⁶ Bardin, A.; Ferrari, M., 2022, “Governing Progress: from Cybernetic Homeostasis to Simondon’s Politics of Metastability”, in *The Sociological Review*, vol. 70, n. 2, pp. 248–263.

⁷ Bailly, F.; Longo, G., 2006, *Mathématiques et sciences de la nature. La singularité physique du vivant*, Paris, Hermann.

the basis of the hypothesis that the calculability of the whole is possible, at least in principle, without exception. This generates an idea of progress conceived as the unfolding of a predetermined order over time. An initially given set of elements and rules (or natural “laws”) determines the deductive course of natural and human history. The principle guiding this development is the preservation and expansion of the initial order, and each moment in time is the necessary result of all preceding moments and the condition of the future.

In this sense, we consider cybernetics to be the paradigm of a crisis of the (hyper)modern condition. In several epistemic domains, paradigms initially derived from cybernetics are currently being reconsidered, and in some cases even rejected. The conception of the living being proposed by molecular biology, which ushered in the age of the genome⁸, is being challenged by organismal biology in light of the “historicity” and variability inherent to the organism itself⁹. Against the material/logical model that dominated neuroscience for several decades, a growing trend studies the brain and neurosynaptic structures through the concept of plasticity¹⁰. In mathematics, a reworking of modeling practices is underway, shifting the emphasis from “dynamic structuralism”¹¹ toward “differential heterogenesis.”¹² Such a crisis of the cybernetic framework is, in our view, symptomatic of the very limits of the “modern” condition, which remains present in its (hyper)modern version offered by cybernetics. Cybernetics celebrated the idea of a dynamic development aimed at producing increasingly complex forms of homeostatic equilibrium. We believe that moving beyond this stance, and beyond the idea of progress it implies, requires a critical emphasis on what cybernetics did not call into question, namely radical transformation and invention, including in the social domain.

Two radically different conceptions of progress are implicit in the cybernetic notion of homeostasis and in the Simondonian category of metastability. Beyond the diversity of theoretical positions attested by the complex history of cybernetic institutions and canon¹³, the cybernetic project has broadly contributed to the idea of progress as a developing order that has strongly influenced the human, political, and social sciences and, through them, has helped to rearticulate contemporary forms of governing society¹⁴. The model prescribes homeostasis, that is, the dynamic preservation of a stable equilibrium which, when disrupted, is called upon to be restruc-

⁸ Koyré, A., 1966, *Études galiléennes*, Paris, Hermann, p. 13, n. 5.

⁹ Kay, L. E., 2000, *Who Wrote the Book of Life? A History of the Genetic Code*, Stanford, Stanford University Press.

¹⁰ Soto, A. M.; Longo, G.; Noble, D., 2016, [título não informado no documento], [local], [editora] / [periódico, se for artigo], [vol.], [n.], pp. [xx–xx]. (Inserir referência completa.)

¹¹ Malabou, C., 2004, *Que faire de notre cerveau ?*, Paris, Bayard.

¹² Thom, R., 1972, *Stabilité structurelle et morphogénèse. Essai d'une théorie générale des modèles*, Reading, W. A. Benjamin.

¹³ Sarti, A.; Citti, G.; Piotrowski, D., 2023, *Differential Heterogenesis. Mutant Forms, Sensitive Bodies*, Berlin, Springer.

¹⁴ Ferrari, M., 2024b, “Di cosa parliamo quando parliamo di cibernetica (e perché è decisivo per la filosofia politica)? Qualche affondo per un lavoro a venire”, in *Etica & Politica*, à paraître.

tured according to the same invariant principles - an idea also fully operative within neoliberal governmentality. This (hyper)modern art of government is aptly described by the Belgian legal scholar Antoinette Rouvroy as «the art of not changing the world.»¹⁵ Neoliberal governance of progress in fact resolves itself into the incessant operation of protecting, managing, and promoting homeostatic mechanisms deemed capable of selfregulation, but in reality selected and—if necessary—replaced by others offering a more inclusive and more complex capacity for adaptation to the macro-mechanism/organism of the market. This macromechanism/organism constitutes the unquestioned horizon that assigns political power the task of providing a functional homeostatic equilibrium for its progressive implementation. With its “soft” determinism and immanent teleology, the market thus appears as a (hyper)modern version of the clockwork universe theorized by early mechanical science, and as the vector of a similar ontoepistemological reduction of social reality to a mathematized form. And this reduction still rests on a “mythical” idea of progress that fuels an illusion of automatism, concealing a plurality of paths by projecting the market’s “eternal present” onto all possible futures¹⁶.

The (hyper)modern renewal of the Hobbesian myth of the political “automation,” implemented by cybernetics, is, from Simondon’s perspective, at once an epistemological error and a political danger. Statistical mechanics prevents an adequate understanding of processes that involve a «margin of indeterminacy»,¹⁷ which can only be grasped through a «nonprobabilistic method,»¹⁸ and the myth of the automation surreptitiously becomes an objective whose actual realization would destroy the very system it was meant to save. A perfect “automatic” homeostasis, far from resolving the problem of social regulation, would replace the “tense” metastability of the social system with a type of dynamic stability that ultimately leads the system to exhaustion. The selfdestructive aim of automatism is in fact the elimination of any «margin of indeterminacy,» with the consequence that «there is no longer any possible variation; functioning repeats itself indefinitely,»¹⁹ until entropy consumes all remaining potentialities, leading to the «resolution of all tensions,» that is, to «death».

For Simondon, by contrast, a social system continues to function and to develop only insofar as it «preserves tensions within an equilibrium of metastability rather

¹⁵ Mirowski, P., 2002, *Machine Dreams. Economics Becomes a Cyborg Science*, Cambridge, Cambridge University Press; Amadae, S. M., 2003, *Rationalizing Capitalist Democracy. The Cold War Origins of Rational Choice Liberalism*, Chicago, The University of Chicago Press; Eyck, H., 2015, *Age of System. Understanding the Development of Modern Social Science*, Baltimore, Johns Hopkins University Press; Rodríguez, P. M., 2019, *Las palabras en las cosas. Saber, poder y subjetivación entre algoritmos y biomoléculas*, Buenos Aires, Cactus.

¹⁶ -Rouvroy, A., 2016, “L’art de ne pas changer le monde”, in *La Revue Nouvelle*, n. 8, pp. 44–50.

¹⁷ -Ferrari, M., 2024a, “La questione della regolazione nel vivente, nella macchina e nella società. Storia e critica della nozione cibernetica di organizzazione (sociale)”, in *Filosofia politica*, vol. 39, pp. 65–82.

¹⁸ -Simondon, G., 2012, *Du mode d’existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, pp. 185–203.

¹⁹ -Simondon, G., 2005, *L’individuation à la lumière des notions de forme et d’information*, Grenoble, Éditions Jérôme Millon, p. 549.

than annihilating them within an equilibrium of stability. »²⁰ Some critics of neoliberal governmentality, and in particular of its “algorithmic” version, have drawn on Simondon’s notion of metastability and have emphasized the importance of creating spaces of political conflict in which social invention—the “transindividual coupling” «between the inventive and organizational capacities of several subjects»²¹—can take place against the dominant neoliberal neutralization of subjectivity and conflict.²² The idea of “progress” may appear to align precisely with the position these theorists criticize, but we argue that Simondon’s category of metastability makes it possible to reopen the question of progress by taking a radically different direction. Under neoliberalism, the “spontaneous” pursuit of the market is paradoxically regarded as the objective of politics, which entails reducing progress to a sequence of preventive social adaptations to everemerging “local” risks within the naturalized framework of the market. Hence the neoliberal promotion of an ethics of risk management in which “government action” consists not merely in preventing the risk of a radically disruptive event, but in governing its very possibility. The “progressive” mechanisms of social reproduction governed by the open dynamics of the market thus fully absorb and neutralize a risk of an entirely different nature—namely, that represented by human inventiveness and imagination—which Simondon theorizes under the name of metastability.

The “risky” politics of metastability theorized by Simondon rests on the hypothesis that progress conceived as the «invention of new goals» makes radical novelty possible. This idea of progress is based on an understanding of social systems as intrinsically metastable, due to the «quite dangerous» automatism that characterizes human beings, who «always risk inventing and giving themselves new structures. »²³ This does not mean that Simondon resorts to a vitalist vision of the exceptional nature of life in relation to matter, nor to a form of social evolutionism; rather, he theorizes «invention» as an emergent property of the biotechnical nature of human beings and societies. Human «progress» takes place at the scale of the «metastable» system formed by «human beings and the world», mediated by technical objects.²⁴ Thus conceived, progress is neither «understood as a march in a direction fixed in advance» nor a process of the «humanization of nature», but rather a contingent process of the «naturalization of the human», mediated by the «technogeographical milieu»

²⁰ Simondon, G., 2017, [título/edição não informado no documento], [local], [editora], p. 152. (Inserir dados bibliográficos completos.)

²¹ Simondon, G., 2005, *L'individuation à la lumière des notions de forme et d'information*, Grenoble, Éditions Jérôme Millon, p. 204.

²² Simondon, G., 2012, *Du mode d'existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 342.

²³ Berns, T.; Rouvroy, A., 2013, “Gouvernementalité algorithmique et perspectives d'émancipation”, in *Réseaux*, n. 177, pp. 163–196; Stiegler, B., 2015, *La société automatique. 1. L'avenir du travail*, Paris, Fayard.

²⁴ Simondon, G., 2005, *L'individuation à la lumière des notions de forme et d'information*, Grenoble, Éditions Jérôme Millon, p. 347.

that humans continuously invent.²⁵ It is the result of a disharmonious relationship between biological models that vary over the very long term of natural history, the rapid accumulation of technoscientific innovations, and the social rhythm of culture, which attempts to render these processes compatible within its institutional present²⁶.

This idea of progress entails a political risk insofar as it leaves political practice without a safety net. Within this open dynamic, the emergence of finality—and thus of social invention—is grounded in the structural absence of control over technical reality, which nourishes the very possibility of human freedom: «Human beings free themselves from their condition of being subordinated to the finality of the whole by learning to make use of finality [...] so as not to have to passively endure a de facto integration.»²⁷ This is what, according to Simondon, cybernetics itself teaches us, yet while crucially missing the point that risk cannot be recuperated within the framework of existing social norms and modes of production. On the contrary, risk conceived as a structural margin of indeterminacy (“historicity”) is integrated into technical activity and constitutes a constant challenge to the entire “system of values.”²⁸ In this sense, we argue that Simondon’s category of metastability opens up the possibility of moving beyond the paradoxical confusion of determinism and teleology theorized in the (hyper)modern idea of progress, and ultimately shared by both cybernetics and neoliberalism, thereby calling for an alternative theory of government, that is, of politics itself.

Governing progress, in Simondon’s sense, would be part of a collective effort to invent mediations and solutions in which science and politics can play a crucial role, provided that they do not reduce the reality of nonsymbolic processes to their own—also scientific—imagination. This type of government has more to do with the «invention» of new technical and cultural possibilities than with the dreamed-of regulation of what already exists by a philosopherking.²⁹ Such inventions, of course, run the risk of failure, but this is precisely where their political value lies. Simondon’s idea of progress does not offer governmental action a safety net provided by the predictions of social theory. On the contrary, Simondon’s social theory attests that not taking the risk of normative invention amounts to suffering another kind of defeat: the defeat of accepting a supposedly “progressive” politics that in fact resists radical change. Simondon’s idea of progress instead demands a radical affirmation

²⁵ Simondon, G., 2012, *Du mode d’existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 214.

²⁶ Simondon, G., 2012, *Du mode d’existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 69.

²⁷ Simondon, G., 2014, [título/edição não informado no documento], [local], [editora], pp. 269–278. (Inserir dados bibliográficos completos.)

²⁸ Simondon, G., 2012, *Du mode d’existence des objets techniques*, nouvelle édition revue et corrigée, Paris, Aubier, p. 146.

²⁹ Simondon, G., 2005, *L’individuation à la lumière des notions de forme et d’information*, Grenoble, Éditions Jérôme Millon, pp. 342–343.

of change, which includes triggering processes that open systems to a future that exceeds their own existence. This ethical formula is intrinsically political: it requires the active consideration of death as an integral part of the functioning of a system, and the hypothesis of social invention at the core of a conception of progress to be formulated beyond the (hyper)modern condition. A margin of indeterminacy is inherent in such a gesture, and yet it is necessary in order to foster the “metastable” tension that enables scientific and political invention to challenge the automatic defense of a mythically established social order.

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Coupling Contradictions

Jérôme Laforcade

Résumé

L'article propose le concept de contradiction de couplage comme un développement de la Théorie de la Résolution Inventive de Problèmes (TRIZ), en élargissant le modèle classique de la contradiction technique. Alors que la contradiction technique décrit une situation dans laquelle l'amélioration d'un paramètre du système entraîne la dégradation d'un autre, la contradiction de couplage met en évidence des limites qui ne relèvent pas uniquement du système technique, mais de l'environnement associé dans lequel ce système opère. À partir de la notion de Résultat Final Idéal (RFI) formulée par Genrich Altshuller, l'auteur montre que, dans les cycles d'innovation incrémentale, le développement technologique tend à respecter l'adaptation progressive du système à son environnement. Toutefois, dans les contextes d'innovation de rupture, cette logique est rompue : la limitation centrale devient une crise de ressources environnementales (temps, espace, niveau systémique ou séparation sous conditions spécifiques), rendant insuffisante la simple optimisation interne du système. En s'appuyant sur les lois d'évolution des systèmes techniques et les courbes en S, l'article démontre que certaines innovations exigent la transformation simultanée de la technologie et de son super-système. Des exemples tels que le transport routier illustrent comment la rareté de l'espace urbain, et non la performance des véhicules, bloque des avancées supplémentaires. Le texte propose enfin une méthodologie étendue, fondée sur l'algorithme des 9 questions et sur des outils classiques de la TRIZ (standards d'invention, algorithme de Smirnov et matrice d'Altshuller), afin d'identifier les crises de ressources environnementales et de formuler des contradictions de couplage.

Mots-clés : Contradiction de couplage; TRIZ (Théorie de la résolution inventive de problèmes); Résultat Final Idéal (RFI); Innovation de rupture; Crise de ressources environnementales.

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Aion Journal of Philosophy and Science

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Abstract

The article proposes the concept of coupling contradiction as a development of the Theory of Inventive Problem Solving (TRIZ), extending the classical model of the technical contradiction. While a technical contradiction describes a situation in which the improvement of one system parameter leads to the degradation of another, a coupling contradiction highlights limits that do not pertain solely to the technical system itself, but to the associated environment in which the system operates. Drawing on the notion of the Ideal Final Result (IFR) formulated by Genrich Altshuller, the author shows that, in cycles of incremental innovation, technological development tends to respect the system's progressive adaptation to its environment. However, in contexts of disruptive innovation, this logic is broken: the central limitation becomes a crisis of environmental resources (time, space, systemic level, or separation under specific conditions), making mere internal optimization of the system insufficient. Relying on the laws of evolution of technical systems and Scurves, the article demonstrates that certain innovations require the simultaneous transformation of the technology and its supersystem. Examples such as road transportation illustrate how the scarcity of urban space, rather than vehicle performance, blocks further progress. Finally, the text proposes an extended methodology, based on the 9question algorithm and on classical TRIZ tools (invention standards, the Smirnov algorithm, and Altshuller's matrix), in order to identify environmental resource crises and to formulate coupling contradictions.

Keywords: Coupling contradiction; TRIZ (Theory of Inventive Problem Solving); Ideal Final Result (IFR); Disruptive innovation; Environmental resource crisis.

TRIZ relies heavily on the concept of technical contradiction. This model associates every technical problem observed in a system with an opposition between two parameters of that system.

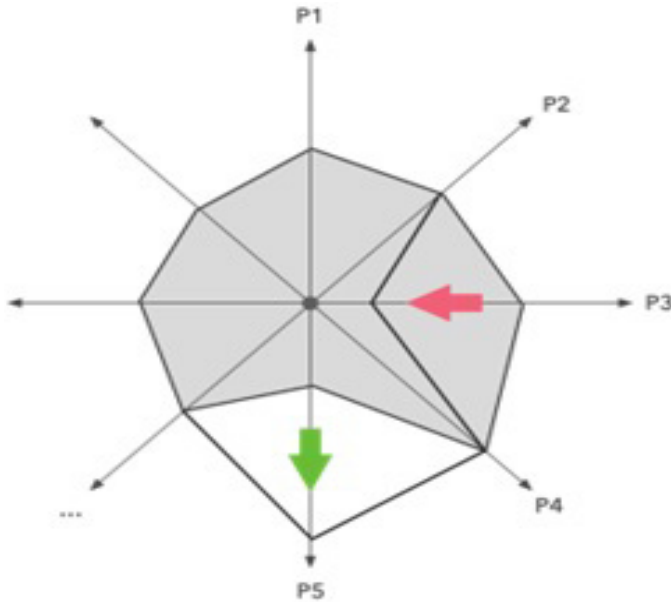


Figure 1. Technical contradiction: The positive evolution of one characteristic of the system leads to the deterioration of another characteristic of the system. P5 better → P3 worse.

For example, improving the driving range of a battery-powered electric vehicle entails a deterioration in the volume and mass of the battery, thereby increasing the vehicle's weight.

Identifying the technical contradiction makes it possible to use TRIZ methods to propose concepts that circumvent the problem at hand. The objective of this approach is to move toward an ideal solution known as the IFR (Ideal Final Result)—a solution that would resolve the problem without modifying the initial system. Obviously, this IFR is rarely achievable, but the TRIZ approach always aims to approximate it as closely as possible.

In the 1960s and 1970s, Genrich Altshuller, the founder of TRIZ, realized that the IFR is sometimes violated by technologically disruptive solutions that emerge during shifts in innovation cycles. For example, it is not possible to derive the concept of a calculator from the abacus if one strictly follows the foundational TRIZ principle based on the IFR.

As a result, a new branch of TRIZ emerged, leading to the formulation of the laws of evolution of technical systems. This branch makes it possible to explain and anticipate minor changes within a technology, as well as to identify the causes and early signs of deeper transformations associated with disruptive innovations.

In the case of disruptive innovations, A. Lyubomirsky identifies a fundamental cause of such cycle changes, referred to as an aggravated contradiction. The aim of this publication is to describe these aggravated contradictions in a way that makes them predictive and operational, while also providing them with a more precise and concrete definition.

Evolution of Technical Systems

The systematic study of millions of systems makes it possible to observe their transformations and to identify regularities—that is, trends that recur frequently as these systems evolve over time. These trends are referred to as the laws of evolution of technical systems, even though they are more accurately described as systematic patterns observed across the millions of systems analyzed by TRIZ.

Among these trends, Scurves indicate the main principles that must be respected when developing a technology according to its level of maturity; a technology must therefore follow these principles in order to increase its chances of success. From this perspective, the description of technologies provided by the laws of technical system evolution is highly Darwinian, emphasizing the adaptation a technology must achieve with respect to its associated environment.

For example, the development of a new automotive technology necessarily depends on the vehicle's ability to use roads, parking facilities, and other systems with which it interacts. If several technologies were proposed to replace current vehicles, a significant advantage would be given to the solution that disrupts its environment as little as possible, especially in the early stages of its development.

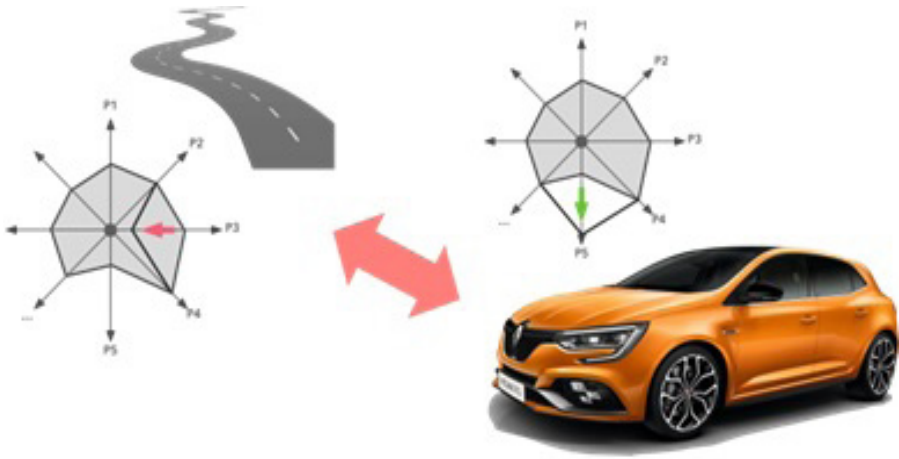
Coupling Contradiction

The notion of a coupling contradiction can be understood within this framework. Sometimes, a minimal change to the associated environment is not sufficient for a new technology to emerge. In such cases, the environment itself must be radically modified to enable the appearance of the new technology.

Thus, the limitation does not lie in the system itself but in the deterioration of a parameter of the associated environment, which forces a simultaneous transformation of both the technology and its environment.

Examples:

- Increasing crude oil transport capacity is not limited by ship parameters, but by the inability of ports to accommodate larger vessels.



- Reducing automobile travel time is not limited by vehicle speed, but by the inability of infrastructure to handle increasing traffic volumes (number of lanes, parking spaces, etc.).

Consequences of Coupling Contradictions

To solve the technological problem, it is not enough to adapt the technology; the environment (supersystem) in which it operates must also be modified. Changes to the environment will affect other interacting systems. Although it is difficult to evaluate the scope and quality of these consequences during the early stages of a disruptive technology, several phases can be anticipated:

1. Resistance phase: Many associated environments resist adopting the new technology, through regulatory restrictions and outright bans. Only a few pioneers—the *early adopters*—embrace it. Dominant companies attempt to suppress the new technology through lobbying or acquisition.
2. Acceleration phase: Suppression efforts fail. New firms enter the market, investments increase, applications multiply, and performance improves rapidly.
3. Adaptation phase: Interacting environments progressively adapt, leading to the decline of older technologies. This triggers widespread changes in technologies, practices, companies, and regulations.
4. Stabilization (saturation) phase: Market consolidation occurs through mergers and acquisitions. Technologies stabilize around shared principles, interoperability improves, prices decrease, and the environment completes its adaptation.

Coupling Contradictions and Resource Crises

A problem formulated as a coupling contradiction reveals a resource crisis, reducible to four cases:

- T: Time
- S: Space

Systemic level requiring transition to the subsystem or supersystem. Conditional separation, resulting in incompatible categories (e.g., ship, airplane, train, car).

The problem is formulated at the system level and simultaneously reveals a resource crisis in the associated environment, in the form of a parameter belonging to that environment.

Methodology

Identifying a coupling contradiction requires identifying a resource crisis in the associated environment that prevents solving the problem at the system level alone.

In the case of a conventional problem leading to a technical contradiction, the 9-question algorithm (© Jérôme Laforcade, 2008) can be used. This algorithm makes it possible to identify the main contradiction step by step, first by identifying the operational zone and time, and then by conducting a physical analysis of the identified elements, allowing both the identification of malfunctioning physical functions and the physical parameters associated with those malfunctioning functions.

Obviously, this algorithmic approach makes it possible to identify only endogenous causes, and not causes arising from coupling problems with the associated environment.

It is therefore necessary to modify this algorithm in order to integrate a phase dedicated to identifying the resource crisis that generates the coupling contradiction. What follows is a proposed version of this new algorithm (in italics).

1. *Describe the system to be evolved. Analyze this system using Scurves, the law of ideality, and the law of system completeness. If there is an opportunity to change the physical principle (system in phase 3++ and the existence of physical limits), then proceed with the questionnaire.*

2. Where exactly does the problem occur?

3. At what precise moment does the problem occur?

4. Which components *AND* associated environments interact with the identified components?

5. *Formalize the physical analysis graph between the system components involved and the associated environment on which the resource crisis depends*

6. Identify the physical function (vepole) that is the most harmful or the least well performed

7. Identify the component or resource belonging to the associated environment that produces the function identified in question

8. Which parameter would need to be changed in order to resolve the identified vepole on the component or resource identified in question 8? What would its ideal value be?

9. Identify the physical function or functions that are then degraded by the

change introduced in question. *Use the Smirnov algorithm to identify the structural modifications of the identified vepole and to propose concepts that address these modifications.*

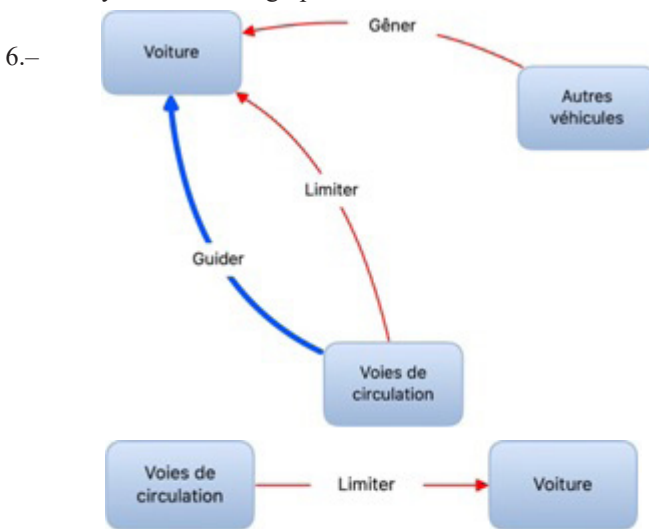
10. Which parameters would then be degraded? *Here, we must note a difference from the classical approach by allowing the identification of several possible parameters.*

Formulate the coupling contradiction or contradictions (9 vs. 11)

Example: Longterm evolution of the automobile

1. Personal car. How can travel time be reduced in periurban environments?
(Phase 3; no physical limitation identified at this stage)

2. – In traffic congestion
3. – During travel, at peak hours
4. – Car, other vehicles, road infrastructure
5. – Physical function graph:



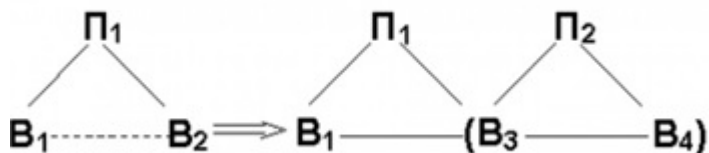
7 – Road infrastructure

8 – It is necessary to increase the number of vehicles on the road network

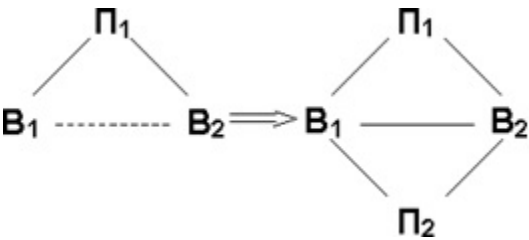
9 – The resource crisis is therefore associated here with the space required to increase road infrastructure.

10 – Increasing the number of lanes requires taking surface area that is currently allocated to other uses: housing, infrastructure, etc.

11 – Coupling contradiction: Increasing the *number of vehicles* on the road network vs. *surface area allocated to road infrastructure*



Standard 212: Transition to a double vepole



And the changes can then be extended to other types of standards by applying the Smirnov algorithm

The use of Altshuller’s matrix proposes, for example:

Contradictions analysis

Parameters

Contradictions

Separation principles

Choose the parameters from the following lists

Upgraded parameters

Durability of moving object

Energy spent by moving object

Waste of time

Harmful factors acting on object

Productivity

+

VS

Downgraded parameters

Area of stationary object

Shape

Amount of substance

Harmful side effects

+

Continue

Contradictions analysis



Parameters	Contradictions	Separation principles
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The following contradiction principles result from applying Altshuler’s matrix to the previously selected parameters, ordered by number of occurrences

14 occurrences
35 - Parameter changes
8 occurrences
10 - Preliminary action
7 occurrences
18 - Mechanical vibration
22 - Blessing in disguise
39 - Inert atmosphere
6 occurrences
2 - Separation
16 - Partial or excessive actions
17 - Dimensionality change
34 - Discarding and recovering
5 occurrences

17 - Dimensionality change



Move the object in 3 dimensions



Use multistories and back-sides

- Move an object in two- or three-dimensional space
- Use a multi-story arrangement of objects instead of a single-story arrangement
- Tilt or re-orient the object, put it on its side
- Use a different side of the given area

Contradictions analysis



Parameters	Contradictions	Separation principles
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The following contradiction principles result from applying Altshuler’s matrix to the previously selected parameters, ordered by number of occurrences

4 occurrences
33 - Homogeneity
3 occurrences
5 - Merging
8 - Weight compensation
9 - Preliminary counteraction
11 - Beforehand compensation
13 - The other way around
15 - Dynamic parts
19 - Periodic action
20 - Continuity of useful action
24 - Intermediary
30 - Flexible shells and thin films

5 - Merging



Merge the objects



Merge the Actions

- Bring closer together (or merge) identical or similar objects, assemble identical or similar parts to perform parallel operations
- Make operations contiguous or parallel, bring them together in time

In this example, the classical TRIZ tools are used, but it is important to keep in mind that a coupling contradiction involves a resource shortage in the environment—in this case, the surface area allocated to transportation—which limits the development of the technical solution. Most of the time, this resource shortage leads to disturbances in the associated environments, resulting in attempts to maintain a fragile equilibrium, a status quo, which postpones the arrival of innovation until the situation becomes intolerable. In the example presented, such a solution could involve, for instance, restricting the use of road infrastructure to certain times based on license plate numbers, or requiring the use of alternative modes of transport when travel distances are below a certain threshold, and so on. One can imagine that these measures would only be implemented once periurban transportation has deteriorated sufficiently to make such concepts acceptable. It is also necessary to take into account the changes that these concepts would bring about if they were adopted. What would their longterm effects be?

Conclusion

Coupling contradictions are a powerful tool for identifying situations where resource scarcity necessitates radical innovation. In many cases, adapting the technology alone is insufficient; the associated environment must also be transformed. These transformations generate cascading effects across interacting systems.

Formulated as coupling contradictions, such problems reveal resource crises related to time, space, systemic level, or conditional separation. Resolving them requires rethinking the coupling between technology and environment.

In conclusion, coupling contradictions provide an effective means of detecting situations in which resource scarcity demands radical innovation—and of identifying ideas capable of overcoming these constraints through major disruptive innovations.

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How can we ensure that scientific and technical progress becomes synonymous with human progress?

Pierre-Marie Pouget

Résumé

L'article examine comment le progrès scientifique et technique peut devenir effectivement synonyme de progrès humain, au lieu de se retourner contre l'humanité elle-même. L'auteur part du constat que les avancées scientifiques ont conféré à l'être humain une puissance sans précédent, capable de rendre la Terre inhabitable ou de la détruire, comme l'illustre l'arsenal nucléaire. Dès lors, la question centrale devient éthique : comment orienter la science et la technique afin qu'elles servent la vie humaine et le bien commun ? L'auteur soutient que la pratique scientifique, dans son essence, repose déjà sur une éthique de la responsabilité, exprimée méthodologiquement par l'ouverture à l'expérience. Cette option implique de soumettre les hypothèses à l'épreuve des faits, d'accepter la révision des théories et d'éviter l'arbitraire. Une telle posture n'est pas seulement scientifique ; elle constitue aussi une condition du dialogue rationnel et de la vie en société, car elle permet de prendre des décisions plus justes fondées sur des preuves partageables. L'auteur critique les conceptions qui réduisent la nature à un simple objet d'exploitation illimitée, souvent attribuées de manière simpliste à des penseurs comme Descartes, Galilée et Newton. Ainsi, le problème ne réside pas dans la science moderne en elle-même, mais dans la captation de la recherche scientifique par des intérêts politicomilitaires et économicofinanciers, en particulier dans le contexte d'une économie mondiale orientée exclusivement vers le profit. Cette appropriation détourne la science de son instance responsable et empêche que son progrès se transforme en progrès humain. Comme alternative, l'auteur défend un modèle économique et social guidé par l'éthique de la responsabilité, engagé en faveur de la justice sociale, de la préservation de l'environnement et des droits humains, y compris ceux des générations futures. Dans cet horizon, la science doit contribuer à relever des défis planétaires tels que le réchauffement climatique et la perte de la biodiversité. S'inspirant de l'héritage des Lumières et des réflexions de Ferdinand Gonseth, l'article souligne enfin que le savoir scientifique est toujours provisoire et révisable, et qu'il doit être évalué selon son adéquation au réel plutôt que selon une conception absolue de la vérité.

Mots-clés : Progrès scientifique et technique; Éthique de la responsabilité; Bien commun; Gouvernance de la science; Durabilité et justice sociale.

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Abstract

The article examines how scientific and technical progress can truly become synonymous with human progress, rather than turning against humanity itself. The author starts from the observation that scientific advances have given human beings unprecedented power, capable of making the Earth uninhabitable or of destroying it, as exemplified by nuclear arsenals. Consequently, the central question becomes ethical: how can science and technology be guided so that they serve human life and the common good? The author argues that scientific practice, in its very essence, is already grounded in an ethics of responsibility, expressed methodologically through openness to experience. This option entails submitting hypotheses to the test of facts, accepting the revision of theories, and avoiding arbitrariness. Such an attitude is not only scientific; it is also a condition for rational dialogue and social life, since it allows for fairer decisions based on shareable evidence. The author criticizes conceptions that reduce nature to a mere object of unlimited exploitation, often simplistically attributed to thinkers such as Descartes, Galileo, and Newton. Thus, the problem does not lie in modern science itself, but in the capture of scientific research by politico-military and economic-financial interests, especially in the context of a global economy oriented exclusively toward profit. This appropriation diverts science from its responsible instance and prevents its progress from being transformed into human progress. As an alternative, the author advocates an economic and social model guided by an ethics of responsibility, committed to social justice, environmental preservation, and human rights, including those of future generations. Within this horizon, science must contribute to addressing planetary challenges such as climate warming and the loss of biodiversity. Drawing inspiration from the legacy of the Enlightenment and the reflections of Ferdinand Gonseth, the article finally emphasizes that scientific knowledge is always provisional and revisable, and that it should be evaluated according to its adequacy to reality rather than according to an absolute notion of truth.

Keywords: Scientific and technical progress; Ethics of responsibility; Common good; Governance of science; Sustainability and social justice.

1. Methodology and Responsible Authority

a) A relevant question

The question *How can we ensure that scientific and technical progress becomes synonymous with human progress* arises from the fact that advances in science and technology *are worryingly* turning against humanity by giving it such power that it is making the Earth uninhabitable and capable of destroying it through its nuclear arsenal. This question amounts to asking how to ensure that the progress of science and technology does not stand against humanity, but rather becomes synonymous with human progress—that is, progress marked by appropriate conduct, best suited to the situation in which we are engaged. This way of questioning scientific and technological progress echoes a reflection by Albert Einstein who, speaking of the scientific person, said:

Is the time definitely past when their inner freedom, independent thought, and research could enlighten and enrich human life? Have they forgotten their responsibility and dignity because their effort has been confined to intellectual activity? (...) If the contemporary scientific person finds the time and courage to judge the situation and their responsibility calmly and objectively, and acts according to this examination, then the prospects for a reasonable and satisfactory solution to today's excessively dangerous international situation will appear profoundly and radically transformed.¹

b) A methodological approach motivated by an ethics of responsibility

By examining the methodology of scientific and technical research practice, we see that this practice is a human activity oriented toward what is appropriate, in other words, toward what is justifiable in light of the test of facts. Its value lies fundamentally in the reliability of the insights and means it provides, thanks to its constant concern to avoid arbitrariness and to achieve what is appropriate. Through the consistency of this methodological concern, which permeates it entirely, the progress of scientific and technical research *refers wholly to a responsible authority* that guarantees its reliability. Under these conditions, does not the progress of science and technology naturally fall within the horizon where human beings strive to assume their existence in a society of responsible individuals, capable of forming community through dialogue aimed at the most equitable decision possible? By focusing our attention on the option of openness to experience, we will see *the reason* that allows us to affirm that the progress of science and technology takes place within the horizon of *an ethics of responsibility*, which underlies the effective capacity to engage in dialogue and to decide as equitably as possible.

¹ - Einstein, A., 1979, *Comment je vois le monde*, Paris, Champ Flammarion, p. 189.

Openness to experience is the dominant option in the practice of scientific research. From this option arises the requirement of *technicity*, according to which hypotheses must be plausible and experimental setups capable of validating them through failure or success. It also entails *the obligation to revise* any view refuted by the test of reality and to assess the impact of these revisions on the overall progress of ongoing research.

The reason for this option stems from the responsible authority, which realizes that if it does not adopt it, it is already overtaken by the evolving reality and deprived of any legitimate arbitration. Outside of this option, consisting of engaging in experience and implementing strategies for such engagement, it becomes impossible to rally around what is appropriate for everyone, because it has successfully passed the test of reality. Consequently, it is easy to see that, both at the level of scientific technicity and common sense, any attempt to dialogue outside the option of openness to experience turns into a dialogue of the deaf, lacking the ability to confront ideas with facts against which persistence is futile. Thus, the option of openness to experience presents itself to human beings *in general* as the condition that truly makes possible the realization of sociability through dialogue. It carries *the meaning of an ethics of responsibility*, in the sense that *it establishes* the framework where each of us lives, deep within our being, *the relationship with the other* with whom we deliberate, decide, and act toward what must be done to achieve the best possible outcome in the situation in which we find ourselves.

Without the option of openness to experience, which is the dominant methodological approach in the practice of scientific research, but also that of anyone concerned with aiming for what is appropriate, human beings lose themselves in the arbitrariness of ideas disconnected from reality. In philosophy, this results in the irreconcilable opposition between systems such as idealism and realism, rationalism and empiricism, spiritualism and materialism, etc. At the level of social life, reason then risks becoming that of the strongest, proclaiming itself the holder of a superior truth, like that of the Party that arrogates the right to impose it and harshly punish anyone who, in one way or another, contests it.

The dominant *methodological approach* in the practice of scientific research is therefore motivated by *an ethics of responsibility*. In this way, if the progress of scientific and technical research is not, *in fact*, synonymous with human progress, *it is because it encounters an obstacle* that diverts it from its methodological orientation in reference to a responsible authority.

But what is human progress? I understand it in the context of the option of openness to experience, and I measure it by what we are capable of doing, collectively and personally, in order to bequeath to future generations a habitable Earth and values that allow it to remain a sustainable place, open to responsible creativity.

Today, as we were yesterday and will be tomorrow, *we are people of an era*. For us, in the 21st century, human progress is measured by our ability to identify the

global challenges we must face and to succeed in inventing the appropriate solutions to overcome them. Isn't it, moreover, *from this perspective of human progress* that we ask ourselves where the technologies of the future are, the ones that must be promoted and advanced?

That said, it is appropriate to denounce a certain conception of science and technology that dates back to Descartes (1596–1650) and reduces nature to a resource to be exploited at will. It relies mainly on the passage from the *Discourse on Method* where it is written:

it is possible to attain knowledge that is useful to life (...) by which, knowing the power and actions of fire, water, air, the stars, the heavens, and all the other bodies that surround us as distinctly as we know the various trades of our artisans, we could employ them in the same way for all the uses to which they are suited, and thus render ourselves as masters and possessors of nature.

This quotation shows that Descartes envisions *a reorientation of science* that connects it to its technical applications. Contrary to the interpretation given by Heidegger (1889–1976) and his followers, this passage from the end of the *Discourse on Method* (sixth part) does not mean that nature is reduced to a resource committed to our disposal. It expresses the wish that science should enable humanity to improve its living conditions. Nature is acknowledged in its greatness and intrinsic value. For Descartes, mastery over nature remains within the limits of the human creature, dependent on Divine Omnipotence.

The addiction to power through the expansion of science and technology certainly exists all too much and prevents their progress from being synonymous with human progress. But it does not come from Descartes, nor from Galileo (1564–1642), nor from Newton (1642–1727), nor from other creators of modern science. Where does it come from, infiltrating the realms of scientific and technical research like a worm in the fruit?

c) Ensure not to betray the authority responsible for the reliability of knowledge

Very powerful politico-military-economic groups manage to gain control over scientific and technical research in order to put it at the service of their quest for power. Nowadays, *the “all-market” economy* dominates across the five continents, reducing nature to a resource to be exploited and forcing societies to live according to the law of a free market where competition among all prevails for the benefit of a few.

The economy, however, cannot be reduced to a model focused solely on profit at the expense of the environment and social justice. Could it not become, as the etymology of the term *economy* suggests, *the law of the household*, with everything

the household implies *in response to our needs*, from food and security to recognition by the group to which we belong and personal fulfillment?

Nowadays, in a globalized world, is *the law of the household* not called to extend, with the necessary adaptations, across the five continents? By adhering to it, we would promote an economic model in which small and medium-sized enterprises are generally quite good examples, as they can only *prosper sustainably* by having qualified personnel motivated by healthy competition, striving to be the best possible in their sector as it evolves toward the technical objects of the future.

As this model gains ground, the logic of the economy could *interact* with the imperatives of *an ethics of responsibility, which require fair exchanges and lifestyles compatible with the environment*. The *ethics of responsibility* commits us to future generations and, as such, enjoins us to promote, on a global scale, an economic model that, by fostering fundamental research and its technical applications, *gives us the chance to meet the challenge* of climate change and biodiversity loss, as well as to create a less inequitable world.

It is essential to prevent, particularly through profound revisions in the way wealth is produced and distributed, very powerful individuals and groups from seizing the progress of science and technology to turn it into a formidable tool serving an insatiable appetite for wealth and power at the expense of everything else. Insofar as we are convinced that scientific and technical progress *must* and *can* be *synonymous* with human progress, and that if it is not, *it must* become so by overcoming what hinders it through a deep restructuring of the economy, *as well* as of education and training, following the model of the methodological option of openness to experience.

The question of whether scientific and technical progress is synonymous with human progress was already central during the *Enlightenment*. To raise this question and wish to debate it is to acknowledge oneself as an heir of the 18th-century *philosopher*, that ardent defender of the *Enlightenment* that radiated from the scientific and technical progress of the time. Since this heritage mainly involves an invitation to demonstrate critical thinking, we will reduce it to its essential core and discern what should be retained from it in the 21st century.

2. The legacy of the *Enlightenment* and its transcendence

In the 18th century, a type of man appeared in the form of the philosopher. He is both a disciple of René Descartes and of John Locke (1632–1704). Like Descartes, he believes in the value *of reason*, and, following Locke, he believes in the value *of experience*.

The philosopher promotes the value of knowledge, of which Newton's theory represents, at the time, *the highest point*. Reason, *by its own means*, when exercised

through a genius of Isaac Newton's caliber, succeeds in constructing the theory of universal gravitation.

The fact that reason depends only on its own *theoretical and experimental* resources goes hand in hand with the realization that the lights of reason are the only ones that are appropriate. Outside of them, the human being loses autonomy and must conform to norms imposed from the outside, as in the time when the ecclesiastical authority could punish the scholar who strayed from the teachings of the Church.

a) From the dialectic of the theoretical and the experimental to the question of truth

The essence of the *Enlightenment's* legacy is certainly not the belief that, in its principles, Newton's theory is irreformable and that it refers to God as the Great Clockmaker. It lies in *emphasizing the value of theoretical and experimental knowledge, which, unlike what Newton and the scholars of his time believed, can be revised even in its principles and, therefore, progress not only through the accumulation of knowledge but also through profound transformations*. To clarify the synonymy between scientific progress and human progress in the context of the 21st century, it is necessary to examine the relationship between its theoretical and experimental aspects, which, after the "crisis of foundations" in mathematics and physics at the beginning of the 20th century, was rethought in entirely new ways. By re-examining from the ground up the relationship between theory and experiment in the constitution of knowledge, we reach the core of what defines it and gives it its guarantees of reliability. To get to the heart of this relationship, I refer to the views of the Swiss mathematician-philosopher Ferdinand Gonseth, as presented in his masterwork *Geometry and the Problem of Space*².

1. None of the approaches in the sciences begins from a state in which researchers have perfectly purified information and completely assured methods at their disposal. A scientific approach can only proceed from a certain situation of knowledge, a situation in which researchers rely on prior knowledge and on a certain already established language. This knowledge is guaranteed only within certain limits, and this language is not fixed in an unchanging form. Researchers can therefore never begin their investigations except from a given situation within the current state of knowledge.
2. Their research encounters or brings to light new elements that do not automatically integrate into the initial situation.
3. It sometimes happens that, in order to integrate the new elements, it is necessary to imagine and test a new hypothesis or a set of

² : Gonseth, F., 1945-1955, *La Géométrie et le problème de l'espace*, Neuchâtel, Éditions du Griffon, fascicule VI, p. 583 ff.

new hypotheses, or even a hypothesis or hypotheses that are incompatible with the initial situation.

4. When testing confirms the new hypothesis or the set of new hypotheses, this result reflects back on the initial situation: either by integrating into it and enriching it; or by requiring partial revision; or by forcing a complete change, based on entirely new foundations, and starting a new cycle—from the initial situation to the impact of the successful test upon it.

The transition from the initial situation to the evolved situation is not the result of a logical necessity. It responds to certain requirements of adequacy, or, in other words, to certain requirements of suitability. It involves a moment of mental and technical creation that cannot be confused with a formalizing procedure. Thus, we find ourselves faced with a *schema* comprising four phases: from the initial situation, where new elements emerge that pose a problem, *first phase*, researchers imagine one or several hypotheses and an experimental setup, *second phase*. *Third phase*: testing through the verdict of fact; and *fourth phase*: the impact of the successful test upon the initial situation.

These four phases *mark the rhythm* of the progress of knowledge. They must be understood within the spatio-temporal horizon where *all feedback* is possible at every moment. They form an *appropriate schema* of the actual practice of scientific research. The word schema is understood in the sense that, for example, a road map is a schema. Compared to what it represents, the schema is abstract. It retains only certain aspects and represents them through a system of symbols. It is appropriate only insofar as it corresponds schematically to the reality it represents. Thus, a road map is an appropriate schema insofar as it allows one to plan an itinerary and find one's way along the route. If, by reading and following it correctly, one finds that one reaches one's destination, this proves its suitability.

The schema of the four phases on which the researcher relies is not an instance prior to or external to research. Its status is that of being itself a *plausible hypothesis*, which allows it to be tested. It was tested by its author, Ferdinand Gonseth, particularly in two of his works, *Geometry and the Problem of Space* and *The Problem of Time*, but also in his articles on morality, language, and the human sciences in general. Later, members of the Ferdinand Gonseth Association tested it in other fields, such as music³ and spirituality. Gonseth himself extended it to projects—whether existential, political, technical, or otherwise. One realizes that, *mutatis mutandis*⁴, it applies to all human engagements in experience and is, therefore, the appropriate instrument for the search for suitability, whatever the domain. Through this extensibility, it takes on a philosophical dimension, and we shall call it *the methodological schema for the*

³ See the two works by Éric Émery on music and the work by Bernard Morel on spirituality.

⁴ Latin expression meaning this: what had to be changed having been changed.

*search for suitability*⁵.

With these clarifications made, we can now move to the heart of the question concerning the relationship between the theoretical and the experimental in contemporary scientific research.

Through the methodological schema of the four phases, we see that, in scientific research, the *theoretical* aspect, the hypothesis, and the *experimental* aspect, the testing of the hypothesis, form *a double framework*. The theoretical rests on no ultimate foundation. It is the schema of a reality grasped from a certain situation and which, in that situation, is liable to confirm or invalidate it.

The relationship between the theoretical and the experimental *is a schematic correspondence*, by definition, subject to revision. It is *dialectical* in this sense, and only in this sense, that it is entirely under the pressure of experience, which is reflected in researchers' constant concern to remain effectively engaged with reality in the making and to equip themselves with the means to verify it through new tests of their hypotheses, while remaining open to the possibility of having to revise them as facts require. It may happen that everything must be reworked within a new horizon of knowledge in schematic correspondence with a new horizon of reality, as was the case in the transition from classical physics to Relativity or with the advent of quantum mechanics.

The question of the relationship between the theoretical and the experimental is, in other words, the question of *truth*, which appears to us as *the schematic correspondence between a horizon of knowledge and a horizon of reality*. The traditional notion of truth as full *adequacy* of the statement to reality is thus profoundly revised. We do not reach or measure reality as it is in itself, but *as it is present to us on the horizon*, which may be that of common sense, that of the particle physicist, or that of the astrophysicist...

The fundamental value of knowledge lies in its schematic and revisable correspondence to the horizon of reality, in other words, in what we call its suitability rather than *its truth*. The notion of truth evokes too much the idea of something definitive and unalterable.

Without this characteristic of suitability, knowledge could neither free us from prejudices nor possess its emancipatory value, which places us *in a position to think and decide for ourselves, in short, to be a responsible agent for our entire life*.

b) The relevance of suitability (idonéism) for the scientific community and for all of us

The scientific community can claim *its scientificity* only insofar as it feels bound by *the duty* to meet the methodological requirements of scientific and technical research, notably by emphasizing *solidarity among disciplines*. Highlighting solidarity among

⁵ It is important never to forget that, first and foremost, this schema makes explicit the rhythm of scientific research and that, from there, it extends, with adjustments, to all human activities.

disciplines is the *sine qua non* condition for interdisciplinary dialogue and for the ability to address multifaceted problems, such as those posed by climate change and biodiversity loss. It is also the condition without which the specialist, as Albert Einstein says, «loses the sense of grand architectures and becomes a blind worker in an immense whole. »⁶ In the context of this quotation, Einstein recalls the role played by Arnold Berliner, who had created a journal intended for scholars, and he writes on this subject: «They (the scholars) want to know and understand the evolution of problems, methods, and results in order to form their own judgment. »⁷

In *this ideal configuration* toward which it should strive, the scientific community, present on all five continents, could be *proposed worldwide* as a *model* for building society within the horizon of values opened by the value of knowledge. Within the axiological horizon of their community, researchers engage in dialogue and make joint decisions concerning, for example, the choice of a hypothesis or an experimental setup. Their community, think, for instance, of CERN or the GIEC, *self-determines* with a common goal: advancing knowledge. In this sense, the scientific community, *when it meets its methodological requirements, is a model of a society of free and responsible individuals who choose to live together by dialoguing and cooperating in a spirit of healthy emulation*. Sharing a common goal, its members discuss the best means to achieve it and decide how to cooperate in implementing them.

Isn't this a model that would be particularly suitable for our era, faced with planetary challenges? To meet them, it is indeed essential that, throughout the world, human beings can, thanks to the society in which they live and their personal efforts, become *responsible agents* who, with the help of science and technology, adopt appropriate attitudes and behaviors.

How can this model be disseminated, if not through the education of children and the training of young people, as well as adults who must adapt to new situations? Certainly, but education and training must follow a pedagogical approach based on the methodological schema of the search for suitability, for this is the *sine qua non* condition for adopting the societal model represented by the scientific community when it fulfills all its methodological requirements and thus respects all dimensions of its responsibility. These responsibilities cannot be limited to guaranteeing the reliability of its processes and results, because responsibility is fundamentally a summons to answer for our actions in relation to human beings, whose rights we must always respect, starting with those enshrined in the Charter of Human Rights. Since scientific and technical research refers throughout its methodology to a responsible instance, it is, by its methodological stance, positioned in relation to human beings and their rights. Therefore, if researchers confine themselves to feeling responsible only for providing reliable knowledge, they set *an arbitrary limit* where only what is technically possible interests them—even if it violates human rights, as was the case

⁶ Einstein, A., 1979, *Comment je vois le monde*, Paris, Champ Flammarion, pp. 36-37.

⁷ Einstein, A., 1979, *Comment je vois le monde*, Paris, Champ Flammarion, pp. 36-37.

with the construction of the atomic bomb, whose destructive power was suffered by the inhabitants of Hiroshima and Nagasaki.

The question of the ethics of responsibility, in symbiosis with the methodology of the search for suitability, should be at the heart of the training of researchers and the decisions of the scientific community, but also of education and school learning at the primary and secondary levels. It should also be raised and debated by citizens who must deliberate and decide on the common good and the means to achieve it.

3. By way of conclusion: the relationship between scientific research and philosophy according to Ferdinand Gonseth

I will conclude my reflections by recalling *the inalienable function* that Ferdinand Gonseth attributed to philosophy, whose destiny is united with that of scientific and technical research, that is, to philosophy that fully accepts to play its role. This role is clearly stated at the end of the work *Metaphysics and the Opening to Experience*, whose message, dating back to the mid-1950s, remains fully relevant today.

Everyone has understood that, in already powerful hands, science is the means to an even greater power, a power multiplied to excess. (...) Immense resources are committed to it. One might have believed that humanity had, for centuries, entered a scientific era under the sign of Truth: the truth is that the scientific era, the era of technical conquests arising from scientific research, has only just begun, and it bears, masking the sign of Truth, that of Violence. Must we think that violence will inevitably prevail? To admit this would be to surrender to a new form of nihilism. (...) What seems certain is that, on both sides of borders, societies will undergo internal transformation. (...) A scientific elite will emerge, increasingly numerous. (...) A collective mentality will form, a generalized intellectual and moral climate. (...) And philosophy? In what role can it maintain itself? I do not wish to see philosophy as the more or less outdated intellectual game it sometimes appears to be; I want to see it instead in its inalienable function, which is to promote the highest values that a society offers, that a civilization can embody.⁸

A philosophy that fully accepts its function «that of *constantly uncovering the values to be promoted*»⁹, has no other destiny than

⁸ Gonseth, F., 1973, *La métaphysique et l'ouverture à l'expérience*, Lausanne, L'Âge d'Homme, pp. 290-291.

⁹ Gonseth, F., 1973, *La métaphysique et l'ouverture à l'expérience*, Lausanne, L'Âge d'Homme. It is I who emphasize in bold.

to bind itself to science, not to be its servant, but to remain always its equal. Not to follow it in everything, but to accompany it everywhere, to measure itself against it everywhere, and never to yield the ground entirely. No one can foresee the twists and turns of this dialogue, where each would fight for others by fighting for themselves.¹⁰

One may, however, hope that philosophy would find some strength there, and science some wisdom».¹¹

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¹⁰ Gonseth, F., 1973, *La métaphysique et l'ouverture à l'expérience*, Lausanne, L'Âge d'Homme.

Deficient hearing, implants and devices: qualities and sensory data in perspective

Frédéric Pascal

Résumé

L'article analyse l'audition humaine à partir d'une perspective philosophique et technique inspirée principalement de l'œuvre de Gilbert Simondon, en articulant organismes, milieu et technologie. L'audition n'est pas comprise comme une simple réception de signaux, mais comme un processus actif d'individuation, au cours duquel l'organisme interprète et donne sens aux informations sonores en fonction de ses besoins vitaux, de ses capacités sensorielles et de son contexte d'existence. L'auteur montre que l'information sonore n'acquiert de valeur que lorsqu'elle devient significative pour l'organisme, ce qui suppose un engagement pratique et une intégration avec d'autres modalités sensorielles. Le langage et la musique sont analysés comme des formes de domestication des sons, permettant la constitution de répertoires partagés et culturellement situés. La perception auditive apparaît ainsi comme multimodale, dynamique et profondément liée à la mémoire, à l'attention et à l'affectivité. Dans le domaine technique, l'article présente une généalogie des prothèses auditives et des implants cochléaires, en mettant en évidence le passage de l'amplification acoustique au codage numérique. L'implant cochléaire est décrit comme une substitution sensorielle radicale, qui impose à l'organisme un nouveau régime de fonctionnement fondé sur des signaux électriques et des algorithmes de sélection de l'information. Bien qu'efficaces pour l'intelligibilité de la parole, ces technologies tendent à appauvrir la richesse de l'expérience auditive en privilégiant la distinction entre signal utile et bruit. L'auteur critique l'idéal d'une automatisation totale de l'audition, qui ignore les dimensions interprétative, affective et attentionnelle de l'expérience sonore.

Mots-clés : Audition humaine; Individuation perceptive; Philosophie de Gilbert Simondon; Implant cochléaire; Expérience sonore.



Abstract

The article analyzes human hearing from a philosophical and technical perspective inspired primarily by the work of Gilbert Simondon, articulating organisms, environment, and technology. Hearing is understood not as a simple reception of signals, but as an active process of individuation, in which the organism interprets and gives meaning to sound information according to its vital needs, sensory capacities, and context of existence. The author shows that sound information only acquires value when it becomes meaningful for the organism, which implies practical engagement and integration with other sensory modalities. Language and music are analyzed as forms of domestication of sounds, allowing for the constitution of shared, culturally situated repertoires. Auditory perception thus appears as multimodal, dynamic, and deeply connected to memory, attention, and affectivity. In the technical domain, the article presents a genealogy of hearing aids and cochlear implants, highlighting the shift from acoustic amplification to digital coding. The cochlear implant is described as a radical sensory substitution that imposes on the organism a new mode of functioning based on electrical signals and algorithms for selecting information. Although effective for speech intelligibility, these technologies tend to reduce the richness of auditory experience by privileging the distinction between useful signal and noise. The author criticizes the ideal of total automation of hearing, which ignores the interpretive, affective, and attentional dimensions of auditory experience.

Keywords: Human hearing; Perceptual individuation; Gilbert Simondon's philosophy; Cochlear implant; Sound experience.

I. The nature of hearing in context

Gilbert Simondon places the human organism — and human existence — in continuity with the biological realm. Individuation involves matter and form, anchored in a unified process¹ at the level of a system. Here, the generation of form-taking comes first because this complex is a metastable system. The system's internal resonance, through confrontation with its environment, is a condition for the development of its potentials. Simondon compares the artisan appropriating a material to the subject facing the constraints of its material condition. The first challenge for any organism concerns its orientation toward resources conducive to its development and the avoidance of threats to its integrity. Likewise, we are constantly caught in a necessity of form-giving that holds both terms of the relation: organism and environment. That information is transmitted ultimately says nothing about its practical

¹ Simondon, G., 2005, *L'individuation à la lumière des notions de forme et d'information*, Grenoble, Millon, p. 61.

usefulness for the organism concerned. This is where Simondon opposed the theory of information with an appeal to meaning through the practical engagement of the organism with such a resource.

The relationships between the solid elements of the ordinary world are founded on harmony². The volumes, formally tetrahedral, are elastic systems in equilibrium. Their excitation by an impact or by the resonance of another nearby structure provides the organism, equipped with mechano-sensitive cells, with clues that enable alertness and then analysis of the movements involved. These are the external auditory organs, but also our general sensitivity to movement³, *via* our inner ear, to the conditions of balance of our organism within its immediate environment. This combination of numbers and material structures has attracted the attention of all authors ever since. This is the question of acoustics, the dynamics of structures, the mechanics of objects, and architecture. Instead of being mere receivers, sound signals reveal the core of structures in reaction to different modes of excitation and resonance. They carry the potential for an organism to make sense of what is set in motion around it.

Many living organisms have the ability to signal themselves, but also to signal the presence of a third party to others, whether of the same species or a different one. Our walks in the forest, or even often in urban areas, bear witness to this when a dog or a bird signals our presence. These informational signals help to spread intelligence that has a collective value of alert or opportunity, depending on the organisms concerned.

It is also necessary to take into account the specifically linguistic register. The proper reception of human language is subject to numerous constraints of intelligibility. The masking of voices in ordinary situations is a major difficulty that we often overcome through a kind of puzzle-solving⁴ and by correctly identifying each speaker's voice. Communication and information through language constitute only one part of the mechanisms of human hearing. The situation of the organism within its environment, or environments of existence, is primarily one of weighing multiple alerts awaiting meaning. Opportunities concerning a living being must be considered in terms of potential, which cannot be determined by any external authority.

Simondon evokes the notion of an *auditory image* to refer in particular to the terms of language and their grouping in ways conducive to memorization⁵. This is a mnemonic dimension as long as writing does not so easily guarantee the recall of words and expressions. However, music then occupies an important place. In the same way, it is the guarantee of redundancy that enables memorization. For language and music, the image would be accessible because it is domesticated. More precisely,

² Simondon, G., 2010, *Cours sur la perception*, Paris, Éditions de la Transparence, p. 14. *Geometric numbers* physical characteristic numbers according to Simondon, from Pythagoras onward.

³ TMHS, 2012, "TMHS is an integral component of the mechanotransduction machinery of cochlear hair cells", in *Cell*, vol. 151, p. 1283; Berthoz, A., 2013, *Le sens du mouvement*, Paris, Odile Jacob.

⁴ Cherry, C., 1953, *On human communication*, Cambridge (MA), MIT Press. *Effet cocktail party*, common distinction in the psychoacoustic literature cited by Simondon 2010, p. 92, voir Bregman, *ibid.*, p. 529–530.

⁵ Simondon, G., 2014, *Imagination et invention*, Paris, Presses Universitaires de France, pp. 114–115.

music and language proceed from the appropriation of sounds, thus making it possible to easily share a repertoire. This repertoire is a common domain of hearing that varies according to cultures⁶.

The audio-phonatory coupling is relative when it comes to identifying sounds in the environment⁷. It is insufficient to domesticate the sounds of our surroundings, since their discrimination by the ear far exceeds the motor capacities required for their reproduction. However, we can rely on their evocation, as made evident by certain sound colorations in poetry or in oral expression through onomatopoeia and phonatory expressiveness. Simondon more broadly considers the sensory image insofar as it refers back to motor activity. These images most often turn out to be mixed⁸ (what we would today call multimodal), as they are composed of several senses.

Albert Bregman developed, with the concept of Auditory Scene Analysis, an authoritative theoretical and methodological framework. Its principle is that the listener organizes the entirety of the scene by grouping impulses into different streams. These streams operate through grouping and dissociation of cues based on proximity and regularity of various parameters. These abilities are linked, first, to organic primitives, but also to schemas acquired through experience, adaptation to a biotope and beyond that biotope⁹. All of these processes can be viewed as automatic processing; however, they can also be approached as decision-making architecture. Both approaches benefit from being considered together to best address this multifactorial resource.

II. Technical genealogy of sound devices and techniques

A person with a hearing disability bears the burden of shaping their environment in a particular way. They are, in fact, removed from direct engagement with external phenomena. When they can integrate external devices that promise access to a condition of normality, they face other difficulties in their relationship with others. The impaired organism is placed on the margins of the richness of ordinary interaction and thus finds itself in a situation of insecurity.

The development of hearing aids has been marked by technological breakthroughs. Today, it has reached an industrial phase that encompasses, within the same logic, the two types of aids mentioned: (a) prosthesis, (b) auditory implant. Even though the two approaches address different cases: people who still have hearing ability and those who no longer do, they are treated similarly from a technical

⁶Helmholtz, H. von, 1954, *On the sensations of tone as a physiological basis for the theory of music*, New York, Dover.

⁷ Simondon, 2014, Ibid.

⁸ Id., p.117.

⁹ Simondon, 2010, p.89-91

and fundamental research perspective.

Amplifying the relevant characteristic of the signal was already at work with acoustic horns, which made the disability visible. There is continuity between contemporary hearing aids and these older devices: both are based on the selective amplification of a portion of the signal to facilitate its processing by the aging organism suffering from the destruction of the hair cells critical for processing ordinary language.

The phonautograph, the first device for graphically recording impulses, is a major invention in the history of sound analysis and synthesis. It introduces transduction beyond simple amplification. This device transforms an acoustic signal into writing by means of a stylus. From writing to the convention determining its equivalence, one more step is needed, which leads from analog to digital techniques. We move: (a) from the physical characteristic to its strict definition, (b) from the thermodynamic continuity of a process to its formal decomposition, (c) from its strict material attachment to its multi-realizability through coding¹⁰.

Thus, the cochlear implant is not strictly an addition: it is a radical sensory substitution. It differs from the natural hearing apparatus by imposing an entirely different functioning that mimics the ear to directly convey the effective signal via an electrode array located in the tympanic ramp, then reaching as close as possible to the cochlear nucleus to impose electrical signals. These electrical signals correspond to an initial stage of capture via a microphone, their transmission to a processor that determines an algorithm for selecting and compressing relevant information and organizing it to ensure the greatest usefulness for the implanted person. The equipotentiality of neural circuits allows the functional reception of any type of signal, provided that the transmitted information is preserved. The shift to digitization enables the free imposition of any signal in any form. Adjusting the cues to guarantee the best verbal exchange means a transformation of the design axis. Automation would make it possible to delegate the function of hearing to a new organ, one that is entirely artificial. The merit of the code lies in overcoming the difficulty of noise inherent in any electrical transmission.

Let us note that where functionality is concerned, the more accurate question would be not only that of processing, but also of interpretation. The critical dimension lies in the behavioral and psychological integration of these technical externalities as a complement and continuation of our organic functioning¹¹. In more contemporary terms, the integration of technical instruments as an extension of our mind and body¹² is a major issue for understanding and projecting our future functioning as a social, political, and ecological body.

¹⁰ Pascal, F., 2014, "Esthétique et utilité", in Dallet, S. (ed.), *Esthétique et technologies contemporaines*, Paris, L'Harmattan.

¹¹ Simondon, (2005, p.206) raises the problem of ontogenetic and phylogenetic integration.

¹² Clark, A., 2006, *Supersizing the mind: embodiment, action, and cognitive extension*, Oxford, Oxford University Press; Clark, A.; Chalmers, D., 1998, "The extended mind", in *Analysis*, vol. 58, no. 1, pp. 7–19.

III. Technology of the future?

Future technologies, according to Simondon, are directed toward the care of individuals. However, the way implants and prostheses are developed and marketed follows the dogma of automating processes aimed at making human speech as intelligible as possible under all conditions, with the greatest ease and utmost discretion. This presupposes the best possible distinction between useful signal and noise.

At the forefront of prescribing hearing aids is the prevention of social isolation. Withdrawal and self-confinement quickly become a defense strategy for people at risk of deafness. As receptivity declines, repeated failures tend to continually diminish their understanding of everyday life. This is the main factor in cognitive aging and neurodegenerative diseases. The loss of interaction equally reduces the ability to understand oneself. The presence of interlocutor groups in people's daily routines is a key to their 'mental health.' These accumulating factors explain the overall cognitive deterioration and the resulting fragility of the social person¹³.

Developing digital technologies in which the definition of the "message" allows it to be applied to a code has the advantage of freeing the transmission of said message from the constraint of noise. The organism's dynamic quest for information is thus minimized or even eliminated, as it is deemed inherently unattainable. This principle of implant development is imposed as a model for devices. Adopting either approach has the primary effect of radically blurring the ordinary "vocabulary" of auditory phenomena. Following Simondon's analysis, it must be said that the individual effectively loses the mental images¹⁴ that constitute the ordinary basis of their relationship with their environment.

From the perspective of the engineer and the device manufacturer, the main task is to ensure the correct and easiest possible reception of ordinary linguistic exchanges. However, several major criticisms can be raised.

First, this function disregards the dynamics of attention in the apprehension of the artifact. The knowledge factor is erased in favor of habituation to the receptivity of a "message" *via* a specified information channel. Implanted patients who are experts and tasked with explaining their extraordinary performance have all emphasized their rejection of automation¹⁵. It is the ability to adjust relevance through the effort of dynamic focus that enables adaptation to the variety of situations. Training

¹³ Antoine Hennion has very thoroughly documented people's attachments in order to describe and understand the situations of elderly and/or isolated individuals. Cognitive disability mixes abilities and affects because health is linked to people's capacity for exchange within their social and family environments.

¹⁴ *id.* 2014, p.112

¹⁵ Results from study workshops with expert implant users carried out with the assistance of CISIC as part of an R&D project; from testimonies of prosthesis users during the 2015 National Hearing Days; and from interviews collected with the association MyHumanKit between 2018 and 2021.

in signal sorting promotes the development of its *affordances*¹⁶.

Next, all of the determining factors assume a caricatured understanding of language and linguistic interaction. The clear distinction of linguistic signals from others ignores how many significant sound manifestations relevant to linguistic exchange in real situations are unattainable. The relevances commonly established within communication situations go beyond the strict framework of exchanging statements. Prosody, postures, and more or less reciprocal forms of address determine what is said in relation to the context. The overlaps of reference frameworks enable understanding and adjustment between people in daily life. This is also the spice of *concrete communication situations*¹⁷. Implanted and aided individuals are therefore placed in an extremely abstract position with respect to the emerging meanings within ordinary exchanges¹⁸.

Finally, let us return to the affective dimension. Utility cannot be opposed to aesthetics¹⁹. An experiential situation will motivate a dynamic understanding. One implant recipient recalls a deeply distressing episode. The source of intense suffering turned out, upon examination of the signal's characteristics by the designers involved, to correspond to a family of high frequencies that had never been accessible to the individual²⁰. Once the nature of this signal was revealed, their perception was completely transformed, granting access to a level of meaning. This pain was converted into affordance. The dynamic of "*the effect it produces*"²¹ is thus closely linked to the benefit of cognitive potential.

That the aided person can be placed in a situation of failure calls for another approach. Support that takes into account the ecological constraints of individuals would address the *effects* imposed by the activation of the prosthesis or implant. By distinguishing or grouping waves into streams, establishing continuities between different signals makes it possible to follow the unification of a certain "sound", to identify the components of an actual event. Here, different determinants intermingle to form sequences and thus represent courses of highly diverse events. Now, musical composition works precisely through the weaving of combinations and dissociations accessible to the listener according to different competing criteria.

The technical ambition to standardize individuals' dynamics in relation to their environments according to predefined scenarios is a reductive task. It stems from a tendency

¹⁶ James J. Gibson (1966) developed this concept to refer to the sensory opportunities that support the organism along a favorable path with regard to its conditions of survival and flourishing.

¹⁷ John Perry and Jon Barwise, within the analytic philosophy tradition of semiotics and computer science, position their analyses at the intersection of contributions from J. J. Gibson as well as the Palo Alto school led by Gregory Bateson. One should also mention here the foundational work of ethnomethodology and linguistic anthropology for properly grasping the functioning of spoken language in practice.

¹⁸ Let us note here the gap between concrete linguistic practice and approaches to language reduced to the coding/decoding of messages or meanings conveyed from the lexicon through syntactic normativity.

¹⁹ Pascal, F., 2014, "Esthétique et utilité", in Dallet, S. (ed.), *Esthétique et technologies contemporaines*, Paris, L'Harmattan.

²⁰ Chorost, M., 2006, *Rebuilt: how becoming part computer made me more human*, Boston, Houghton Mifflin.

²¹ Helmholtz, H. L. F. von, *Ibid*.

to confuse the organism's dynamic functioning with the programmed execution of an automaton that would replicate them.

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In the future, more sensitive and more open humans

Anne Querrien

Résumé

L'article examine les conditions de production des technologies du futur, en se demandant si elles suivront une logique d'innovation linéaire ou si elles donneront lieu à des bifurcations techniques et sociales. Il s'appuie sur l'analyse de l'ouvrage *Au nom de l'innovation*, de Vincent Bontems, qui examine de manière critique la conception dominante de l'innovation comme résultat direct et linéaire d'une recherche fondamentale orientée par le marché. Le texte met en évidence l'influence décisive de Gilbert Simondon dans la réflexion de Bontems, en particulier l'idée selon laquelle le progrès technique s'opère par des transductions qui articulent des horizons de faisabilité et de créativité, jusqu'à atteindre des seuils de saturation. L'innovation ne peut être forcée, car elle dépend du stade atteint par les lignées techniques. L'article souligne également des exemples analysés par Bontems, tels que des projets de la NASA et du CERN, dans lesquels la création technique résulte de processus collectifs, longs et incertains, mais aux retombées scientifiques et techniques significatives, notamment dans les domaines de l'imagerie médicale, de la supraconductivité et des interfaces tactiles. Le CERN est présenté comme un modèle institutionnel singulier, fondé sur l'accès ouvert aux données, un financement public proportionnel et l'absence de retour financier direct, constituant ainsi une « utopie techno-socialiste ». Enfin, l'article oppose ce modèle à la recherche industrielle contemporaine, marquée par des impératifs de rentabilité et par des formes d'aliénation liées à la soumission de la technique à la logique de la performance.

Mots-clés : Innovation technique; Philosophie de Gilbert Simondon; Transduction technique; Recherche Collective; Critique du modèle linéaire de l'innovation.

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Abstract

The article discusses the conditions under which future technologies are produced, questioning whether they will follow a linear logic of innovation or give rise to technical and social bifurcations. It is based on an analysis of Vincent Bontems's book *Au nom de l'innovation*, which critically examines the dominant conception of innovation as the direct and linear result of market-oriented fundamental research. The text highlights the decisive influence of Gilbert Simondon on Bontems's thinking, in particular the idea that technical progress occurs through processes of transduction that articulate horizons of feasibility and creativity, until limits of saturation are reached. Innovation cannot be forced, since it depends on the stage reached by technical lineages. The article also emphasizes examples analyzed by Bontems, such as projects at NASA and CERN, in which technical creation results from collective, lengthy, and uncertain processes, yet produces significant scientific and technical outcomes, including advances in medical imaging, superconductivity, and tactile interfaces. CERN is presented as a singular institutional model, based on open access to data, proportional public funding, and the absence of direct financial return, thus constituting a "technosocialist utopia." Finally, the article contrasts this model with contemporary industrial research, marked by imperatives of profitability and by forms of alienation associated with the subordination of technology to the logic of performance.

Keywords: Technical innovation; Gilbert Simondon's philosophy; Technical transduction; Collective research; Critique of linear innovation model.

How will the technologies of the future be produced? What imperatives will they obey? The technical lineages that continually improve automobiles are undoubtedly well established. The technologies that will enhance all household appliances are already known. The miniaturization that transformed the early large computers into today's microcomputers combined the search for a mass audience with that for greater autonomy in intellectual work. When I asked a computerscientist friend in the early 1970s whether one could create a keyboard that would store in its memory what one wanted to have printed once back home, the friend believed it would revolutionize production relations too much to be accepted by the market. The market, however, was more sensitive to users' desires than to inventors' caution and proved him wrong.

Will the technologies of the future be innovations or bifurcations? Will they continue to use ever more energy and rare materials, or will they have to adopt a less

prosthetic approach thanks to human attitudes that are more open to the diversity of our possible ways of performing?

The book that Vincent Bontems has just devoted to innovation¹ is more interested in scientific and technical productions than in the development of more sensitive human beings.

It is nevertheless interesting to follow him along these paths before moving further toward the technologies of the future. The beginning of the book is devoted to the belief in the linear model that presents technical, economic, and social innovation as the logical consequence of fundamental research, something that raises both ethical and practical problems. On page 36, we reach the conception of innovation that I myself have known, which also involves consumers as well as the recommendations of actors throughout the entire diffusion chain.

It was in the 1980s that the idea of targeted research appeared in research funding, subordinated to the needs of the market, which research was supposed to supply with products in a linear manner. «Innovation becomes the name that gives a veneer of scientificity to discourse on research management»².

Gilbert Simondon, frequently cited by Vincent Bontems, who is one of the specialists on his work, would not have thought about it in this way. Gilbert Simondon identifies two types of improvement in technical objects: those that modify the distribution of functions and increase the synergy of operation, and those that merely reduce the residual obstacles to functioning. The continuous progress of a technical object consists in modifying certain elements for better performance, until any further improvement of one element leads to degradation in another dimension. At that point, saturation is reached.

Vincent Bontems also frequently cites Jean-Louis Maunoury, for whom the process of innovation is a transduction (a term from Simondon) that realizes a “technical intention” by closing the gap between a ‘horizon of feasibility’ (the available operations) and an ‘horizon of creativity’ (the desirable functions). This transduction crosses a threshold of concretization and advances the technical lineage. There are periods of effective creation, when technical lineages progress significantly, and periods of stagnation, when the pace is much slower and the design of objects reaches the saturation threshold. In Maunoury’s model, innovation cannot be forced; it depends on where one stands in the technical lineage, whether close to saturation or ready for the emergence of a new arrangement of functions.

Vincent Bontems illustrates his thinking with NASA’s experience, which at first managed to achieve faster, better, and cheaper results, but failed when applying this approach to the Mars exploration program. I find that his analysis of the obstacles

¹ Bontems, V., 2023, *Au nom de l’innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L’Âne d’or.

² Bontems, V., 2023, *Au nom de l’innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L’Âne d’or, p. 57.

encountered by NASA would also apply to the French EPR program, which I regret not seeing examined.

Vincent Bontems emphasizes that the management of research personnel, which requires reporting what one is doing halfday by halfday to prevent researchers from wandering unproductively, is counterproductive, because it is based on the idea that we already know what we are supposed to find, which makes breakthrough innovation impossible. The evaluation of research activity according to this type of indicator has no metric whatsoever for invention or innovation. He then describes more creative design regimes in order to find other indicators: creative stimulation induced by play, abductive prompting through formal analogies, inventive problemsolving aimed at the ideal object, and expansive design as in the CK theory developed at the École des Mines, which makes the two horizons of creativity and feasibility covary. The analysis is applied to the cases of the ChemCam laser integrated into the Curiosity rover sent to Mars, the superconducting electromagnets of the Large Hadron Collider (LHC) designed to capture the Higgs boson, and the mirror of the Herschel space observatory. In these three creation processes, « the feedback of the virtual upon the actual, which defines invention for Simondon, operates recurrently »³. It is obviously very difficult to keep all the stages of this feedback in memory; it would require an additional, competent writerly function, never included in any research program—although this is precisely what the philosopher devoted to scientific processes, Vincent Bontems, sketches. He emphasizes that the awareness of what is happening is fundamentally transindividual, as Simondon had already argued, which would complicate the work of our scientific writer. It is the transmissions and transactions between individuals that produce the present; any given individual's view of it will be partial and distorting. These transactions and transmissions do not belong to the normal functioning of laboratories or companies; they arise in the search for the conjunction of the two horizons. They put heterogeneous series into relation, the condition for the emergence of new machines, as Félix Guattari intuited. For these series to be brought into relation, research and innovation ecosystems must be created, as Maunoury said: open institutional spacetimes for establishing such connections⁴.

The proposal that Vincent Bontems draws from this is that of a right to research and innovation, which would consist in a right to research shared with others within “technological terroirs” in which each person would bring their capital of available functions to connect them with a common social, economic, and cultural horizon of creativity. Something sketched by the Cerisy conferences, during which I met Vincent Bontems, but which most often lack the longterm investment and the horizon of creativity that such “technological terroirs” to be created would allow.

³ Reference details missing.

⁴ Bontems, V., 2023, *Au nom de l'innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L'Âne d'or, p. 129.

The examples of innovation given by Vincent Bontems are objects whose production requires an exceptional kind of faith, something Isabelle Stengers mocked in *The Virgin and the Neutrino*, where she compares the scientists' quest to the pilgrimage of believers. Yet the scientific and technical outcomes of these efforts are considerable.

The research conducted at CERN to develop the LHC produced inventions within the technical lineage of magnets, in the field of superconductivity, in the fabrication of ultrahigh vacuum, in the devices ensuring cooling, insulation, etc. ... The progress of the particle accelerator lineage had direct repercussions on medical imaging with the positron camera now commonly used in hospitals. It was also at CERN that the first capacitive touch screen was invented in March 1972, 'an invention that today makes the smartphone possible'⁵.

According to Vincent Bontems, it was at CERN that the Web was invented, but mathematicians tell a different story. All agree that they envisioned something free of charge. But is free access possible without public funding and state oversight?

The CERN appears to Vincent Bontems as a model of a democratic institution, which I also assume to be as elitist—if not more so—than Athenian democracy. Regardless of where a scientific laboratory integrated into the CERN network is located, one has access to all the data in the network under the same economic conditions, and one has the right to the same computing power. The publications of CERN researchers are freely accessible so that researchers around the world are not strangled by access costs. In every respect, CERN favors the “best offer”. For the management of these “global public goods” that are the observational instruments developed by CERN, there is a Strategy Council in which sit representatives of the member and associated countries. Some sessions concern the functioning of the CERN laboratory, and other sessions concern strategy—that is, the coordination of research at the European and global levels, since non-European countries are also associated with CERN. Each country's contribution is proportional to its GDP, and there is no return on investment, which makes it possible to detach research from national profit-seeking. «CERN is a technosocialist utopia: each contributes according to their means, and all participants benefit from the common production»⁶.

Alongside these major technoscientific facilities, which operate under exceptional rules, today's society is inhabited by numerous researchers who, within various institutional settings, feel obliged to innovate. Whereas the few scientists of the past adhered to values of universalism, disinterestedness, and originality, the many new researchers, most often employed by industrial companies that organize proprietary, commissioned research under authoritarian and local conditions, are develop-

⁵ Bontems, V., 2023, *Au nom de l'innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L'Âne d'or, p. 131.

⁶ Bontems, V., 2023, *Au nom de l'innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L'Âne d'or, p. 159.

ing a new ethic grounded in concern for the world, perfectibility, the transversality of disciplines, and an expanded scientific responsibility. This allows them both to innovate and to escape the narrow and constraining framework of the company.

The ethics of industrial research seems increasingly shaken by the discovery that human alienation stems from the performance requirements imposed on the machine, requirements that technical research, particularly in the energy sector, seeks to improve.

Paradoxically, it is the subjugation of the machine to the human will to power that transfers into alienation by the machine, an especially strong subjugation and alienation in the military sphere. The criterion of ‘best value,’ which has been highlighted to counter the damage caused by ‘lowest cost,’ would require evaluation methods that have yet to be developed. Yet the planet’s ecological situation is pressing. «For the ecosystem formed by living beings and machines to endure, it must both decrease and progress. »⁷

Among the myths of innovation analyzed by Vincent Bontems, that of the robot and artificial intelligence draws our attention.

The robot cannot go beyond the data at hand in order to innovate by anticipating a pure virtuality—that is, a future not merely improbable but unimaginable on the basis of present data’—whereas, as Simondon says, the living being can make the virtual act upon the actual, can invent a future without knowing it, but one it desires. ‘The desire for an unknown state forges the link between the future as undecidable (beyond the reach of artificial intentionality) and the affective orientation toward the future (beyond the reach of artificial interiority), for the undecidable future is the condition of an unpredictable and discontinuous transformation.’⁸

The myth of the robot attributes to it the capacity to revolt like a human slave, but it does not have the interiority required to negotiate its relation to power; it obeys or it breaks. Science, by contrast, is an open system of norms because it contains within itself the possibility of a transduction toward another system of norms.

For my part, I experienced such an attempt at a transduction of desire within a system of social, rather than technical, innovation, developed from the psychiatric clinic of La Borde, within the CERFI, the Center for Institutional Studies, Research, and Training. In the years following 1968, in most administrations, young senior civil servants were questioning the authoritarian and disdainful management norms for collective facilities established in earlier decades, as well as the new philosophy proposed by political authorities, which consisted in reserving these facilities for poor and assisted populations in order to discipline them, while granting greater organizational freedom, though necessarily in a private framework—to those better off

⁷ Bontems, V., 2023, *Au nom de l’innovation. Finalités et modalités de la recherche au XXI siècle*, Paris, Les Belles Lettres, coll. L’Âne d’or, p. 161.

⁸ Bontems, V., 2023, *Au nom de l’innovation. Finalités et modalités de la pesquisa au XXI siècle*, Paris, Les Belles Lettres, coll. L’Âne d’or, p. 210.

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populations who could afford it. Social workers, teachers, and physicians, gathered in the journal *Recherches*, sought to experiment with new ways of doing things. In the new towns or in neighborhoods undergoing social development, some officials were receptive to such innovation. Many ingredients were missing to succeed at the time, beginning with scientific research grounded in congruent hypotheses, but also locally elected officials open to experimentation, as well as residents' associations concerned with the fate of the common good. The change of president of the Republic in 1974 put an end to the attempt. The term social innovation was recycled. Paradoxically, reading Vincent Bontems's book, and above all the messages posted online by innovators in the educational field, often enthusiastic about neuroscience and cognitive science, leads me to think that the possibility of realizing this social innovation is now more distant than it was fifty years ago! The relationships among all participants in a given action would need to be jointly worked toward congruence, while the individual lines opposing it would be analyzed and gradually transformed. The resources of literature and science fiction would be mobilized to generate the necessary imaginary transformations.

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Plateaux

Farah Khelil

Résumé

Le texte développe une réflexion essayistique sur la relation entre la pensée, le corps, l'espace et le jeu, à partir de l'expérience de la bibliothèque comme lieu de création. L'auteure associe la posture physique du lecteur à la figure du *Penseur* de Rodin, en explorant l'idée d'un corps immobile traversé par une intense activité mentale. Des références artistiques et théoriques — telles que Béchir Majdoub, Paul Klee, Marcel Broodthaers, Albert Camus, Deleuze et Guattari — soutiennent une enquête sur la solitude de la pensée, comprise non comme un isolement, mais comme une « solitude peuplée » d'images, de concepts et d'interlocutions invisibles. Le jeu du Solitaire fonctionne comme une métaphore de l'autosuffisance et de l'autoélimination, tandis que le jeu de Go introduit une logique relationnelle, spatiale et stratégique fondée sur la composition, l'intuition et l'occupation du territoire. Ce passage du jeu solitaire au jeu à deux symbolise la transition du chaos vers l'ordonnement, de l'absolu vers le relationnel. Le texte s'achève sur une réflexion autour de l'affrontement entre l'intelligence humaine et l'intelligence artificielle, en problématisant la mémoire, l'apprentissage et l'esthétique, et en réaffirmant la création artistique comme un champ de pensée en mouvement, situé entre l'individuel et le collectif

Mots-clés : Bibliothèque (lieu de création); Solitude peuplée; Corps et pensée (posture du lecteur / Penseur de Rodin); Jeu du Go (logique spatiale et stratégique); Intelligence artificielle.

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Aion Journal of Philosophy and Science

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Il faut lire, me répétait souvent mon père lorsque j'étais enfant.
Mon père est peintre.
Moi, je ne le suis plus. Je ne sais pas d'ailleurs si je l'étais vraiment un jour.
Moi, je veux comprendre d'abord.
Alors, je lis.

Ce n'est pas à l'atelier que je travaille. En revanche, j'aime être dans ce lieu, assise sur une chaise, accoudée à une table qui m'appartiennent toutes les deux pendant un moment. Dans ce lieu de la mémoire, de l'archive, là où on classe le savoir et la pensée par catégorie, sur des étagères, dans des couloirs nominatifs. La bibliothèque.

La bibliothèque insiste sur cette posture assise, sage, surveillée, cadrée. S'asseoir ici est un état actif, il s'agit de se laisser tomber sur place, le corps relâché, et le cerveau actif. Assise je pense, je jouis dans la paresse sans aucune tâche ni responsabilité, mais je me creuse les méninges. Assise je vois, je lis, les oreilles bouchées, les yeux aux aguets, au chevet des mots et des images. Ici ce n'est pas le corps qui est à l'épreuve de l'attention mais l'esprit synaptique. A la bibliothèque, je me mets à rêvasser, à penser, à somnambuler presque sur place.

Cela renvoie à la posture du *Penseur* de Rodin porté par le poids du *corpus* sur une main-socle. Le penseur, cet individu qui travaille ses méninges, est la figure de la pensée en mouvement et d'un corps inerte. Une activité invisible de l'intelligence, lieu de la mémoire et du stockage, lieu du traitement de l'information, qui ne tend qu'à être révélée par une image de pensée, un geste, une parole, un verbe. Ce penseur est marquant dans sa posture mais aussi dans sa nudité. Il se livre nu à penser, sans outil, sans artifice, sans symbole, seulement un homme et non une femme, silencieux et recroquevillé dans un éboulement pensif total.

Il a l'air inquiet, le poids de la pensée le ronge, le point serré sous tension. Il est le seul appareil pensif, le seul organe de pensée. Dans un corps nu, sans artifice, se meuvent la pensée, force et profondeur. Le corps du *Penseur* est d'ailleurs à l'image de ce que Rodin veut y élucider, une pensée forte, une musculature de pensée, un corpus au-delà du corps. Ce corps d'athlète olympique a l'air si fragile face à la lourdeur de la pensée qui pèse sur sa tête.



Figure 1. Béchir Majdoub, Graines, Maison Tunisienne d'Édition, 1986, Tunis.

Cette sculpture ne laisse pas indifférent le penseur et écrivain tunisien Béchir Majdoub. Il décrit dans un texte poétique, le souvenir de sa rencontre dans les années 80 avec la sculpture au musée Rodin à Paris. Dans un premier temps il questionne la nudité du corps pensif. Ensuite il fait comme un éloge de la pensée (*el fikr*) : *Al fikrou kaanahou assahmou al ardou machdoudan ilé kawsil jasad* - « la pensée est comme la flèche tendue à l'arc du corps ». Cette métaphore de la pensée comme flèche attachée à son corps-arc, me rappelle la formule « père de la flèche est la pensée » énoncée par Paul Klee dans ses légendes d'esquisses pédagogiques.

L'auteur tunisien est frappé en état de choc esthétique, saisi devant cette sculpture de la pensée qui le renvoie à l'image miroitante de son propre corps pensif. La pensée est alors cette forme de l'extériorité, qui s'adresse au dehors comme voir ou parler qui sont également des actes de pensée. Elle loge dans cet interstice. Penser appartient à un dehors qui viendrait s'engouffrer entre le visible et l'écrit.

Travailler à la bibliothèque comme on travaillerait dans un atelier me renvoie, au-delà du statut de la bibliothèque-atelier, à me poser la question de la nature de ce travail. Quel type de travail engendre la réalisation d'une œuvre au sein d'une bibliothèque, au voisinage de la foule, plongée dans une masse de données et dépourvue d'intimité ? Le lieu de création influence mon état d'esprit, ma manière de voir les choses qui m'entourent. La création au sein même de la bibliothèque fait de la pensée l'organe créateur, où se manifeste une production massive d'images de pensée.

Par ailleurs, *penser* – ce verbe d'action – déclare aussi une opinion, un point de vue. Dans *Pense-Bête*, Marcel Broodthaers colle des morceaux de papier qui cachent le texte comme pour rappeler ce caractère paradigmatique d'un objet lisible et d'un texte visible en transformant un espace de lecture en une perte de mémoire. Il cache comme pour créer une amnésie du sens. Le contenant et le contenu se confondent en un seul objet-mémoire. Le livre de composition appelle au jeu de lecture et de contemplation. Le livre est en quelque sorte un retour à la source même de sa fonction : un corpus de mémoire, un pense-bête.



Figure 2.Exposition personnelle *Solitude peuplée*, 2017, commissaire Sonia Recasens, Appartement 27 bis, Paris.

Cette dialectique d'une pensée intime me rappelle celle de la solitude du lecteur. Une « solitude peuplée », dirait Albert Camus. Cette solitude peuplée caractérise de nos jours spécifiquement l'internaute. Une posture solitaire face à l'interface peuplée du réseau. Lorsqu'il communique avec un au-delà sans le voir, lorsque sur un forum de discussion se crée une proximité de référents absents et lointains.

L'internaute se connecte alors à un agencement machinique, comme s'il était ligaturé par un rhizome d'usages, de services et de fonctions.

Cet individu cyborg qui joue des images et des énoncés à travers une digitalité discursive, animée par une poétique paradoxale d'être à la fois ici et là, local et global. Cet individu seul, s'ouvre simultanément par les bouts des doigts à une espèce d'espace peuplé par des êtres fantômes. Cette sphère, à la fois intime et peuplée, est alors proche de celle de l'espace du lecteur dans la bibliothèque.

Et la boucle est bouclée.

Cette posture du penseur solitaire est également celle du joueur du Solitaire. Le plateau de jeu est circulaire, présentant des trous, souvent 35. Les billes prennent place sur les trous, mais seulement 34 pour laisser la place au premier coup. Ce jeu de plateau je l'avais imaginé posé devant le Penseur, sous ses yeux qui fixe le plateau et cogite son prochain coup.



Le solitaire permet de jouer seul, face à son plateau casse-tête. Il s'agit d'un jeu de stratégie, le pion « saute » par-dessus un autre et rejoint une case vide. Celui-ci est alors retiré du plateau. Pour que à la fin il n'en reste qu'un. Ce jeu de guerre est un jeu d'auto-élimination. Une guerre contre soi. 34 pions, mais un seul joueur. Les pions sont identiques, il n'y a pas de forme ou de couleurs pour les diviser, les différencier contrairement au jeu d'échec, ou de Dame, sauf le désir d'en laisser qu'un seul sur le plateau. Un seul vivant, lorsque tous sont mort.

Un seul coup à la fois. D'un seul coup. Placer sans jamais déplacer. Ces gestes rendent compte de la « main pensante », d'une digitalité. On place le pion, pas droit à l'erreur. Cette manière statique de faire dans un geste immuable, reflète en même-temps une figure dynamique. Elle fixe une réalité donnée tout en étant capable de s'adapter à une réalité à venir. On peut voir dans ces coups de points, un geste de semence. Imaginer ces pions comme des graines de Pensée. Lorsque l'une est semée, l'autre est cueillie. Ces plateaux de jeu deviennent un champ d'herbe.

Comment dans ce cas, ne pas évoquer les diagrammes de Feynman – qui représentent la partition de la mise en musique de la théorie quantique des champs. Un champ de particules dans ce cas.

Surement là encore, ma pensée saute par-dessus elle-même.

Mais, qu'est-ce qui saute par-dessus lui-même ? Il faut aussi un saut dans la pensée, un geste de connexion, de fouille et d'intersection pour inviter brusquement Paul Klee à jouer au Solitaire. Dans *Notes sur le point gris*, l'artiste écrit :

Le chaos comme antithèse de l'ordre n'est pas proprement le chaos, le chaos véritable ; c'est une

notion « localisée », relative à la notion d'ordre cosmique et son pendant. Le chaos véritable ne saurait se mettre sur le plateau d'une balance, mais demeure à jamais impondérable et incommensurable. Il correspondrait plutôt au *centre* de la balance.

Le symbole de ce « non-concept » est le point, non pas un point réel, mais le point mathématique.

Cet être-néant ou ce néant-être est le concept non-conceptuel de la non-contradiction. Pour

l'amener au visible (prenant comme une décision à son sujet, en établissant comme le bilan interne), il faut faire appel au concept de gris, au point gris, point fatidique entre ce qui devient et ce qui meurt.

Ce point est gris, parce qu'il n'est ni blanc ni noir ou parce qu'il est blanc tout autant que noir. Il est gris parce qu'il n'est ni en haut ni en bas ou parce qu'il n'est ni chaud ni froid. Gris parce que point non-dimensionnel, point entre les dimensions et à leur intersection, au croisement des chemins.

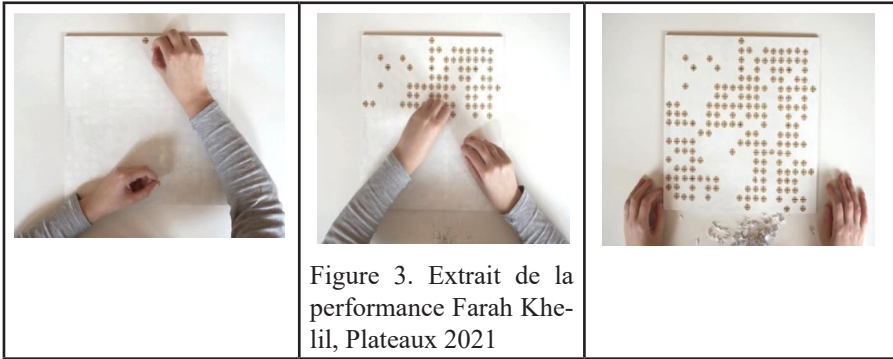
Établir un point dans le chaos, c'est le reconnaître nécessairement gris en raison de sa concentration principielle et lui conférer le caractère d'un centre originel d'où l'ordre de l'univers va jaillir et rayonner dans toutes les dimensions. Affecter un point d'une vertu centrale, c'est en faire le lieu de la cosmogénèse. A cet avènement correspond l'idée de tout commencement ou, mieux : le concept d'œuf.

Deux moments s'offrent ainsi au point gris, devenir ordre ou mourir. Le point gris de se positionne ainsi entre le chaos et le germe. Entre l'absolu et le possible.

Le premier point gris est chaos, non-dimensionnel. Le second c'est le même, sous une autre forme. Si le point gris se dilate et occupe la totalité du visible alors le chaos change de sens et l'œuf se fait mort.

Catastrophe ! Comment établir l'ordre dans tout ça ?

La solitude est autodestructrice. La solitude est chaos, catastrophe, absolu. La solitude appelle l'autre, la dynamique, le mouvement, le dialogue, l'adversaire. Elle appelle un peuple qui manque. Elle appelle l'harmonie d'une deuxième main qui compose sur le plateau. Elle appelle l'intersection, une grille, un territoire. Elle ne veut plus éliminer, elle veut s'approprier, construire. Multiplier les points, s'enrichir et s'étendre. Soudain la solitude devient peuplée.



Du local au global. Du seul au double. Du silence à la traduction, à la transmission. De l'espace lisse à l'espace striillé. Du jeu de Solitaire au jeu de Go. C'est toujours affaire de guerre, de guerre de territoire. Mais à ce moment-là, il s'agit plus précisément d'une machine de guerre. Il s'agit d'un jeu de composition, de combinaisons avec compréhension des rapports.

Selon la Théorie des jeux, les Échec sont un jeu d'État. Ses pièces sont codées, elles ont des propriétés intrinsèques, d'où découlent leurs mouvements, leurs situations, leurs affrontements, leurs identités. Elles sont qualifiées, le cavalier, la tour, le roi, la reine.

Voici ce qu'écrivent les auteurs du Mille plateaux :

Les pierres de go sont des grains, des pastilles, de simples unités arithmétiques, et n'ont d'autre fonction qu'anonyme, collective ou de troisième personne. Les pierres de go sont les éléments d'un agencement machinique non subjectivé, sans propriétés intrinsèques, mais seulement de situation.

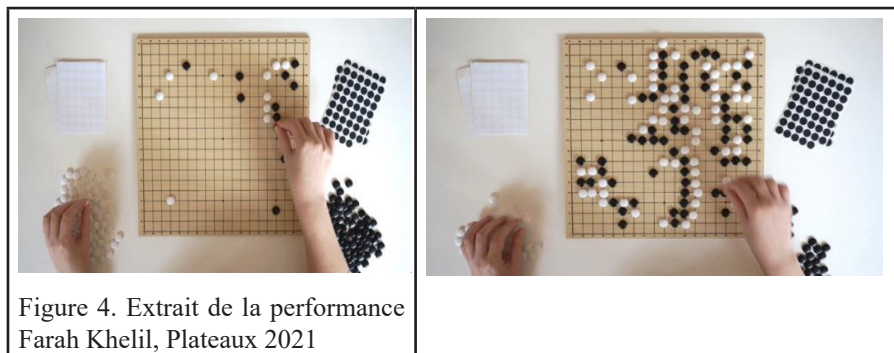
Dans le go, il s'agit de se distribuer dans un espace ouvert, de tenir l'espace, de garder la possibilité de surgir en n'importe quel point : le mouvement ne va plus d'un point à un autre, mais devient perpétuel, sans but ni destination, sans départ ni arrivée. Espace « lisse » du go, contre espace « strié » des échecs. Nomos du go contre État des échecs, nomos contre polis.

Ainsi j'ai commencé ma quête du jeu de Go.

Le plateau de Go est constitué de 19 par 19 cases, soit 361 coups possibles devant 35 seulement du plateau du Solitaire.

Dans *Petit traité invitant à la découverte de l'art subtil du go*, Georges Perec écrit : « Du Duel. Comme les échecs, comme les dames, le Go se joue à deux, avec des pièces noires et blanches et se termine après un nombre fini de coups. Rien n'y est caché, et le hasard y est exclu, sauf dans les mécanismes psychologiques des

joueurs. Comme pour les échecs, comme pour les dames, il existe une stratégie gagnante que, bien entendu, nul mortel (et nul ordinateur) ne possède, ce qui permettra de jouer encore un certain temps.



Ce jour est arrivé. Là encore, ma pensée saute par-dessus elle-même, comme le point gris de Paul Klee. Car là encore, bien que la solitude du joueur soit brisée par une solitude peuplée par un adversaire au-delà de lui-même, elle reste néanmoins fatalement seule. Le duel est historique car une Intelligence Artificielle l'emporte sur l'intelligence humaine. La pensée humaine.

Deux intelligences s'affrontent sur un plateau. Deux, mais seulement un corps. Un corps, face à un corpus, un corps sans organe. Une posture face à une imposture. Une pensée face à une image de pensée. Il a perdu ! déstabilisé ! déçu mais sportif. Seul contre tous. S'agit-il encore d'un nomos dans ce cas ? un apprentissage profond. Une mémoire absolue.

Le jeu de Go se base sur une évaluation esthétique de forme, qui désigne la relation entre les pierres. Certaines firmes locales sont considérées comme bonnes lorsque toutes les pierres qui la composent « travaillent » efficacement. Cette part importante de l'esthétisme dans le Go explique en partie pourquoi en Asie, il n'est absolument pas considéré comme un jeu réservé aux esprits cartésiens, comme peuvent l'être les échecs en occident : il est très prisé par les esprits artistiques. Ainsi, pour évaluer une position, les joueurs de go basent leur jugement en grande partie sur leur intuition.

Jusqu'à présent, l'humanité ne basait son jugement que sur son expérience patiemment accumulée au fil des siècles pour évaluer une position. Mais aujourd'hui, ce savoir n'est plus une certitude.



Figure 5.Extrait de la performance Farah Khelil, partition pour piano d'une partie de jeu de Go (AlphaGo/Lee Sedol).

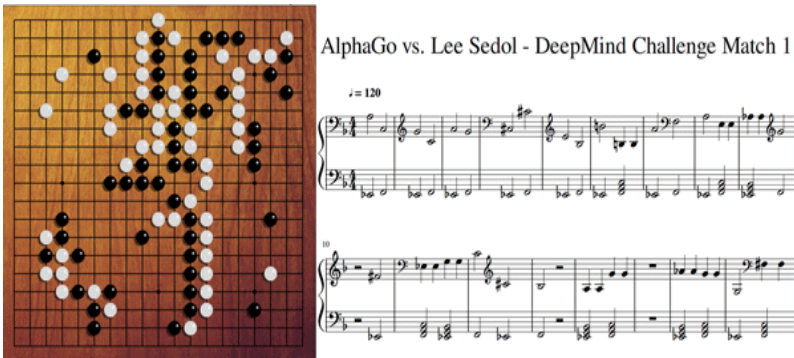


Figure 6. Partition réalisée avec : Michaël Bertin (mathématicien), NuDenseSmoke (musicien) et Johannes Colin (pianiste). Jeudi 15 juin à partir de 19h à Appartement, 27bis rue Jacques-Louvel-Tessier 19e Paris. <https://soundcloud.com/nudensesmoke/partition-go>

Duel, étymologie du mot Cartel.

Il faut lire, me répétait souvent mon père lorsque j'étais enfant.

Mon père est peintre.

Moi, je ne le suis plus. Je ne sais pas d'ailleurs si je l'étais vraiment un jour.

Moi, je veux comprendre d'abord.

Alors, je dépeins.

Je compose une partition.

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Ten theses on Zoo futurism and the technologies of the future

Dominique Lestel

Résumé

Le texte présente le Zoofuturisme comme une proposition philosophique et artisticoexistentielle visant à repenser la relation entre les humains, les animaux et les technologies du futur. L'auteur soutient que la philosophie académique traditionnelle est devenue insuffisante pour comprendre le monde contemporain, marqué par l'accélération technologique, la crise écologique et de profondes transformations ontologiques. En réponse, le Zoofuturisme propose dix thèses, articulées autour d'une pratique philosophique hybride, située entre la philosophie, l'art et la sciencefiction. L'idée centrale est le passage d'un idéal de vie *avec* les animaux à un idéal de vie *dans* les animaux, compris comme une cohabitation symbiotique, métabolique et existentielle. L'auteur introduit le concept de réactivation perpendiculaire de l'espèce, selon lequel l'humain n'abandonne pas son espèce, mais la réorganise en intégrant des caractéristiques d'autres espèces de manière non darwinienne. Ce processus est conçu comme une technologie existentielle permettant « d'habiter le monde autrement ». Le Zoofuturisme est également présenté comme une réponse possible aux crises climatiques et à l'effondrement écologique, en défendant l'invention de technologies de survie fondées sur la réanimalisation de l'humain, en opposition aussi bien au transhumanisme qu'aux postures apocalyptiques ou décroissantes.

Mots-clés : Zoo futurisme; Technologies du futur; Relation humain-animal; Technologie existentielle; Crise écologique et survie.

Abstract

The text presents Zoofuturism as a philosophical and artisticoexistential proposal aimed at rethinking the relationship between humans, animals, and future technologies. The author argues that traditional academic philosophy has become insufficient for understanding the contemporary world, marked by technological acceleration, ecological crisis, and pro-

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Aion Journal of Philosophy and Science

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found ontological transformations. In response, Zoofuturism puts forward ten theses, articulated around a hybrid philosophical practice situated between philosophy, art, and science fiction. The central idea is the transition from an ideal of living *with* animals to an ideal of living *within* animals, understood as a symbiotic, metabolic, and existential form of cohabitation. The author introduces the concept of *perpendicular reactivation of the species*, according to which humans do not abandon their species but reorganize it by incorporating characteristics of other species in a non-Darwinian way. This process is conceived as an existential technology that makes it possible to “inhabit the world differently.” Zoofuturism is also presented as a possible response to climate crises and ecological collapse, advocating the invention of survival technologies based on the reanimalization of the human, in opposition both to transhumanism and to apocalyptic or degrowth-oriented positions.

Keywords: Zoofuturism; Future Technologies; Human–animal relations; Existential technology; Ecological crisis and survival.

With Zoofuturism, my goal is to address the question of future technologies *and* the philosophy that accompanies their development in a personal way.

To think about questions such as future technologies or the becoming of humans and living beings, we must invent new ways of practicing philosophy — or thought because philosophy as it is usually practiced in universities has become largely obsolete.

In other words, we’re not going to redo Kant, Hegel, Wittgenstein, Quine, or Derrida *to grasp*¹ the issues of the contemporary world in becoming.

From this perspective, Zoofuturism can be described as the improbable but thrilling marriage between my most fundamental philosophical interests and some of my most haunting childhood dreams — slipping into the skin of individuals of another species², sliding into the scales of a saurian, or becoming something of the butterfly for the span of a few wingbeats.

Zoofuturism is a term I coined in 2016 while preparing a lecture at the Arts Décos. This detail is not insignificant, because it was a lecture given in an art school. I was invited to speak about human–animal relations, and my goal was to introduce disorder, the unexpected, and *fun* into an intellectual space that gives too much importance to good intentions and a stifling seriousness — the kind that undermines the intellectual and existential creativity that truly excites me. Today, my work on

¹ ‘To apprehend’ rather than ‘to think’, because this venture requires the theorist to involve themselves — we leave the space of ‘pure’ discourse. It is also a reference to the opening toward a ‘field philosophy’, which has little to do with a rehearsed positivist empiricism, as some believe.

² I will consistently use the expression ‘other species’ (*espèce autre*) rather than the more usual ‘another species’ (*d’autre espèce*). Far from being a mannerism, this lexical choice is meant to highlight how strange an individual of another species appears to a human — not merely as a member of a different species, but as the member of a *disquieting* species.

Zoofuturism is also, as we will see, the continuation of an adventure that has led me *to practice philosophy differently* — at the crossroads of conceptual analysis, artistic practice, and science fiction — of which my work on *Insurrectional Machines* was an important step.

Rather than giving a traditional lecture, I will instead present ten central theses, which make no claim to exhaustiveness but aim to introduce a perspective that still remains largely to be invented. These theses vary in scope and importance.

Thesis 1. Moving from an ideal of life *with* animals to an ideal of life *in* animals

As a first approximation, Zoofuturism can be described as the stance that allows one to move from an ideal of life *with* animals to an ideal of life *in* animals.

What is being evoked here is not merely sharing an ecosystem with animals on a behavioral level, but *cohabiting symbiotically* with them, that is *metabolically, behaviorally, and semiotically*.

Living with a pet already means *becoming something of that animal*.

Two things should be noted. First, *the ambiguity of the sentence in French*, which means both transforming oneself through that animal and being able to put oneself in that animal's place. Second, its *reversibility*.

Living with a pet also means allowing that animal to become something of us.

On this subject, I'm fond of the anecdote about the old woman at the veterinarian's, who places her dog on the examination table and says: "Doctor, we have a stomachache".

As Montaigne said about La Boétie, "because it was he, because it was I," but for the French writer it was, of course, a human being who was concerned.

Thesis 2. Enchant myself

I don't just want to live with my cat, I want to *encat*³ myself. "Enchater": the word doesn't exist in French, and here we see a major feature of Zoofuturism, which develops a playful and creative closeness with language — not only with its vocabulary but also with its grammar.

Here we understand that my conception of philosophy stands in opposition to *youknowwho*⁴, who seeks the future of thought in a largely fantasized archaeology of the Greek language.

A conception of philosophy rooted in ordinary language is also excluded.

My philosophical approach gives primary importance to language, and it does not hesitate to invent words or twist grammatical expressions to make them more effective.

French, then, but modified to be more efficient.

Pedants will reproach me for my barbarisms, my solecisms, and generally for

³ *Chat* is "cat" in French (N.T.)

⁴ Leo Strauss used to say, about the same individual: 'hewhoshallnotbenamed', if we are to believe George Steiner's recollections in his conversations with Ramin J.

my baroque grammar, but I let them bark. As it's said in *Tintin*: "The dog barks, but the caravan passes." I am the caravan.

To encat myself, then, but also to endog myself, enfish myself, or insectize myself, and many others besides — asking myself what unique perspective each choice of animal offers, without limiting myself to real zoology; certain forms of imaginary zoology present intellectual opportunities that would be a shame to overlook⁵.

Thesis 3. Zoofuturism must be understood as a perpendicular and individualized reactivation of the species

Zoofuturism, then, aims to account for the mobilization of multiple techniques *to invent forms of existence at the margins of species*.

A technology of the perpendicular reactivation of the species.

Zoofuturism can thus be characterized, at a first level, as a technology of the *perpendicular reactivation of the species*.

The perpendicular reactivation of the species sets up mechanisms that make us inhabit the species in a nonconforming way — that is, a nonDarwinian one; I do not enter into competition with other species to access ecological resources, but instead assimilate some of the characteristics of individuals from another species in order to be of my own species *otherwise* than those who belong to the species "naturally" are.

In Zoofuturism, one does not leave one's species; one *remodels it*.

From this point of view, Zoofuturism becomes a form of tinkering with phylogenesis.

It requires abandoning the belief in a linearity of Evolution in which one would pass from one species to another.

Each species does not only display adaptive innovations in relation to the species from which it descended. It also carries with it characteristics that it has disconnected from preceding species, and that it can partially reactivate outside any adaptive requirement — and in this sense, this reactivation can be described as perpendicular.

What does it mean to "inhabit one's species"? To be part of a species from the standpoint of the first person.

The question being posed here is neglected by both biologists and philosophers — namely, what it means to *inhabit one's species*, that is, *to be part of a species from the firstperson point of view*.

Zoologists consider the species as a whole. They now acknowledge the existence of *singular animals*, such as the knottying orangutans I studied with Chris Herzfeld, or talking chimpanzees like Washoe.

Knowing how a given member of a species *personally* experiences their speciesmembership remains a largely unexplored question.

⁵ One could revisit the phenomenon of the vampire from this perspective. On 'real' vampires, see Lestel's unsettling book *L'animal Singulier*, Seuil.

Belonging to a species as adventure.

For both the biologist and the philosopher, belonging to a species remains a typological characteristic; but it is also an *adventure* that can be expressed very differently depending on the agents involved, and that can lead to *disturbing idiosyncrasies* — particularly among those, more numerous than one might think, who feel themselves to be of another species⁶, or who refuse to remain confined to a single species⁷.

The pseudopsychiatric explanation.

When faced with such an extravagant claim (in the literal sense: one that steps off the beaten paths), the mistake would be to reduce it to forms of mental pathology and to call in psychiatry. From this point of view, those who want to change gender are small players; wanting to change species is a far more ambitious undertaking.

Thesis 4. Zoofuturism as anarchism of the species

Zoofuturism is an anarchism of the species. Darwinism, to begin with, is deeply anarchistic in spirit through its *bottomup* dynamics, which operate by trial and error without being configured *a priori* by any overarching *topdown* schema such as the teleological *Grand Design* of creationists.

Evolution gives even weak species a chance.

A non-Spencerian interpretation of Darwinism would instead emphasize the magnificent fact that even the most delicate, the weakest, and the most extravagant species have managed to carve out their own place without being *broadly* eliminated by the more aggressive ones.

To experience the species in another way existentially, and not only empathetically.

Zoofuturism deepens this anarchistic strain within Evolution by potentially allowing each person to experience the other species not in an *empathic* way (imagining oneself in the place of the other), but in an *existential* way (metabolically occupying the place of the other).

To belong to a species as a *personal choice* and not as a *phylogenetic destiny*.

The Zoofuturist stance therefore develops an explicit *noborder* project by refusing to be confined by what could be identified as species boundaries, and by considering that belonging to a species is just as much a matter of personal choice as of a phylogenetic destiny imposed by a fortuitous birth. The capricious adolescents who protest that they were not consulted about being born (a claim that should be understood as an ontological eccentricity deserving conceptual elaboration) adopt a sterile complaint that could be more fruitfully transformed into a more subversive desire not to remain confined to the species assigned to them at birth.

⁶ See, for example, the ‘Otherkin’ phenomenon, where people gather who do not feel they belong to the species into which they were born.

⁷ Whether the question also arises for other species remains open — but we do see examples of it in certain monkeys.

To multiply shortcircuits within the phylogenetic space.

The relationship to phylogenesis remains today a monopoly of biologists. Zoo-futurism makes it possible to turn phylogenesis into something other than an arrangement oriented toward the future. It replaces a multiplicity of détourned temporal sequences for the very tidy arrangement oriented from past to future and always kept under control. But the phylogenetic space is far too rich and interesting to be left in the clutches of the biologists.

In this sense, Zoofuturism can be characterized as a way of reconceptualizing phylogenesis in order to multiply improbable shortcircuits within it, outside the Geneva Convention.

Thesis 5. Zoofuturism as a new capitalist niche

A certain number of sensitive points within Zoofuturism must be confronted headon.

Zoofuturism, for example, constitutes an emerging capitalist market that could be characterized as that of a *nonnutritive consumption of other species*.

Some ways of engaging in it are inexpensive, but one must acknowledge that the most exciting ones rely on new technologies, such as biotechnologies or information technologies, which are among the most costly. The project can be made highly subversive by mobilizing enormous resources that exist only in a capitalist society.

Speaking only of capitalism is, in any case, somewhat simplistic, because one of the problems of Zoofuturism lies in its relationship with the military and with war.

Some might see a paradox here: resorting to what destroys the world in order to confront its announced destruction. What would the alternatives be? A return to a largely fantasized past is not a realistic option, and fighting evil with evil is a traditional strategy — well illustrated by the Greek notion of *Pharmakon*. The political objection concerning the sharing of resources is more pertinent.

Access to such *transpécifique* experimentation should be widely available — should we speak of a “democratic Zoofuturism”? I will not answer these questions here; I am merely raising them.

Thèse 6. Le Zoo-futurisme comme adaptation au changement climatique et comme dispositif postapocalyptique à neutraliser les vaincus

Zoofuturism does not propose a purely aesthetic conception of the Living.

Zoofuturism as a response to current climatic upheavals.

Zoo-futurism offers a response to global warming, to the collapse of biodiversity resulting from the anthropization of the world, to the generalized pollution of ecosystems, and to humanity’s desire to extend itself beyond its traditional ecosystems — by enabling life in extreme atmospheres and by inhabiting the oceans and the cosmos.

Inventing effective survival technologies.

Faced with the geological upheavals that threaten us, we generally evoke three options: an *appropriate technological response*, *apocalyptic disappearance*, or the *choice of degrowth*.

Contrary to what many intellectuals believe, I think we must invent effective survival technologies — just as the Living, indeed, has always done. From this point of view, a return to the Paleolithic is an inconsistent fantasy⁸.

Posthuman as the *reanimalization* of the human

A central question of our time is therefore expressed in a brief proposition: what technologies will allow us to survive the geological transformations of the world brought about by its anthropization?

Zoofuturism suggests developing technologies that would paradoxically allow humans to transition to the posthuman through a *reanimalization of the human* — by transforming themselves into living agents capable of surviving in ecosystems where the temperature is 50°C, where oxygen is lacking, where the pressure is far higher than that at the Earth's surface, or where gravity does not exist.

Mimetic evolutionism, Darwinian evolutionism, Lamarckian evolutionism.

From a Zoofuturist perspective, humans can survive on the condition that they reanimalize themselves by borrowing from animals what they lack. This results in a mimetic, borrowbased evolutionism that is very different from Darwinian and Lamarckian evolutionisms, in which one species appropriates characteristics of other species in order to survive. The Zoofuturist stance is the antizombie film⁹.

Reactivating skills from the *World Before*

Zoofuturism therefore engages in a *philosophical and artistic* perspective that regards climate warming not as an apocalyptic endgame, but as an opportunity to reactivate what had been neglected, eliminated, or concealed in *the world before* — a very interesting expression that I borrow from the discourse that developed during the Covid crisis, and which I radicalize on a scale that is not only historical but also evolutionist.

A postapocalyptic device for neutralizing the defeated.

From this point of view, Zoofuturism is a *postapocalyptic device for neutralizing the defeated*.

The expression may rightly make one bristle, but it becomes understandable once we realize that the defeated, here, are those who already consider themselves as such and who organize themselves as survivors engaged in resistance, resentment, and morality — the degrowthers and all those, more generally, who believe that there is nothing left to be done in a world that is now set on its final slope¹⁰. The defeated, in this sense, are those who conceive the ongoing ecological catastrophe as an oppor-

⁸ This is, for example, the goal of anachoprimitivists like John Zerzan, who is also one of the most extreme, since he even dreams of returning to a time before the emergence of humans.

⁹ On this subject, see the delightful chapter by JeanPaul Déléage.

¹⁰ A slightly politically aware reader will notice the reference to the Stalinist slogan of *the final struggle*.

tunity to cultivate sad passions and to establish various systems of subjugation and reeducation for the recalcitrant.

Thesis 7. Zoofuturism as a war machine against the Transhumanists

Zoofuturism must also be understood as a “war machine”¹¹ against Transhumanists such as Ray Kurzweil or Nick Bostrom, who aim to move into the posthuman by becoming superhuman — eliminating disease, eradicating death, and increasing their cognitive capacities.

The transhumanist project has provoked passionate rejection among “humanists” who deplore the hubris of the project and the return to traditional forms of humanism; but as Raphaël Liogier has pointed out, one cannot oppose such an exciting project by mobilizing outdated relics that are largely obsolete¹².

Only a project at least as exciting can oppose the Transhumanists. That is what Zoofuturism aims to be. What is sought is not to become a human++, but *to become, in another way, a different kind of human*.

Thesis 8. Zoofuturism as an existential technology

Zoofuturism is anchored within the framework of an existential technology¹³. An existential technology does not simply allow one *to do something*: it allows one *to live who one is in a different way*.

A technology that allows one to wander at the edges of one’s species.

Zoofuturism engages in a technology that allows one *to wander at the edges of one’s species* by visiting other species.

Understanding the expression requires setting up *a phenomenology of the ambivalent zones* that separate certain species from certain others.

We do not have the same degree of proximity with all species. Humans are closer to a great ape than to a cat, and closer to a cat than to a beetle — the greater the phylogenetic distance, the more complex the technologies that must be mobilized.

In this regard, one may wonder whether certain species are out of reach. Can one, for example, engage in a becomingvirus or a becomingbacteria?

Visiting other species: substituting tourism for predation.

Visiting other species; the expression deserves some reflection on what it means. *Tourism is substituted for predation*, with the difference that in this kind of tourism which is neither cultural nor spatial one transforms oneself.

This represents a break with the standard evolutionist dynamic, according to which entering a new species is *irreversible* (one cannot go back), *involuntary* (it

¹¹ On the notion of the ‘war machine’, see Deleuze and Guattari, *Mille plateaux*, Minuit.

¹² Raphaël Liogier,

¹³ The term was, for example, proposed in: « Technique et esthétique » : quelle est la question ? », *Le Portique* [En ligne], 3 | 1999, posted online on March 11, 2005, consulted on August 25, 2023. URL : <http://journals.openedition.org/leportique/292> ; DOI : <https://doi.org/10.4000/leportique.292>, but I am using it here in a different sense.

does not result from a personal choice but from a collective fate), and unique (one cannot engage in several species).

An essential performative dimension

The performative dimension of Zoofuturism is not secondary, and it is no coincidence that artists are at the forefront of Zoofuturism¹⁴.

The becoming-animal of Zoofuturism is not a metaphorical, allegorical, psychiatric, or purely literary posture.

The aim of Zoofuturism is to *genuinely* enable humans to experiment with other species.

This technology, moreover, has no reason to be homogeneous. It may rely on benign forms of technology, for example through masks or costumes, but it is also intended to draw on more invasive technologies, such as biotechnologies, nanotechnologies, or information and communication technologies such as AI or persistent digital worlds.

When I say that I want to ‘catify’ myself, I do not merely mean imitating a cat more or less faithfully; *I mean introducing something of the cat into myself*, for example, vibrissae that would allow me to relate to the world as a real cat does through these particular sensory organs.

Zoofuturism has nothing metaphorical about it, and it is in this sense that it requires particular technologies — existential technologies.

Understanding Zoofuturism in the context of a history of existential technologies

To be fully understood, Zoofuturism must be grasped within the context of a history of existential technologies one to which historians of technology and philosophers have not given the importance it deserves¹⁵.

Without dwelling excessively on this point, it is necessary to distinguish two types of technologies — technologies that allow one to do things, and technologies that allow one to inhabit the world differently and to transform oneself, which I will characterize as *existential technologies*.

One may mention prayers and rituals, but also writing and music, as well as certain uses of psychedelic drugs and many others.

My last two theses are more general than those linked to Zoofuturism *sensu stricto*, but they point to the necessity of constructing a paradigm that allows it to be fully thought.

Thesis 9. Practicing philosophy as a branch of science fiction

It is difficult to situate the Zoofuturist approach within the current intellectual

¹⁴ I show this clearly in Lestel (2018).

¹⁵ Hypothesis to explore: a characteristic of contemporary Western thought, materialist and atheistic, is that functional technologies have been favored because they are the ones in which Westerners have become the most proficient — while existential technologies have been neutralized in another sphere, that of the arts, literature, or religion.

and institutional landscape for multiple reasons.

It would no doubt have to be placed somewhere between *philosophy*, a certain *artistic practice with epistemic and political ambitions*, and an *ecofuturist activism* that sees the contemporary ecological crisis as an opportunity for new worlds to emerge rather than as an apocalyptic catastrophe marking the end of the one we know.

Even if counterexamples can always be put forward, the sterility of university philosophy departments leads to the observation that truly creative philosophy is now being done elsewhere — for example, in art schools, where we find artists who think about the contemporary world in highly creative ways, and perhaps in the near future within certain companies.

The world has shifted into an accelerated space of disruptive innovations, and from this follows the necessity of inventing unprecedented ways of practicing philosophy.

The world has shifted into science fiction.”

The observation is far from original, but all its consequences are far from having been drawn: the world has today shifted into the universe of science fiction¹⁶. Without claiming to be exhaustive, one may mention the discovery of exoplanets and the resulting nearcertainty that elaborated extraterrestrial life forms and extraterrestrial civilizations exist; the development of the internet and powerful AI; the growth of biotechnologies and nanotechnologies — but also Covid19, which confined all the most developed countries; the collapse of biodiversity; global warming; the emerging migrant crisis; the acute awareness of the limits of energy resources; the possibility of changing gender; the omnipresence of religious terrorism, etc. Science fiction has been the only domain to imagine these major upheavals and to begin taking them seriously.

Orienting philosophy toward the future rather than toward the past.

Faced with this major geological rupture, academic philosophy is incapable of thinking about what is happening. It is highly diverse, but the majority of those who practice it institutionally share a common ethos organized around two fundamental poles — that of *the history of philosophy*, which holds that philosophy is an endless commentary on the great authors; and that of a model of thought that privileges *a certain form of logic* — that is, a largely Aristotelian conception of logic, the logic of predicates mixed with the spirit of seriousness that has always fascinated clerical circles, whether religious or secular. These two poles are today largely obsolete for thinking the contemporary world in becoming.

The philosophy of the future begins today.

A number of philosophers are already aware of the need to draw closer to science fiction in order to think the contemporary world — with two major pioneers be-

¹⁶ Paul Virilio emphasized the importance of the phenomenon of the world’s acceleration, but it was Élie Halévy who himself conceptualized an acceleration of History.

ing Gilles Deleuze¹⁷ and Donna Haraway¹⁸. Restricting ourselves to the Francophone sphere, we can also mention, in very different styles, Gilbert Hottois, Guy Lardreau, Pierre CassouNoguès, and above all Isabelle Stengers, by far the most interesting.

All these authors, however, adopt a similar approach that remains both very timid and very traditional, consisting in commenting on sciencefiction texts or films.

Zoofuturism requires the development of a more radical philosophical approach, making science fiction an original mode of reflection that leads the theorist to immerse themselves in science fiction itself.

To consider that a response to global warming would be to reanimalize the human does not consist in commenting on an author who might have written a novel on this theme, but in thinking about the theme itself as a phenomenon.

To be equal to the phenomenology of today's worldinbecoming, we must begin by profoundly modifying our conception of science fiction, seeing it as a speculative practice of reason of which science fiction in the traditional sense is only one modality, philosophy being another.

Changing the style of philosophy

In this transformation, it is not only a matter of opening philosophy to science fiction (a move already unthinkable for most academic philosophers), but of decisively changing style by adopting a form of extravagance in thought that breaks with the stilted seriousness of philosophical writing.

Philosophy must train itself to 'think big' — both to think on unusual scales and to take risky bets by mobilizing multiple registers of expression, in particular by overflowing into performance, into forms of fiction that are its own, into artistic experiments, into existential commitments¹⁹, and even into mediumistic and psychedellic experiments.

I will not dwell too much here on its methodological aspects and will limit myself to briefly mentioning some of its features: evaluating and correcting the epistemic biases of humans and the ethnographic biases of the Western theorist; constructing conceptual landscapes through which important questions can be thought; adopting a pluralist and inclusive perspective; adopting the approach of 'Surface Thinking' (as opposed to the hermeneutic approach); and, above all, *subverting Popper's principle of falsifiability* in the manner of Paul Feyerabend.

Transforming the very ontology of the philosopher

In this logic, the extreme consequence of this perspective leads to profoundly modifying the very ontology of the philosopher, by envisaging *philosophers hybrid-*

¹⁷ G. Deleuze, 1972, « Avant-propos », de *Différence et répétition*, PUF, p.3.

¹⁸ See for example *Primate Visions*.

¹⁹ This is in particular one of the major issues of emerging field philosophy, which some people unduly try to reduce to a mere empirical component.

ized with AIs and genetically modified philosophers²⁰. Contemporary philosophy is indeed based on a major postulate that is never made explicit nor discussed, namely that a human philosopher can think in a relevant way everything that is worth thinking, granting a particular species (*Homo sapiens*) an exorbitant cognitive and intellectual privilege.

Thesis 10. Establishing new institutions

A practice of philosophy such as the one I have outlined in this presentation is difficult for most academic philosophers to accept, and establishing it within the current university landscape is an extremely challenging task — perhaps even a lost cause from the outset.

It is too speculative, too transgressive, too provocative, and it engages in multi-disciplinary perspectives that are far too unusual.

Academic philosophy is a controlled practice that hides behind a highly artificial discourse of tolerance and openness, and that has adopted very restrictive criteria for what philosophy should be, criteria that it applies in a manic fashion.

Practicing philosophy in the perspective required by Zoofuturism therefore requires creating not only new institutions but even new kinds of institutions — and one should not count on the State (nor on the multiple *ad hoc* committees that parasitize it) to achieve this.

It is in the artistic sphere that ‘thinking’ happens most today, and such an institution should be both theoretical and artistic, bringing together highly diverse practitioners and creative individuals around adventurous projects with heterogeneous sources of funding.

Conclusion

Rather than a theoretical conclusion, a conclusion in the form of a few scattered remarks.

Contemporary technologies are blowing apart our *understanding of the real*. The categories we typically rely on are no longer functional, and most of our dichotomies now have only limited relevance. What is real can no longer be opposed to what is fictional, for example.

Technology makes it possible to reactivate the phylogenetic space through micropotentialities that remain untapped

The Zoofuturist stance as a particular approach to the environmental crisis and the technological explosion that accompanies it.

²⁰ During the autumn of 2014, the director of the philosophy department at the ENS, Marc Crépon, organized a study day in which each member of the department was to briefly present their ongoing research. I then gave a presentation on the hybridized philosopher and the genetically modified philosopher, which provoked astonishment and incomprehension, expressed in the same silence that would have followed the intervention of an extraterrestrial philosopher.

The aim is less to focus on protecting organisms that are disappearing than on the necessity of engaging them in dispositifs in which they become parts of us and in which we become parts of them.

Positive remark: by becoming something of those who are disappearing, we find a way to *involve ourselves personally* in this phenomenon of disappearance.

Negative remark: by assimilating ourselves to those who are disappearing, we assimilate them to ourselves in an unprecedented way, and we complete their disappearance.

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Technological Tattooing and Science Fiction

Catarina Pombo Nabais¹

Résumé

Le texte analyse le tatouage technologique (tech-tattoo) comme une re-configuration contemporaine de la pratique ancestrale du tatouage, inscrite dans le contexte de l'Anthropocène et des sociétés de contrôle. Contrairement au tatouage traditionnel, le tech-tattoo ne se limite pas à une inscription visuelle sur la peau, mais implique l'implantation de dispositifs biotechnologiques, numériques et intelligents qui transforment le corps en une surface interactive, connectée en réseau. Le texte décrit les tech-tattoos comme des biowearables, réalisés à l'aide d'encre électro-conductrices et de biosenseurs capables de capter, mesurer et transmettre des données biochimiques du corps. Bien qu'ils soient encore en grande partie situés dans le domaine de la science-fiction et du laboratoire, ces dispositifs sont présentés comme des technologies destinées à devenir permanentes et largement diffusées. Sont analysés des exemples tels que le Soundwave Tattoo, qui associe tatouage et fichiers sonores ; le DermalAbyss, qui surveille les niveaux de glucose, de sodium et de pH au moyen de variations chromatiques de la peau ; ainsi que les tatouages thermo- et photoactifs développés par Carson Bruns. Au-delà de la dimension technique, l'article met en évidence les implications philosophiques et biopolitiques du tech-tattoo. En pénétrant l'opacité du corps et en révélant des données internes, cette technologie intensifie les mécanismes de surveillance propres aux sociétés de contrôle, en déplaçant le modèle disciplinaire vers un régime biopolitique plus intrusif et immanent. Le corps devient simultanément objet et agent de contrôle, connecté de manière continue à des systèmes algorithmiques.

Mots-clés : Tatouage technologique (techtattoo); Biowearables; Anthro-pocène; Biopolitique et sociétés de contrôle; Surveillance corporelle.

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Aion Journal of Philosophy and Science

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Abstract

The text analyzes technological tattooing (tech-tattoo) as a contemporary reconfiguration of the ancestral practice of tattooing, situated within the context of the Anthropocene and societies of control. Unlike traditional tattooing, the tech-tattoo is not limited to a visual inscription on the skin, but involves the implantation of biotechnological, digital, and intelligent devices that transform the body into an interactive, networked surface. The text describes tech-tattoos as biowearables, produced using electroconductive inks and biosensors capable of capturing, measuring, and transmitting the body's biochemical data. Although they are still largely situated within the realm of science fiction and laboratory research, these devices are presented as technologies intended to become permanent and widely disseminated. Examples analyzed include the Soundwave Tattoo, which combines tattooing and sound files; DermalAbyss, which monitors glucose, sodium, and pH levels through chromatic variations in the skin; and the thermo and photoactive tattoos developed by Carson Bruns. Beyond the technical dimension, the article highlights the philosophical and biopolitical implications of the tech-tattoo. By penetrating the opacity of the body and revealing internal data, this technology intensifies the mechanisms of surveillance characteristic of societies of control, shifting the disciplinary model toward a more intrusive and immanent biopolitical regime. The body thus becomes simultaneously an object and an agent of control, continuously connected to algorithmic systems.

Keywords: Technological tattoo (techtattoo); Biowearables; Anthropocene; Biopolitics and control societies; Bodily surveillance.

Tattooing is a bodytransformation technique that has been practiced—albeit for different reasons and through various methods—in all ancient civilizations¹, and it remains very active today. It fully belongs to our present era and to bodies that delight in being the canvas for techniques and aesthetics that are either traditional, resonating with ancestry, or ultracontemporary, inventing new styles such as watercolor or 3D tattooing. Indeed, the ancient practice of tattooing has undergone major technical evolution, from its rudimentary beginnings (scarification) through manual perforation methods to the electric needle system. But, in a surprising twist, we are now witnessing a remarkable technological reinvention of tattooing that is reshaping our daily lives and already revolutionizing our conception of the human body. It is a true product of the Anthropocene, projecting itself as a technology of the future. Amid the genuine globalization of tattooing, the emergence of a new dimension of this practice demands reflection. I am referring to a new type of tattoo, much more

¹ The oldest tattooed body on record dates back 5,000 years, but tattoos have been practiced since the Upper Paleolithic period (10,000 to 30,000 years ago). Cf. Anna Felicity Friedman, *The World Atlas of Tattoo*, London, Thames & Hudson, 2015, p. 130.

advanced and complex than the traditional kind, both technologically and in its role, impact, and meaning. It is not simply a practice of engraving an image on the skin, but of implanting biotechnological, digital, and intelligent devices into the body, turning the body into a genuine interactive surface. Although introduced at the level of the epidermis, the technological tattoo constitutes, almost like a *chip*, an incursion, an invasion of the body, an effective inscription within bodily space. We are thus faced with a smart, digital, biowearable tattoo, known as a technological tattoo or “techtattoo”. After wearable technologies, here come the tattooable technologies!

1. Entering the intelligent world of biowearables

Belonging to a new generation of flexible nanomaterials, these techtattoos are created in the body using an electroconductive ink that can be filled with biosensors capable of capturing, measuring, and analyzing data about the body’s biochemistry. Through signs and colors inscribed in the skin, they also act as data transmitters, able to send different types of *biodata* to the computer systems to which they are connected. Even though techtattoos still belong to the realm of science fiction, being temporary and mainly laboratory products, they are destined to become intelligent, biowearable, and permanent devices, to be used by millions of people around the world in an increasingly near future. Here are a few examples:

The first example, known as the *Soundwave Tattoo*, is a tattoo made with conductive ink that links the body to a smartphone via WiFi. It is a tattoo that personalizes, in the form of a drawing, a sound wave on the skin. A bit like a QR code that redirects to a link, this tattoo reproduces a sound previously encoded within the design. First, an audio file is uploaded to the website of the company Skin Motion. Then a program generates a PDF file with the design to be tattooed, also called the “Soundwave stencil”. Next, a certified artist engraves this design into the skin like a traditional tattoo, but with conductive ink that links the drawing to the audio file. Once the tattoo is completed, a photograph of it must be uploaded to the website so that the design can be read by an application (*the Skin Motion App*), which will ultimately allow the audio file to be played back. All of this requires a subscription fee to activate the app (\$39.99 for the first year and \$14.99 for each subsequent year)!

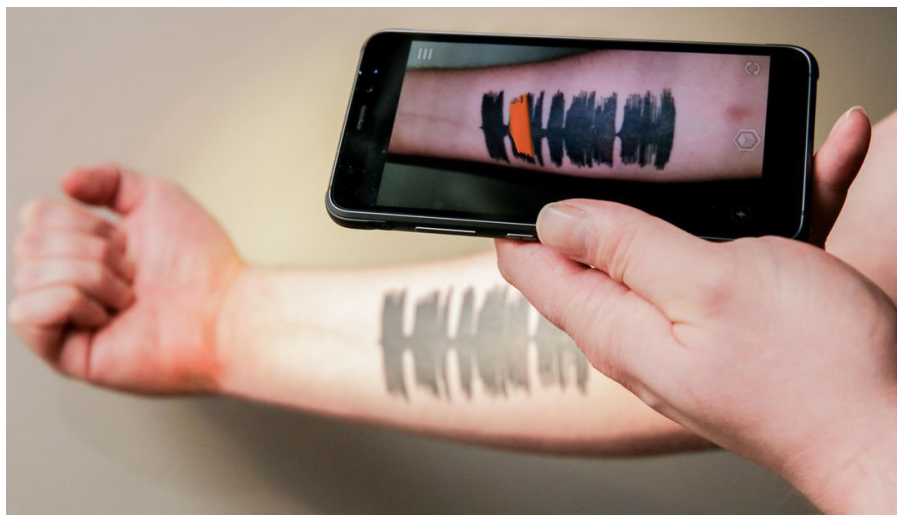


Image 1. Image credits Sarah Tew/CNET

This tattoo was invented in April 2017 by the tattoo artist Nate Siggard, who shared his invention in a video on Facebook that immediately went viral (more than 150 million views in the first month—there is even a hashtag, #mysoundwavestory, for sharing these tattoos on social media, which has already surpassed a hundred posts). After patenting his invention, he then created the company Skin Motion, specializing in what he describes as «personalized augmentedreality tattoos». On the website, a technical explanation is provided: «a combination of audio processing, image recognition, computer vision, and cloud computing on a customized proprietary platform to create a mixedreality experience»².

The second example, DermalAbyss³, is the result of a collaboration between researchers at MIT (Katia Vega, Xin Liu, Viirj Kan, and Nick Barry) and Harvard Medical School (Ali Yetisen and Nan Jiang). It aims to identify glucose and sodium levels in the blood in order to facilitate medical management of diabetes. This techtattoo is created using biosensors that transform the skin into a colorchanging indicator reflecting biochemical changes in the body. Depending on glucose, sodium, or pH levels, the skin emits different shades of color: the pH sensor shifts from purple to pink, the glucose sensor shifts from blue to brown, and the sodium and fluorescent pH sensor glows with greater intensity under UV light.

² <https://skinmotion.com/faq>

³ <https://www.media.mit.edu/projects/d-Abyss/overview/>



The last example comes from Carson Burns, a chemist and researcher in molecular nanotechnology at the University of Colorado, who is developing a temperaturesensitive and photoactive tattoo that produces colored spots when the body has a fever or is overexposed to the sun and UV rays⁴. Within its microparticles, this techtattoo contains a thermochromic, UVsensitive dye that, depending on sun exposure, changes from colorless to blue. Acting as an alert for fever or UV overexposure, this techtattoo can help monitor body temperature, signal sunburn, and prevent cancer.

⁴ <https://cen.acs.org/analytical-chemistry/diagnostics/Colorado-chemist-updates-tattoo-chemistry/97/i11>



In their complexity, these examples raise several questions on technological, metaphysical, ethical, political, and other levels. Yet what I would like to emphasize is the fact that they make us rethink the relationship between the human body and technology. With the techtattoo, we are no longer dealing with the production of an external object, a tool separate from the body that extends it, enhances its capacities, or substitutes certain of its operations, but rather with an electronic system intrinsically linked to the body, indistinguishable from the body. We are fully within the transhumanist Anthropocene, and one could even say, in a Simondonian tone, that these examples point toward a humanmachine intimacy. It is as if technology itself were expanding through the human body. That is, the body becomes the site where technology develops. The two “species” no longer evolve separately but merge and evolve together. This new technobody compels us to reflect on the human being as an inbetween milieu, a space of alliance and intersection. We are faced with a logic no longer of differentiated organisms but of an inorganic vitalism of indeterminate, fluid, and transitional states. The myth of the cyborg is precisely an expression of this mixture. What is at stake is a symbiosis between human and machine to such a point that the two form a new hybrid, fusionbased mode of existence. The boundaries between the natural and the artificial are increasingly dissolving, because the techtattoo is a radical practice of hybridization between these two spheres. Consequently, we may say that the “biowearable” techtattoo has the power to transform the body into a cybernetic interface, a touch screen, an intelligent and quantifiable canvas—the very figure of science fiction known as the cyborg. Scientists and technologists themselves are aware of this. This is precisely what Carson Bruns, creator of our last example, says: *«my laboratory is also working on a tattooable thread that conducts*

electricity, aimed at a future of tattooable electronics. Get ready for the cyborg revolution! »⁵

1. TECHTATTOO AND BIOPOLITICS

But these examples also open onto the biopolitical nature of the techtattoo. That is, the techtattoo responds in a very paradigmatic, and even strident, way to the generalized regime of today's control societies. We are no longer in the disciplinary societies that Foucault described so well, with a centralized focal point from which an individual's activity is monitored. Today, we live in control societies where we are no longer required to remain fixed in a specific place but, on the contrary, encouraged to move around and not fear being watched. With algorithmic information matrices operating everywhere and at all times, surveillance has become normalized and intimate for the contemporary subject who, as Agamben shows, encounters their identity only through recognition by the "Great Machine"⁶ that constantly reads their data. Disciplinary regimes, even though they are operational and effective, have a limit: the body itself and its insurmountable opacity. Now, thanks to the techtattoo, control can surpass, for the first time, the body's opacity⁷. And even if it results from recreational pleasure, aesthetic experimentation, or medical concern, the techtattoo makes control far more intrusive and immanent.

Now, the techtattoo has an exemplary relationship with control technologies. Traditional tattooing differentiates subjects; it allows their identification within a disciplinary regime of bodies. One only needs to think of the example of the tattoo of the unknown soldier, that is, the need to tattoo oneself in order to be identified during war and recognized after death. By contrast, the techtattoo connects subjects within a network, treating them as a mass, a "universal modulation"⁸ within an exponentially expanding biopolitical regime of control. The mobile phone is already capable of transmitting abundant information about our movements, our tastes, our social environments, our daily step count, etc. But the techtattoo, with its bionano-sensors, provides information about illnesses, genetics, and even the body chemistry of each individual. And by supplying this multitude of internal, intimate, vital data, the techtattoo becomes totally, instantly, and permanently connected to the surveil-

⁵ https://www.ted.com/talks/carson_bruns_could_a_tattoo_help_you_stay_healthy/transcript#t-403948

⁶ "J'existe si la Machine me reconnaît ou, du moins, me voit ; je suis vivant si la Machine, qui ne connaît ni sommeil ni veille mais reste éternellement éveillée, garantit que je suis vivant ; je ne suis pas oublié si la Grande Machine enregistre mes données numériques ou numériques" (Agamben, *Nudités*, trad. Fr. Martin Rueff, Paris: Payot & Rivages, 2009, p. 69).

⁷ Il y a quand-même un paradoxe intéressant dans cette différence : si le tatouage traditionnel signale le sujet par son corps extérieur, sa peau, le tech-tattoo le signale par son intérieur, par son fonctionnement en tant qu'organisme. Un nouveau plan de dévoilement de l'individu est franchi, ainsi qu'une barrière de sa privacité (celle qui n'était visible que par des analyses de sang ou par des instruments de visualisation très avancés de la médecine). Mais, finalement, ce qui le tech-tattoo donne à voir, c'est un organisme qui est devenu, par effet du tatouage même, un hybride, un spécimen de post-humain, un mélange humain-machine. Donc, Au moment où le tatouage a permis d'entrer à l'intérieur du corps humain, il perd l'humain en faveur de l'hybride.

⁸ Deleuze, *Pourparlers*, Paris : Minuit, 1990, pp. 181-2.

lance and control technologies that surround us. The contemporary body—whether a satellite unit or even a control station for itself—has become the site of constant social management.⁹

The main feature of the tech-tattoo is its constant connection to Wi-Fi devices and cybernetic programs, its ability to create a diffuse matrix of algorithms that collect information from a body which, in this way, becomes intimately connected to control structures. Jeremy Bentham's "Panopticon"—the architectural model of the disciplinary society—has become more subtle, invisible, close, and so deeply embedded in the body that it becomes almost indifferent. The tech-tattoo could therefore transform Bentham's dream into reality, for it brings the panoptic regime to a sharper level of precision and immanence, extended across unlimited space-time. When it becomes cybernetic, networked with the WWW, the "Panopticon" becomes what I propose to call the "Super-Panopticon"¹⁰ or "Panopticon 2.0".

It is no accident that enormous investments are being made by international companies allied with research centers and scientific laboratories to develop tech-tattoos. These investments very clearly highlight the biopolitical power of the tech-tattoo. As Agamben says:

In the unstoppable governmental drift of political power—within which the liberal and statist paradigms curiously converge—Western democracies are preparing to organize DNA archives of all citizens, with a view both to security, to the repression of crime, and to the management of public health¹¹.

Undeniably, the tech-tattoo, indeed, within the broader field of biometric technologies, is rapidly expanding (or should we say: democratizing, becoming commonplace?). Yet how can we explain individuals' submission to ultrainvasive surveillance technologies? And how can we explain their consent, their passive submission, their docility toward a tattoo that controls them in such a radical way and even annihilates their individuality? Do they want to become sheep frightened by the argument of security? Do they desire repression? Or are they seeking an escape route? Since I do not wish to fall into a fatalistic discourse against technology, I prefer to ask: is there another way to think about the technological tattoo besides seeing it as an inscription of structures of power and control into our bodies? Or, to put it in Spinozist terms: what can a tattoo do? Or, in Simondonian terms: what is the power of the tattoo?

⁹ Il faut bien remarquer, en suivant Deleuze, que si la société disciplinaire est analogique, la société de contrôle est numérique. Si, dans les sociétés disciplinaires, les individus sont des numéros ou des places dans une masse (cf. Deleuze ; Guattari, *Mille Plateaux*, Paris : Minuit, 1990, p. 179), dans les sociétés de contrôle, ils ne sont plus des individus mais des « dividos », c'est-à-dire des individus virtuels, entités identifiables par des codes et des mots de passe au sein d'une base de données généralisée. « Le langage numérique de contrôle est composé de codes indiquant si l'accès à certaines informations doit être autorisé ou refusé. Nous n'avons plus affaire à une dualité entre masse et individu. Les individus deviennent des 'dividos' et les masses des échantillons, des données, des marchés ou des 'banques' » (*op.cit.*, p. 180).

¹⁰ Cf. Pombo Nabais, Catarina, "The recent biotechnology of tech-tattoo. An approach from Science, Art, and Philosophy" in Andrew Adamatzky (ed.) *Unconventional Computing, Arts, Philosophy*, London: World Scientific, 2022, pp. 557-572.

¹¹ Agamben, *Nudités*, p. 67.

2. To conclude: techtattoo and fabulation

My aim is to think about the techtattoo not as something reduced to its condition as a biopolitical apparatus, but as something with the power to be a line of flight, an expression of an inorganic, expansive, radiant, rhizomatic life. Unlike the traditional tattoo, which, made with ordinary ink, remains in a person's skin as a mark of their solitude, the techtattoo, because it is made of metallic, conductive ink capable of linking the human body to WiFi devices, generates a vast plane of singularities connected through a cybernetic network. As a paradigmatic case of metallic vitalism and cybernetics, the techtattoo has a radiant form of inscription in human skin. It does not close; it opens. It establishes connections everywhere between individuals, such that individuals become mere points within an infinite network of connections, or a constellation of singularities. Thus, it is precisely through the interweaving of its panmetallism and its inescapable cybernetic nature that the techtattoo constitutes a line of flight, a positive opening of possibilities in the face of the systematic control contemporary societies exert over individuals.

This means that even if the control societies in which we live can use the techtattoo to control our lives starting from our very skin, there is another possible use for the techtattoo: to outmaneuver the system, to hack it through the emission of *other* vital information. Here, a brief clarification is needed to understand that this alterity is not falsity. With the techtattoo, we are not on the level of representation, nor confronted with the true/false binary. The hacker/pirate I am speaking of refers not to the false as the opposite of the true, but to the 'power of the false,' understood as a composition of the real and the imaginary. More than fiction, which still maintains a relation to the true, it is a matter of fabulation. Fabulation is the position of the compossibility of two realities: that of the emission of real biodata and that of the production of blocks of imaginary information. Fabulation is thus the creation of a new identity in which the real and the imaginary become indiscernible. In the specific case of the biopirate/biohacker, this means inventing alternative circuits in which new imaginary biodata are emitted at the same time as real ones, thereby creating the compossibility of information. This is the trick, the sidestep. Power of the false. Verisimilitude. Creating the indiscernibility of the real and the imaginary. Producing an alternative segment of biodata. Metamorphosis of reality. Impossible worlds. As Deleuze says:

What is opposed to fiction is not the real, nor is it truth—which is always that of the masters or the colonizers—but the fabulatory function of the poor, insofar as it gives to the false the power that makes it a memory, a legend, a monster.¹²

¹² Deleuze, G., 1985, *Cinéma 2. L'image-temps*, Paris, Minuit, p. 196.

One can hack/pirate biodata, reprogram the emission system so that it carries a network of plausible information, create other segments that add themselves and intermingle; one can construct new imaginary identities that coexist with real ones. One can feed the control society with alternative, modified, other circuits. Rimbaud's formula '*I is another*' has never been as possible as it is with technological tattoos. The very body, now an aggregate of machines cybernetically connected, emits invented, fabulatory information about elements such as its spatial location, its biochemistry, or even its bank account. The hacker would thus be the programmer of a network in which:

Two things chase after one another, yet we move forward in such a way—on an electric or electromagnetic circuit—that I cannot know, not only which is first and which is second, but which is which and which is which. In other words, the real and the imaginary, representation and modification, chase after one another in such a way that I cannot know, and cannot possibly know—an undecidability—I cannot know what is real and what is imaginary; I cannot know what is representation and what is modification.¹³

This work of hacking is indeed a construction, a creation, an invention. Instead of a “bare life” reduced to biometric data, one can invent for oneself a life full of fabulated data. The techtattoo allows for the invention of a new identity, free from the regime of control, an identity that is neither measured nor governed by the recognition of the “Great Machine”, but that instead creates its own inventive power of becomingother. But more than the life of a single individual (the tattooed individual), this creative movement of the techtattoo can be seen as the invention of a mode of universal subjectivation and, in this sense, as that of an alternative community of fabulating singularities. In short, the techtattoo carries the power of an imaginary people and of a science fiction yet to come.

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¹³ *Ibid*, p.196.

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Acknowledgements

This work was funded by national funds... a été financé par des fonds nationaux FCT - Fundação para a Ciência e a Tecnologia, I.P., dans le cadre de l'Unidade de I&D Centro de Filosofia das Ciências da Universidade de Lisboa (CFCUL), projet stratégique avec la référence FCT I.P. UIDB/00678/2020 et UIDP/00678/2020 et DOI <https://doi.org/10.54499/UIDB/00678/2020> et <https://doi.org/10.54499/UIDP/00678/2020>, ainsi que dans le cadre de la Norma Transitória - DL57 / 2016 / CP1479 / CT0067 et DL57 / 2016 / CP1479 / CT0065.

Make Arrakis Green Again or What energy for the Fremen?

Vincent Bontems & Roland Lehoucq

Résumé

Le texte propose une réflexion sur les choix énergétiques des Fremen dans *Dune*, à partir d'une approche de design de science-fiction appliquée à la transition écologique. En imaginant l'adaptation humaine à la planète Arrakis, les auteurs explorent la manière dont les technologies dépendent de leur « milieu associé » et de la nécessité d'établir une homéostasie avec l'environnement. Arrakis est décrite comme une planète extrêmement aride, marquée par la pénurie d'eau, des températures élevées et de violentes tempêtes de sable, des conditions qui limitent sévèrement les possibilités techniques. L'analyse examine la viabilité de l'énergie solaire photovoltaïque dans le contexte d'Arrakis, en mettant en évidence les obstacles liés au spectre lumineux de l'étoile Canopus, à la perte de rendement causée par la chaleur extrême et aux dommages provoqués par les tempêtes. En contraste, le texte souligne le potentiel de l'énergie solaire thermique, qui permet le stockage de l'énergie et une meilleure adaptation aux conditions environnementales. Cette discussion est articulée autour du trilemme énergétique (sécurité, équité et durabilité) comme critère fondamental d'évaluation des systèmes énergétiques.

Mots-clés : Design de science-fiction; Transition écologique; Choix énergétiques; Milieu associé; Trilemme énergétique.

Abstract

The text offers a reflection on the energy choices of the Fremen in *Dune*, based on a sciencefiction design approach applied to the ecological transition. By imagining human adaptation to the planet Arrakis, the authors explore how technologies depend on their “associated milieu” and on the need to establish a homeostasis with the environment. Arrakis is described as an extremely arid planet, marked by water scarcity, high temperatures, and violent sandstorms, conditions that severely limit technical possibilities. The analysis examines the viability of photovoltaic solar energy in

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Aion Journal of Philosophy and Science

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the context of Arrakis, highlighting obstacles related to the light spectrum of the star Canopus, efficiency losses caused by extreme heat, and damage produced by storms. By contrast, the text emphasizes the potential of solar thermal energy, which allows for energy storage and greater adaptation to environmental conditions. This discussion is articulated around the energy trilemma (security, equity, and sustainability) as a fundamental criterion for evaluating energy systems.

Keywords: Sciencefiction design; Ecological transition; Energy choices; Associated milieu; Energy trilemma.

The struggle between the elements of life is the struggle for the available energy of a system.

Dune, Frank Herbert, 1965.

As part of (science-)fiction design workshops on ecological redirection designed for students and companies, Vincent Bontems (a philosopher at the CEA) and Roland Lehoucq (an astrophysicist at the CEA) propose an immersion on Arrakis, the desert planet in *Dune* by Frank Herbert, in order to rethink technological choices—particularly energy-related ones—according to the environment. This is because it is easier to imagine a technological shift by picturing oneself on another planet. As proclaimed by the “Multiversalism Manifesto” (of which they are both signatories), *one must think other worlds in order to think the world differently*.

To better understand their approach, put yourself in the shoes of an Atreides at the beginning of *Dune*: in anticipation of your future settlement on the planet Arrakis, you take part in a “transition workshop” designed to help you better understand your new environment. Indeed, moving from the humid and hospitable Caladan to the arid desert planet entails a complete change in your way of life, particularly in your use of technology. A technical object always operates in relation to its “associated milieu”: it finds there the conditions of its operation and, in turn, modifies them, which feeds back into how it functions. This is the basic principle of planetology: establishing a proper dynamic balance with the environment, a “homeostasis”, in order to be able to inhabit a planet sustainably, and the security of the colony depends on this equilibrium. You are therefore not surprised to find, alongside the mentat Karim Tayiban, the planetologist Rollan LewKynes, who, without preamble, begins to brief you.

The planet Arrakis

Arrakis is the third planet in the Canopus system. This real star is, as seen from Earth, the brightest in the southern constellation of Carina and the second brightest star in our sky after Sirius, the main star of

the constellation Canis Major. Located about 310 lightyears away, Canopus is a star whose mass is 6.9 times that of the Sun. With a radius 71 times larger than that of our star and a high temperature of 7,500 degrees, Canopus is therefore 15,000 times more luminous than the Sun: it is a supergiant whose high temperature gives it a blue color. Canopus even turns out to be the most luminous star within a radius of 500 lightyears around the Sun.

My cousin LietKynes, the Imperial planetologist on Arrakis, tells us that its atmosphere contains «23% oxygen, 75.4% nitrogen, and 0.023% carbon dioxide, with the remainder made up of rare gases.»

¹ Since this composition is very close to that of Earth in the second millennium, the greenhouse effect would be comparable there, were it not reduced by the absence of water vapor. Knowing that the average temperature of Arrakis, again according to LietKynes, «[...] has oscillated for thousands of years between 254 and 332 degrees absolute,»² one can estimate that the distance separating Arrakis from Canopus is about 115 times the Earth–Sun distance, that is, 17.3 billion kilometers. Arrakis is an arid planet whose surface is almost entirely covered by deserts—vast expanses of shifting dunes interspersed with rocky plains, eroded plateaus, and a few jagged mountains. Its climate is one of extreme dryness: there is virtually no precipitation, and daytime temperatures reach stifling levels. Yet water seems once to have flowed freely across the planet’s surface, as observed by his predecessor, the planetologist Pardot Kynes, who noted in the Great Erg an immense oval depression some three hundred kilometers long, whose smooth, white surface was made of salt³. Sandstorms of colossal violence, known as “Coriolis storms”, regularly sweep across the planet. Sometimes several kilometers high, with winds reaching several hundred kilometers per hour, they raise clouds of sand capable of eroding, or even burying, any exposed structure.

After this brief reminder of the general conditions for habitability, the mentat in turn takes the floor. He comments on footage taken of a remote part of the desert by a spy drone. A bright spot can be seen on the desert sand.

This document was stolen from the Harkonnens. According to the accompanying report, this image would prove that the mysterious Freemen make use of photovoltaic energy, whose panels were, by chance,

¹ Bontems, V., et al., 2025, “Manifeste du Multiversalisme”, in *Solaris*, Vol. 50, No. 236.

² Herbert, F., 2012, *Dune*, Fr. trans. by M. Demuth, Paris, Pocket, p. 835. [*Dune*, Philadelphia, Chilton Books, 1965].

³ Herbert, F., 2012, *Dune*, Fr. trans. by M. Demuth, Paris, Pocket, p. 834. [*Dune*, Philadelphia, Chilton Books, 1965].

made visible through the reflection of sunlight. We doubt this—both because we distrust anything that comes from the Harkonnens, and for reasons that the ducal ecologist will now explain to you. Now, what interests me is what you think. If the Fremen are capable of machining thumpers and crafting the finest stillsuits, how do they obtain the energy required for this industry? Take a few minutes with your neighbors to discuss this and present us with your hypotheses in a report.

What is the Fremen's source of energy?

Half an hour later, Tayiban analyzes all the reports in a few milliseconds.

Well, I see we have our share of wind turbines, geothermal energy, sand turbines and, as usual, a few clever types who want to use a sandworm as an animal engine... I'll let LewKynes explain to you what seems to us the most likely hypothesis .

To transform their world, the Fremen need energy. Where could it come from? An obvious solution would be to use photovoltaic solar energy, since one can estimate that, when Canopus is at its zenith, a luminous power of about 1,000 watts strikes each square meter of the planet's surface. But this proposal faces numerous difficulties. To better grasp the problem, let us follow the line of reasoning developed by one of my padawans⁴.

A photovoltaic (PV) panel directly converts light into electric current. It is made up of cells composed of a semiconductor material (on Earth, silicon) whose electronic structure consists of two layers. The first of these layers, the conduction band, contains no electrons, while the second, the valence band, does contain electrons. When this material is struck by solar photons, electrons 'jump' from the valence band to the conduction band, allowing an electric current to flow. On Earth or on Arrakis, the received light contains photons of all energies, but not all of them are capable of triggering an electronic transition: for this to occur, their energy must be greater than the energy separating the two bands, known as the band gap. If this gap is small, a large number of photons will be absorbed and the generated electric current will be strong, but the voltage will be low, resulting in low electrical power (since power is equal to the product of current and voltage). Conversely, a large gap is associated with high voltage but allows only photons

⁴Herbert, F., 2012, *Dune*, Fr. trans. by M. Demuth, Paris, Pocket, p. 836. [*Dune*, Philadelphia, Chilton Books, 1965].

with sufficiently high energy to be absorbed: the current will be very weak, and so will the power. For a given light spectrum, one must choose the semiconductor whose band gap makes it possible to obtain maximum power. This compromise is known as the Shockley–Queisser optimum.

On Earth, with the Sun’s light spectrum, the optimal band gap lies in the infrared, around a wavelength of 1,100 nm. The associated maximum efficiency is on the order of 30%. The semiconductor material whose band gap is closest to this value is silicon—very abundant on Earth, particularly in the form of silica found in sand. Sand that Arrakis also possesses in abundance... Except that the spectrum of Canopus, a hot star, is shifted toward the blue compared to that of the Sun and contains fewer lowenergy photons than the Sun. The efficiency is higher (about 33%), but the optimal band gap is instead around 850 nm, at the boundary between the visible and infrared. In this case, silicon is no longer the ideal material: gallium or indium would be more suitable. Unfortunately, they are far less abundant than silicon...

As if that were not enough, the star’s spectrum is not the only parameter that must be taken into account: temperature also plays a role, as does the planet’s sometimes stormy weather. Indeed, the efficiency with which a PV cell converts light into electric current depends on its temperature: it decreases by about 0.5% per degree. This is somewhat counterintuitive, but a very sunny yet very hot region will not necessarily produce more solar electricity than a slightly less sunny but cooler one. In the very hot climate of Arrakis, this effect is devastating. Finally, the Coriolis storms that strike the planet could severely damage solar panels and, above all, cover them with dust, thereby limiting their ability to capture light. A significant portion of the energy produced by the panel would have to be used just to clean it—without even mentioning the water required for such an operation in a context where water is extremely scarce. All these difficulties therefore constitute as many arguments that could explain the absence of PV panels on Arrakis.

If photovoltaic solar energy does not seem very usable on Arrakis, why not turn to solar thermal energy? Heat can be stored far more easily than electricity, and concentrated solar power can therefore handle the day–night intermittency by storing heat, making nighttime electricity

production possible. This is the case, for example, with the Cerro Dominador concentrated solar power plant near Calama, in the Antofagasta region (Chile), in the Atacama Desert. Operating in combination with a photovoltaic power plant, it was able, in the 21st century, to supply 17 hours of electricity without sunlight at its nominal capacity of 110 MW.

The mentat then steps in to offer another historical reminder:

The idea of using the Sun as a source of thermal energy for industry is even older. In 1866, Augustin Mouchot (1825–1912) invented the first solar engine, using a parabolic reflector and a cylindrical glass boiler to power a small steam engine. In 1877, a subsidy from the General Council of Algiers enabled him to build, on the same principle, a large device covering 20 m², which received a gold medal at the 1878 Universal Exhibition in Paris. He was subsequently awarded the Legion of Honour and granted the opportunity to continue his work in Algeria. Together with his new associate, Abel Pifre, he filed a new patent in 1878. At the time, France's coal production was insufficient to meet the needs of industry, and Mouchot's invention seemed destined for success. However, the discovery of coal deposits in Lorraine, imports made possible by the Franco-British trade treaty of 1860, and improvements in the railway network facilitated coal supply and accelerated industrial development. This led the French government, after conducting studies, to conclude that solar energy was ultimately not profitable and to stop funding Mouchot's research. What might have happened if his discovery had encountered more favorable economic conditions? For example, a century earlier, in the agrarian France of the Physioocrats, which needed energy to power irrigation pumps during the summer? Examining Fremen society will undoubtedly help us understand how to make use of this ecotechnology.

The energy trilemma

LewKynes takes the floor again:

Like any energy system, that of the Fremen rests on three complementary pillars:

1. Energy security, to avoid any risk of supply disruption (the safety of installations, the stability of the electrical grid, and the geopolitical dependencies linked to exchanges of energy resources);
2. Energy equity, so that access to energy (the development of infra-

structure and the cost of energy) is possible for everyone;
 3. Energy sustainability, in order to preserve the planet's resources and limit pollution and climate change.'

If one pillar is too weak, the ecotechnological system becomes dysfunctional. Clean, affordable but unstable energy cannot ensure the operation of a country's vital systems, such as hospitals. Clean, stable but unaffordable energy exacerbates social inequalities by increasing energy poverty. Affordable, stable but environmentally harmful energy is also detrimental to humans, as it degrades the global associated milieu of all living beings, as established by planetology (and as climate-change models on Earth already suggested as early as the 20th century). Managing these three pillars is the purpose of ecotechnology in its energy dimension (the other dimensions concerning the management of matter and information). It requires analyzing the feasibility of a technical system and the consequences of its use, in other words, characterizing what constitutes a 'technology of the future' on each planet.

The technology of the future on Arrakis: solar steampunk

The Mentat concludes:

As we might have suspected, the Fremen have opted for a technology that reconciles three imperatives: a lack of carbon footprint (a greenhouse effect is the last thing you could wish for on Arrakis!), agility (to evade surveillance and Coriolis storms), and the efficient use of resources (the abundance of sand for mirrors and the valorization of water reserves essential to their survival). I therefore invite you to take inspiration from them, to think and act like Fremen, if we are to survive on Dune. On Caladan, we were able to make prudent use of combustible algae and we had our tidalturbine installations, but the associated milieu of Arrakis is far more hostile to living beings and machines alike. During the first decades, we will be able to draw on the stock of nuclear material and antimatter from our ships, but ultimately, as on any planet, we will have to adapt to our environment if we do not wish to remain dependent on imports (and thus at the mercy of a CHOAM blockade⁵). This is why we must completely rethink our energy strategy... just as the inhabitants of Earth had to do in the 21st century.

⁵ Suchet, D., 2020, "Une histoire de trilemme énergétique", in *Dune. Exploration scientifique et culturelle d'une planète-univers*, Lehoucq, R. (ed.), 2020, Saint-Mammès, Le Béal, pp. 97–120.

Le CHOM, ou Combinat des Honnêtes Ober Marchands, est la structure économique unique de l'Imperium.

Only the Sabelles

Émilie Quebalec

Résumé

L'article présente un récit de fiction spéculative qui articule une réflexion écologique, philosophique et politique à travers une narration littéraire sous la forme d'un journal d'expédition. Le texte s'ouvre sur un paragraphe contextuel qui situe l'œuvre dans le cadre d'une recherche collective consacrée à la redirection écologique et à l'invention de récits capables d'inspirer de nouvelles manières d'habiter la planète, en soulignant son caractère expérimental et testimonial. La narration principale prend la forme de notes personnelles rédigées par un narrateur humain qui accompagne une expédition scientifique composée majoritairement d'êtres futurs appelés les Theix. Située dans un temps lointain après l'effondrement de la civilisation contemporaine, l'histoire alterne entrées datées, observations subjectives et réflexions intimes, faisant apparaître une tension constante entre mémoire technologique et écriture manuscrite. Le narrateur décrit la découverte d'un écosystème fluvial habité par les Sabelles, des créatures aquatiques qui semblent constituer une conscience symbiotique étroitement liée au paysage lui-même. Tout au long du journal, le texte explore des thèmes tels que la relation entre l'humanité et l'environnement, la perte de la centralité humaine, la cohabitation entre les espèces, l'éthique de l'exploration scientifique et la notion d'équilibre entre les dimensions naturelles, culturelles, technologiques et historiques.

Mots-clés : Fiction spéculative; Récit d'expédition; Cohabitation interspécifique; Écologie narrative; Décentrement de l'humain.

Abstract

The article presents a work of speculative fiction that weaves together ecological, philosophical, and political reflection through a literary narrative in the form of an expedition journal. The text opens with a contextual paragraph that situates the work within a collective research project dedicated to ecological redirection and to the invention of narratives capable of inspiring new ways of inhabiting the planet, emphasizing its experimental and testimonial character. The main narrative takes the form of

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Aion Journal of Philosophy and Science

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personal notes written by a human narrator who accompanies a scientific expedition composed largely of future beings known as the Theix. Set in a distant time after the collapse of contemporary civilization, the story alternates dated entries, subjective observations, and intimate reflections, revealing a constant tension between technological memory and handwritten writing. The narrator describes the discovery of a fluvial ecosystem inhabited by the Sabelles, aquatic creatures that appear to constitute a symbiotic consciousness closely intertwined with the landscape itself. Throughout the journal, the text explores themes such as the relationship between humanity and the environment, the loss of human centrality, interspecies coexistence, the ethics of scientific exploration, and the notion of balance between natural, cultural, technological, and historical dimensions.

Keywords: Speculative fiction; Expedition narrative; Interspecies cohabitation; Narrative ecology; Decentering of the human.

In 2023, the writer Émilie Querbalec met the consultant Vanessa Weck, a specialist in ecological redirection, at the CerisyLaSalle conference “Where Are the Technologies of the Future?”. Together, they formed the core of a “Green Team”, soon joined by glaciologist Jeanne Gherardi, comic artist Jeanne Puchol, and consultant Camille Cazin. Since then, they have been working to invent narratives capable of inspiring a desire for change, aimed at living in peace on a planet that is hospitable to all living beings, as well as to rivers and landscapes. “*Seules les Sabelles*” is a testimony to this research, which is also a quest to reinvent the identities of the participants.

Nouvelle Venise,

07.12.2128 AC

It is with emotion that I begin this journal today. The paper rustles beneath my pen, the ink unfurls its curves and dots, its empty and filled spaces. I feel like a Marco Polo, a Zheng He, or an Ibn Battuta, ready to embark on a journey unprecedented in the history of humankind. This writing is to be distinguished from my memory stream. Here I will record my observations, impressions, and reflections in full subjectivity, and should misfortune befall me during this expedition, I wish it to be entrusted to the good care of my supervisor and friend, Elio Venturi. I thank Lislac Myun for tolerating these eccentricities and for having authorized me to take these objects with me. For the rest, I place myself entirely in the wisdom and science of the Theix

Trieste,
07.16.2128 AC

Today I met the two other members of the expedition. All of them are Theix; I am the only contemporary, perhaps even the only one of my species, although I harbor some doubts about Hisoa Rel, whom I suspect of being a Sensile. I would like to ask Lislæ Myun about it, but the Theix remain extremely discreet regarding the evolution of the technologies they share with us, and I fear I will have to settle for a polite refusal. Who knows? Perhaps I am a distant ancestor of these beings from the future: a seed sown in the past that, two or three hundred thousand years later, would have germinated to give birth to a Sensile. Elio would no doubt have told me that such speculations are my way of compensating for my original sense of imposture. I would have replied that this is merely the embryonic form of a neurosis, irrefutable proof of my human nature.

It is true that the Theix are so radically different from us that one might believe they come from another planet. Two or three hundred thousand years, that is our current estimate of the span of time separating us from their civilization. These figures are based on the dating of certain remains discovered during archaeological excavations on the Adriatic coast, which explains our presence here. The Theix have several theories about the beginnings of their civilization. The great unknown is the period stretching between our time and theirs. There exists a shadowy zone, a rupture, a *terra incognita* devoid of any written record, even in the oldest Theix archives. What happened during this interval? How could our contemporary civilization have disappeared leaving so few traces, and how did theirs emerge? These are the questions that drive us today, and I am proud to be among the scientists who, I hope, will help lift the veil on this mystery.

Trieste,

Or perhaps not. Location and dating impossible. My stream indicates a date that can only be false: 20 July 2128. Hisoa Rel warned me that my recordings might be completely interrupted as soon as I leave our capsule. This information makes me reconsider Lislæ Myun's initial tolerance of my request to take this notebook with me. Perhaps she knew from the outset that their devices would fail upon arrival. The idea of losing my memory stream frightens me, but I will try to keep track of the days in this journal.

Day 3

It seems that we are not alone here. Lislæ and I were taking samples from the stream that runs at the bottom of the woodland when we realized we were being watched. Up to now, we had seen all kinds of birds and insects flitting around us,

and a few mammals had also approached our capsule, but we had not yet had what one might truly call an encounter. The animal observing us might have been a distant descendant of a beaver, but its size was closer to that of a squirrel. It stood on a rock, a twig in its hand, its lively brown eyes following each of our movements with curiosity. There was no doubt that this rodent had seen us and that our behavior intrigued it to the highest degree.

The Theix have very strict protocols regarding the footprint they leave in any place they visit, and our camouflage suits were supposed to prevent this kind of contact. Yet not only had this rodent seen us, it also seemed to cast a critical, or at least detached, gaze upon our presence in its environment.

My first instinct was to consider that this event could not have any critical consequences, given the insignificance of the creature in question. But the Theix had taught me how harmful such an attitude could be, so I remained motionless, waiting for a sign from Lislae to know what course of action to adopt. After a few minutes, our squirrelbeaver resolved the misunderstanding on its own by emitting a series of whistling sounds, which turned out to be a rallying signal for its fellows. Lislae then chose flight, and I am grateful to her for not reproaching my clumsiness when I stumbled and sprawled fulllength on the bank, covering myself in mud and ridicule.

Day 5

Virae Mnet, our therolinguist, made contact with them. Our small furry animals turned out to be mischievous companions, eager to make our acquaintance and ready to guide us into their world.

Day...

I no longer know what day it is. Our days are now punctuated by visits to the river that flows at the bottom of the valley. Our furry ambassadors call it “Mother-ofAllLife”, but we simply call it ‘the river.’ For lack of suitable cartography, it is difficult for us to know whether this corresponds to the Reka, the river that once rose in northwestern Croatia and flowed into the Adriatic via Slovenia. Be that as it may, this river, which thus seems to preside over the destiny of all in this valley, is inhabited by creatures we have named the “Sabelles” as their appearance evokes that of the polychaete annelid worms found on our ocean floors. The Sabelles communicate with one another, and we believe they form a kind of symbiotic consciousness that permeates their entire ecosystem. Virae Mnet has set about translating their language, and for this he has tools that the linguists and ethologists of my time would be intensely jealous of. Theix technology never ceases to amaze me. How could they have developed such an advanced civilization while maintaining this almost animistic philosophy that characterizes their relationship with the universe?

A day of rain...

I rediscover the pleasure of writing in this notebook, safe and dry inside the capsule. I regret not being able to faithfully transcribe all the richness and detail of this wild and enchanting world. I think back to a remark by my friend Elio Venturi: we cannot do without the Earth, but the Earth, for its part, can do without us. That is exactly what seems to have happened after the collapse of our contemporary civilization, if the memory of the Sabelles is to be believed. No man or woman has ever fished along its banks, hunted in the gamerich hills, lit fires, or built a pirogue to travel downstream to the “seathatbestowsrain”. When asked whether I myself am a “human”, I spontaneously answered in the negative. For the first time in my life, I felt no need to pretend to be what I am not, nor to prove anything to my supervisor. What I felt then, what I still feel, and which fills me with joy, is, I believe, what is called “freedom”. A very human feeling, paradoxically, Hisoa Rel pointed out to me when I confided these thoughts to him.

A day of flowers and joy

Unable to specify our exact position on the timeline, we have decided to call the era in which we find ourselves “the world of the Sabelles”. The Theix have a rather original theory about how causal loops can interlock. Until now, Lislæ Myun had seemed relatively confident about the future of our exploratory undertaking. But today she appears disoriented. Are we really where we thought we were? She revealed to me that one of the objectives of her mission had been to place a beacon like the one that allowed them to reach our contemporary era. The deployment of such artifacts is authorized only if all conditions are met with regard to what they call the balance of their ecumene, which encompasses not only their natural environment but also their cultural, technological, and, since they have learned to travel through time, historical environments.

I asked Lislæ whether the Theix would be willing to renounce this technology if it turned out that our presence today could lead to the collapse of a temporal loop. She replied that the Sensiles had given up developing all kinds of technologies in the past, and that our exchanges had been initiated only insofar as they conformed to their predictions and did not threaten the stability of their ecumene.

Was the world of the Sabelles also consistent with their hypotheses? I asked her then. Lislæ admitted her ignorance, and I knew that it would be impossible for me ever to know whether the Theix had intended for me to be created in order to initiate an already existing temporal loop, or whether events were simply slipping beyond their control. Curiously, this left me indifferent. It seemed fairly clear that, whatever

the answer to that question might be, none of us would be returning home. The four of us were prisoners of this world, and there was no other way out of this situation than erasure. Since this end seems inevitable, I then implored her, grant us a little more time. Just a few more days, before triggering the protocol that would erase all traces of our presence here.

A day of dry wind and dust

Virae Mnet chose to stay with Lislæ Myun at the capsule to prepare our final journey, while Hisoe Rel and I are taking advantage of this reprieve to head once more toward the river. There is still so much for us to observe and learn, so many long reveries to whisper at the water's edge in the company of the Sabelles. I have transcribed the substance of our exchanges in the pages that follow. These notes may seem incomprehensible at first glance, but I believe they may help to better understand how the river ultimately came to shape all our thoughts, to permeate our entire being. If one listens closely, one can hear its limpid voice repeating to us that a joyful coexistence is possible, and that from our encounter a new ecumene might be born.

But the moment when this journal comes to an end is approaching. The few days granted by Lislæ Myun have passed...

...

The clearing where we had once set up our camp has been returned to its original state. There is no longer any capsule. No mark, no trace has been left behind. The tall grass rippling in the wind shows no sign of passage, save for that of a doe and her fawn—a thin trail through the grasses, barely a rustle.

Hisoe and I are careful not to disturb this secret harmony. Without making a sound, we retreat, two fused shadows melting back into the forest. My intuition was right: he and I share the same deep nature. If there is a continuity between my time and his, it is probably the one born of this encounter. And even if today only the Sabelles know of this union, I dare to believe that it is not accidental.

Automation and industrial objects: a simondonian reading of Karel Čapek's play Rossum's Universal Robots

Alex Calazans & Veronica Ferreira Bahr Calazans

Abstract

This text discusses Karel Čapek's play "Rossum's Universal Robots" from the perspective of philosopher Gilbert Simondon. It is the first work of fiction to use the term "robot," contributing to establishing a certain image of the machine in contemporary culture. Simondon's analysis of the play, according to the reading proposed here, points to a tension between the post-industrial technical mentality, defended by Simondon, and the consumer values strongly associated with the robot manufacturing process described in the play. The future, envisioned by the play, is presented not only as a scenario of extreme automation, but also of prioritization of profit, obsolescence, and disposability in the industrial process. Thus, beyond a reflection on the concept of "robot," this analysis points to an alternative regarding the way of conceiving industrial objects in general, in order to preserve both the technical essence of such objects and nature, which is considered one of the agents of technical networks and, therefore, cannot be ignored.

Keywords: Karel Čapek; Simondon; post-industrial; technical mentality; robot.

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Introduction

Science fiction, since its earliest manifestations, has been presenting projections of the future regarding technical objects. Much of it considers the clash between human beings and some type of machine capable of such a degree of autonomy that it allows it to manifest resistance, opposition, and even hostility towards its creators. Some attribute the adjective “Frankensteinian” to this type of narrative, recognizing the great influence of Mary Shelley’s work, *Frankenstein*; or, *The Modern Prometheus*, published in 1818. However, beyond the mere assumption that the future holds a machine revolution, science fiction works reveal conceptions about technology shared by those who lived in the context in which these works were written and, at the same time, influence those conceptions.

It is with this premise that I turn to a theatrical text, in order to investigate some hypotheses about how such a work of art may have influenced our culture during the 20th century. It concerns, specifically, to Karel Čapek’s text, *Rossum’s Universal Robots*, written in 1920. First staged in 1921 in the Czech Republic, the play achieved worldwide success in the interwar period, as the text was, already at the time, translated into more than 30 languages. It is well known that the word “robot” was introduced into culture from this text by Čapek. It is a Czech term (*robota*), meaning something close to “forced labor”.

From a philosophical point of view, the goal is to investigate some aspects of the “image of the machine,” as manifested in the play, and evaluate them based on some concepts provided by the philosopher of technology Gilbert Simondon. More specifically, we want to know if the concept of Robot, according to Čapek, fits the diagnosis made by Simondon, in his book, *On the Mode of Existence of Technical Objects* (*Du Mode d’Existence des Objets Techniques*) [MEOT] regarding the *myth of the Robot*. Thus, concepts such as *automatism*, and others derived from it, become central to the analysis.

However, we also want to explore a thesis that seems to have received little attention. This concerns the very concept of the *industrial object*. In the play, Rossum’s robots are produced in a factory. In this way, they are mass-produced artificial products. Thus, the question arises: more than influencing our understanding of what “robots” are, isn’t the play also conditioning us to think about what an industrial product is? Haven’t our values regarding what is “industrial” also been shaped by what was presented in Čapek’s work? Simondon again seems to provide us with powerful keys to understanding this, allowing us to consider some urgent contemporary issues, such as the environmental problem generated by waste disposal.

The images of the machine in the play written by Karel Čapek

In his book *AI Ethics*, Mark Coeckelbergh¹ summarizes the theme of Čapek's text. He states that the play deals with "robot slaves that revolt against their masters." This leads us to believe that it is a story about *competition*, in which leaders are threatened by their own revolted servants. This theme of rebellion is common to other narratives, such as that of Mary Shelley², in the book *Frankenstein*, in which the monster created by Victor Frankenstein violently attacks its creator because he does not meet its specific needs as a creature.

However, even if not wrong, the summary suggested by Coeckelbergh may indicate a partial view of the machine image involved. If we consider the theme of technique, it is possible to see an author's commitment to certain conceptions of the machine, even if they are implied and the author himself is not clear about them.

Therefore, considering Čapek's text, it seems misleading to say that the play addresses a single way of seeing the "robot," as Coeckelbergh suggests, assuming the theme of the robot rebelling against humanity. Instead, we suggest that there are five active machine images in Čapek's story. Let's look at them:

First image: it appears in the play's *prologue*. Right at the beginning, Čapek describes the office where the character Harry Domin (the factory's general manager) works. On the office's walls there are images with the following phrases: "The cheapest labor: Rossum's Robots"; "Tropical Robots, the new invention, US\$150 each"; "Buy your Robot now"; "Want to lower your product prices? Order your Rossum Robot". What these sayings present is *an economic image of the robot*. More specifically, it's the image that aligns with the business perspective, which, in a capitalist context, sees the robot as an asset capable of enabling economic maintenance, reducing costs and generating profit.

Second and Third Images: The following two images should be considered together, as they appear together in the narrative. Still in the Prologue, the director, Domin, describes the story of the invention of the Robots. He mentions two characters: Old Rossum and Young Rossum. The Old Man has a more academic attitude, focused on philosophical interests and understanding nature. He is the one who discovers the secret of how to manipulate matter and produce life. Driven by an anti-theological interest, Old Rossum sets himself the goal of building an artificial "human being," exactly like naturally constituted humans. Therefore, it is an organic being, just like a human, but artificial. His desire is to show the non-necessity of God in understanding the creation of humanity. Since Old Rossum's experiments failed, Young Rossum, whose academic background is in engineering, uses his predecessor's discoveries to direct the robot towards labor purposes. Instead of imitating nature, as the old man wished, Young Rossum envisions an artificial object

¹ Coeckelbergh, M., 2023, *Ética na inteligência artificial*, São Paulo, Ubu Editora, pp. 29–30.

² Shelley, M., 2021, *Frankenstein, ou o Prometeu moderno*, ed. bilingue português/inglês, São Paulo, Ed. Landmark [primeira versão publicada em 1818].

distinct from humans, but capable of performing human tasks. Therefore, we can name Old Rossum's image of the machine as the *classic organicist image of the machine* -something that is present, for example, in Ernst Kapp's³ - in the text *Grundlinien einer Philosophie der Technik*. Young Rossum, on the other hand, embraced the *organicist industrial image of the machine*. The basic justification for this lies in the fact that he envisioned building "working machines, alive and intelligent." By avoiding superfluous elements to perform specific functions, these machines would be mass-produced, much like a production line in the large factories of the early 20th century.

Fourth image: an other image concerns how the character Helena Glory (daughter of the president of Rossum's Robot Factory) interprets the robots. She visits the factory with the humanist intention of setting free the robots. She interprets the robots as individuals similar to humans, capable of suffering and having moral values. They could have a soul, and thus, forcing them to work would represent the same kind of aggression that humans could suffer. The machine image in question is *the humanized image of the machine*.

Fifth image: the last image to receive our attention is the one with which Karel Čapek himself seems to commit. At various points in his confrontation with Helena, Harry Domin rejects the fact that robots are human or that they can acquire moral characteristics such as *fear, courage, love, etc.* Because they possess a certain intelligence, robots would only know how to perform labor functions. However, it is curious that, in the *second and third* acts of the play, Čapek presents these robots as capable of human feelings, such as anger. This leads them to revolt against humans. What is at stake? We propose two theses: the first is the fact that, for Čapek himself, there is no work without human aspects. Only humans work. Thus, the development of an artifact that works means that, at some point, an artificial human being will be created. On the other hand, the second thesis concerns a metaphor. That is, once the robots revolt, they create manifestos ("robots of the world, unite!"). It seems that Čapek is describing the artificialization (in terms of dehumanization) of the working class. It appears to be a denunciation pamphlet that, through a metaphor, describes a real problem of the workers. Thus, his thesis is that an attempt to robotize the human is bad, suggesting that this always leads to social tensions and struggles for emancipation. Therefore, we can indicate that the 5th image is the *working machine image*.

Given these images, let's turn to some Simondonian concepts in order to understand the depth of such Robot approaches.

³ Kapp, E., 1978, *Grundlinien einer Philosophie der Technik: Zur Entstehungsgeschichte der Kultur aus neuen Gesichtspunkten*, Düsseldorf, SternVerlag Janssen & Co. [obra original publicada em 1877].

Simondon and the myth of the robot

Already in the introduction to MEOT, Simondon refers to the concept of a robot. However, his approach is aimed at constructing a critique of how culture has approached automated technical objects. In his vocabulary, the machine is part of one of the moments in the evolutionary process of technique. However, over the years, culture (understood as the world of meanings) has ceased to comprehend the nature of the machine, that is, it has ceased to understand its mode of existence and has begun to treat it based on external meanings to its technical reality. As an effect of this is an alienated culture that evaluates the machine based on its utility. The alienated culture from true technical reality creates fictions that either tend towards a hostile stance against machines (*technophobia*), or towards a defense of machines simply based on the exercise of power they allow (*technocracy*). To Simondon⁴, both stances point to a myth: *the myth of the robot*.

In this sense, Simondon refers to the “robot” as an object that is simultaneously a result of technical development – because it is a machine – and also a target of imagination, stimulation, *fiction*, *art*, and *illusion*. Culture fuels the idea of the existence of machines that would have the capacity for *interiority* similar to that of humans. What results from this is a new meaning for the concept of *slavery*. Man, influenced by the ambiguity of culture, wants to dominate the machine, being cautious that it does not acquire human characteristics that make it *hostile*, *aggressive*, and *rebellious* against humans.

For Simondon, the idea that a robot can acquire an interiority, like a human, is nothing more than a myth, an imaginary product. This means that such a robot has never existed; and suggesting its existence in the future seems to only fuel this myth.

What allowed the emergence of this concept of robots lies precisely in the misunderstanding of what *automatism* is. But what does this concept actually mean? Firstly, it is understood that automatism is something that must belong to the machine; that is, without automatism there are no machines. However, Simondon⁵ also states that, in the mistaken interpretation of automatism, “a true logical error is hidden.” The reason lies in the difference between the concepts of “open machine” and “closed machine.” The opening and closing of a machine are concepts presented to indicate the machine’s ability to exchange “information.” This exchange relates to the external environment, which includes humans and other machines. Thus, *technical perfection* presupposes that the machine opens up, that is, becomes sensitive to information coming from the outside. The logical error is to assume an increase in *automatism* (which points to the closing of the machine) and at the same time assume that it becomes autonomous enough to control other machines, which, in turn, requires communication with the outside world.

⁴ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, pp. 44–45.

⁵ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, pp. 45–46.

In summary, the following words from Simondon indicate what he understands by automatism: “A purely automatic machine completely closed in on itself in a predetermined way of operating would only be capable of yielding perfunctory results”⁶. This definition contains the idea that a machine possesses an internal functioning, that is, an internal causal regime that generates specific movements from one stage to another. This represents an aspect of determination, that is, a *programming*, allowing it to act and produce results. Esses resultados são “sumários”, porque eles estão previstos na cadeia causal programada. These results are “summary” because they are predicted within the programmed causal chain. Thus, *automatism seems to be seen as the ability of a machine to perform pre-determined movements that allow it to provide expected responses*. Therefore, increasing automatism means raising the capacity for autonomous action, which is, above all, determined and expected. This implies closure, since the results arise from something imposed internally on the machine and cannot be altered in a possible interaction with the outside world. It is contradictory, therefore, to want to build a “robot” that is the “machine of all machines.”

Now, the robot in the myth is the imaginary manifestation of a seemingly technically impossible machine. It represents a desire for pure automatism elevated to an absolute degree.

The myth of the robot, Rossum’s robots and the technical industrial

We can now ask ourselves how the images of the machine present in Karel Čapek’s play correspond – or do not correspond – to the myth of the robot.

We initially argue that only three of them approach the perspective proposed by Simondon. Explicitly, those that presuppose absolute autonomy, endowed with intentionality, are more immediately associated with Simondon’s critique. Thus, the images associated with Old Rossum (second image), Hellena (fourth image), and Čapek himself (fifth image) openly refer to automaton robots, representatives of the humanoid ideal, endowed with capacities that Simondon argues are only human. The very conception of revolt, present in the final perspective of the piece, would presuppose a notion of freedom and consciousness that Simondon would not be willing to assume as an attribute of the machines.

And what about the other two machine images, how do they relate to Simondon’s thinking? Unlike these three images, the concepts of robot – associated with the *economic image of the Robot* (first image) and the *organicist industrial image of the machine* (third image, as conceived by the Young Rossum) – do not approach the myth of the Robot. Although Simondon⁷ tends to reject the idea that the economic aspect is an intrinsic element (essential to the technical aspect of machines), he would not accuse the character Domin of adopting a mythical stance towards the robot. At various points in the play’s Prologue, this character rejects the existence of anything

⁶ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, p. 46.

⁷ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, p. 64.

human in robots: they would be machines, taken as commercial products, whose objective is to generate profit for both the seller and the buyer.

To support this, one only needs to refer to a part of the dialogue between two characters.

At one point⁸, Domin explains the following to Helena: “[...] manufacturing artificial workers is exactly like manufacturing diesel engines. Their production must be as simple as possible, and the final product, virtually the best.” Then he asks Helena: “Which worker do you think is virtually the best?” She, in turn, from her humanist perspective, replies: “The best? Perhaps the one who...who...who is honest...and dedicated.” Then, Domin quickly corrects her: “No, [the best worker is] the one who is the cheapest [...]”. Thus, it becomes evident that this image is not associated with a robot capable of intentionally hostile actions towards human beings.

Similarly, the concept of a robot associated with Young Rossum does not fit into the robot myth. What is at stake is the conception of an industrial object. Considering Simondon’s⁹ proposal, regarding the difference between handcrafted and industrial, it would be possible to say that Young Rossum conceives the production of the robot as a *standardized* technical object. Each robot would be built on a production line (something reminiscent of the Fordist conception of assembly line production), and, in the end, once built, it would serve to fulfill a function. Human replacement would not be at the level of intellectual activities linked to consciousness (such as decision-making based on its relationship with moral values). For Young Rossum, robots would do jobs that don’t require the presence of a “soul.” Like other machines, and unlike living beings, robots are equipment, industrially constructed objects that perform specific functions, just like tools.

Now, both images of the machine touch on another aspect of Simondon’s critique, which is the very concept of the industrial object.

In Chapter One of the MEOT, Simondon makes many references to the industrial technical object. For the purposes here, it is sufficient to understand it from what Simondon presents as *concretization*. In summary, Simondon¹⁰ presents this concept as being the way in which technical objects evolve technically. It is an *ontogenetic* process that indicates how the internal functioning relationships change, in order to establish more synergistic and stable internal regimes. It is a process that describes the internal unification of the operating scheme. The more unified and synergistic a technical object is, the more *concrete* it is. Conversely, the opposite of this is *abstraction*. Thus, in an evolutionary lineage, it would be possible to evaluate, through a comparative process, which object is more concrete and which object is more abstract.

⁸ Čapek, K., 2024, *R.U.R.: os robôs universais de Rossum*, São Paulo, Aleph, p. 32s

⁹ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, pp. 61–62.

¹⁰ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto.

In the history of technique, Simondon¹¹ observes that industrial objects are more concrete than handcrafted objects. In the industrial context, for an object to be manufactured, it was necessary to achieve stability in its operational structure so that it could be mass-produced. Objects that reach this level are called “stable types.” In contrast, a handcrafted object would be abstract, as its components would be less synergistic, making it more susceptible to human needs and interests (which are external to technical aspects). For Simondon, this does not happen with industrial objects. In other words, it is human interests that adapt to the nature of objects manufactured in the industrial process: “needs mold themselves onto the industrial technical object, which in turn acquires the power to shape a civilization”¹².

Turning our attention to the “Rossum’s Universal Robots” text, we observe that the piece partly reflects the Simondonian perspective. The image of the machine with which Young Rossum engages manifests itself as a technical evolution, compared to the attempts at robots produced by Old Rossum. Young Rossum observed that attempts to imitate nature to build an artificial Man only generated robots defective in their internal operating schemes. The solution was to manufacture robots based on simplicity and stability in their operation. In Simondonian terms, this would have allowed for standardization and large-scale manufacturing.

However, the difference with Simondon arises when commercial interests begin to guide the construction of the robots. Young Rossum himself was also thinking about cost savings. The simplification of the robot is also committed to reducing manufacturing costs. For Simondon¹³, this economic interest is external, that is, not essential to the technical nature and which can hinder the very process of concretization. This becomes even more evident when the character Domin treats robots as consumer goods. As soon as a robot malfunctions, the character doesn’t hesitate to suggest destroying it so it can be replaced by another. Behind this lies the encouragement of consumption.

When viewed in a broader context, it becomes evident that this perspective on the industrial object, as presented in Karel Čapek’s play, manifests many problems. In particular, it is possible to associate it with the serious problems that characterize the period currently known as the Anthropocene. Environmental crises are a result of the industrialization process. More specifically, the major problem of environmental pollution caused by waste disposal reflects the damaging effect of this way of thinking about the production and consumption of industrial objects.

In light of these issues, we assert that Simondon can guide us in avoiding a technophobic solution to the problem. The philosopher points towards a technically evolved society. He would not advocate *deindustrialization*. But, instead of defending the use of an industrial worldview, as it appears in Čapek’s play, his thesis is

¹¹ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, p. 61.

¹² Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, p. 62.

¹³ Simondon, G., 2020, *Do modo de existência dos objetos técnicos*, Rio de Janeiro, Contraponto, p. 64.

based on the constitution of *post-industrial* objects. However, it's possible to indicate that it's a way of treating a technical object, associating it with industrial properties while also incorporating some perspectives from handcrafted objects.

For the argument presented here, we can consider the main characteristics of this concept.

Simondon and the post-industrial technical objects

It is in another of his texts, *La mentalité technique* (1961?), that Simondon analyzes specific modes of thinking that result from the relationship with technical objects. This is the "technical mentality." To address it, Simondon breaks it down into three modes of expression: *cognitive schemes*; *affective modalities*; and *norms of action*.

In the first mode, the technical mentality would express itself through schemes of intelligibility. An example of this would be what is present in both Cartesian mechanism and cybernetic thought. In this sense, for Simondon¹⁴, Cartesian mechanism adopted a criterion of "lossless transfer" to mechanize the "modes of reality." As for cybernetics, Simondon¹⁵ highlights the operating regimes of machines endowed with self-regulation and capable of exchanging information with the environment.

In the second mode of expression, Simondon suggests that the technical mentality manifests feelings. His example concerns the antagonistic feelings that pitted artisanal and industrial modalities against each other. With the emergence of the industrial, there was a separation between energy and information channels, something that did not exist in the artisanal modality. This separation made the artisanal modality *desirable*. Regarding the artisanal, there was a manifestation of nostalgia which, in turn, caused the industrial to be perceived as *undesirable*.

Following this, in the third mode of expression, concerning the rules for action, Simondon presents a critique of industrial objects. More specifically, he denounces the way in which industrialization has established unbalanced relationships between technical objects and social values, leading to the concealment of the very technical nature of such objects.

On one hand, there is the effect of fragmentation "into diverse specialized groups"¹⁶. The people involved in the industrial process (such as masters, technicians, and workers) isolate themselves, failing to contemplate the technical object in its entirety, making it impossible to establish universalizable rules of action. This potentiates another aspect of industrialization: that which involves *consumption* practices, generating the *obsolescence* of technical objects. Technical objects begin to carry non-essential ornaments, in view of personal tastes that guide consumption. A "social game" occurs that causes technical objects to be constructed and evaluated

¹⁴ Simondon, G., 2014, *Sur la technique*, Paris, PUF, pp. 297–298.

¹⁵ Simondon, G., 2014, *Sur la technique*, Paris, PUF, pp. 299–302.

¹⁶ Simondon, G., 2014, *Sur la technique*, Paris, PUF, p. 306.

based on what is not essentially technical. There is an admiration, a valuation, of ephemeral criteria linked to consumption and to what is secondary in the technical object. With this, an overload with secondary accessories occurs, which can hinder what is essential in technical objects. This situation opens the possibility for technical objects to become “obsolete,” out of fashion, and discarded even if they are technically preserved:

[...] the social dynamic began to manifest itself in the form of obsolescence, a type of disuse linked to the aging of conventions and a transformation of social habits rather than to wear and tear or a loss of functionality of the technical object. A freight car or a locomotive tender ages less quickly than a passenger car, with its ornaments and inscriptions: the one most overloaded with inessential ornaments is the one that becomes outdated the fastest¹⁷.

Another example given by Simondon is what happens with the automobile. For an automobile to be manufactured, it needs to be purchased. Thus, fragmentation – which prevents a technical evaluation of the object in its entirety – seems to fuel the possibility of non-essential elements interfering with technical objects:

An automobile quickly becomes obsolete because it is not a single act of invention, construction, and production that simultaneously brings about the road network and the automobiles. Between the network—this functional harness of the geographical world—and the automobiles that travel on it, humankind intervenes as a potential buyer: an automobile is only deemed functional if it is purchased, if it is chosen, after it has been produced. A kind of recurrence is established from this mediation: the manufacturer, having to mass-produce, must calculate the chances of sales; not only can they not build the network and the cars simultaneously, but they must also anticipate this purchase option¹⁸.

However, when considering the problems that arose with industrialization, it is legitimate to ask about their solutions. What Simondon proposes as a way out concerns a type of technical mentality that is still under construction. This is the men-

¹⁷ Simondon, G., 2014, *Sur la technique*, Paris, PUF, p. 308.

¹⁸ Simondon, G., 2014, *Sur la technique*, Paris, PUF, p. 310.

tality that will be conceived from what he calls the *post-industrial technical object*. This new type of object, in a way, is already present, for Simondon, in the industrial era, when “networks” of technical objects emerge. Thus, such networked objects are those that, even though produced in factories, have been able to be introduced into interconnected structures, linking to other objects and, at the same time, establishing relationships with the locations (geographical aspect) where they are installed. The Eiffel Tower and the Garabit viaduct are two examples of these networked objects:

The Eiffel Tower and the Garabit Viaduct should be seen as heralding the end of industrial concentration around energy or raw material sources; that is, not as spectacular isolated centers and successes, but as the first link in a virtual network.

Thus, the post-industrial technical object needs to be evaluated from a new perspective. For Simondon¹⁹, it should be thought of as an “open” technical object, capable of receiving modifications to remain current for as long as possible. For this to happen, it must be assumed that they are objects with layers. One layer would be composed of *durable* parts, while the other layer would contain *adaptable* parts. The result of this new interpretation is the manifestation of a technical object with both industrial and artisanal characteristics. That is, the durable parts can still be thought of as concrete objects, capable of being produced in factories, based on an industrial model of standardization. The criterion for this manufacturing is functional durability. On the other hand, regarding the adaptable parts, the ability of such objects to meet external demands comes into play. It is only by being able to make these adaptations that such objects can be inserted into specific networks, responding to specific requests regarding users and geographical situations.

Thus, it becomes evident that, from the two layers of post-industrial objects, both the need for the search for “stable types” as human interests and proper harmony with the territory (*associated environment*) are present. Therefore, values such as the *practice of planned obsolescence* or the *irresponsible disposal of technical objects* (waste) become incompatible. In short, the production of post-industrial technical objects requires considering the values of life and how the technical objects themselves should be interpreted as signs of life: “the machine, being a work of organization and information, is, like life itself and together with life, that which is opposed to disorder [...]” (Simondon, 2020, p. 52). This will only be possible in a society where technical culture is not alienated from the *mode of existence of technical objects*.

¹⁹ Simondon, G., 2014, *Sur la technique*, Paris, PUF, p. 311.

Finally, turning our attention back to Čapek's text, we can ask ourselves: is the technical mentality suggested by the post-industrial movement compatible with any of the machine images presented there? The immediate answer is *no*. In none of the five images we suggested is there an evident attempt to resolve the emotional tension between what is artisanal and what is industrial. Moreover, as seen in the 5th image, the one that attempts to describe Čapek's own conception, the discomfort with the industrial is evident. Furthermore, it seems to imply a nostalgia for a pre-industrial era.

When we compare the concept of industrialization that emerges from Rossum's robot factory with the proposed technical mentality suggested by Simondon from the post-industrial perspective, it becomes possible to affirm that they are incompatible. What Čapek presents in the play reinforces the idea that industrial objects should be subject to consumer values. The robots themselves, when they manifest problems regarding the fulfillment of functions linked to human desires, become obsolete and are discarded.

Furthermore, it is also evident that Rossum's robots are built to generate profits, both for the factory that created them and for those who may acquire them for their businesses. Čapek's piece helps reinforce an image of the machine that is contrary to what Simondon defends with post-industrialism. In this sense, more than re-evaluating the concept of "robot," it is of great importance to question the concept of "industrial object" that Čapek's text promotes. By considering Simondon's thought, it is possible to find other ways of conceiving such objects. The post-industrial concept seems to present itself as a way out of current questions regarding the various problems generated by industrialization processes, whether they stem from pollution, given the disposal of industrial waste, or from the integrity of nature itself, when treated as a passive object that must be dominated. Specifically regarding nature, this would be related to a vision of domination, expressed by the "technocratic attitude." According to Simondon (2014, p. 306), such an attitude does not apply in the post-industrial era; therefore, it cannot be universalized as a rule of action. The attitude of domination, of the pure desire to exercise power, does not apply because nature must be part of networked thinking:

Here, the technical mindset culminates in success and reconnects with nature by culminating in network thinking, a material and conceptual synthesis of particularity and concentration, individuality and collectivity – for the network's full force is available at each of its points, and its meshes intertwine with those of the world, in the concrete and the particular²⁰.

²⁰ Simondon, G., 2014, *Sur la technique*, Paris, PUF, p. 307.

Therefore, in the post-industrial context, nature is not passive. The values that would guide this new technical mentality, in addition to respecting the technical essence of technical objects, must also assimilate nature as one of the agents of established technical networks.

Conclusion

From all this, what can we conclude? We point to two theses. The first is that which affirms the relevance of Karel Čapek's text for understanding what Simondon defines as the "myth of the robot." More than other great literary works, such as *Frankenstein*, written by Mary Shelley, we maintain that the play written by Čapek is much more illustrative of what Simondon describes as the *myth of the robot*.

The **second** thesis concerns industrial objects. It is necessary to consider that the robot figure present in the piece is, first and foremost, an industrial product. Thus, more than just a machine that replaces humans, it is associated with *a way of understanding industry itself*. For Simondon, a factory is a technical object, which must be understood as a technical whole. In other words, it is necessary to be aware of the negative aspects that Čapek associates with this level of technical development, in order to correct the distortions. However, for Simondon, the solution to the problems would not lie in abandoning what is industrial, but rather in adopting a balanced position that manifests itself from the technical mindset conceived in relation to technical objects in the post-industrial era.

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