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RESEARCH ARTICLE

The centrality of the machine in the thought of Jacques Lafitte

Darío Sandrone[1] · Andrés Vaccari[2] · Diego Lawler[3]

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Abstract
Jacques Lafitte occupies an odd place in the philosophy of technology. He was a French engineer who made a significant and conceptually innovative contribution to this field, yet his influence has been elusive and largely ignored until relatively recently. Many of Lafitte's ideas find echoes in the work of later philosophers (particularly Gilbert Simondon), yet, notably in the case of Simondon, apparently without any direct line of influence. Lafitte placed the machine at the centre of his thinking about technology and articulated various layers of analysis around it; for example, he considered machines in the broader context of an artificial world or "mechanosphere", which encompassed certain aspects of philosophical anthropology (namely, how to think the human in the context of human–machine relations, in the context of socio-political organizations). In this work we seek to reconstruct Lafitte's ideas and briefly trace some of their later impact. We identify three dimensions (or theses) in Lafitte's analysis: *epistemological*, *ontological* and *anthropological*. We argue that the most remarkable fact about Lafitte's thought is the way it inaugurates, and anticipates, the approach of later currents, not just in the "French tradition", who also made an effort to integrate machine theory into broader philosophical, anthropological and political aspects, in terms that echo Lafitte's. In particular, we will focus on Gilbert Simondon and cybernetics.

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✉ Andrés Vaccari
Andres.Vaccari@mq.edu.au

Darío Sandrone
dariosandrone@gmail.com

Diego Lawler
diego.lawler@gmail.com

[1] Universidad Nacional de Córdoba, Haya de La Torre S/N, Ciudad Universitaria, Córdoba, Argentina

[2] Universidad Nacional de Río Negro / CONICET, Villegas 360, 8400 Bariloche, Argentina

[3] Sociedad Argentina de Análisis Filosófico (SADAF) / CONICET, Bulnes 642, 1176 CABA, Argentina

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1 Introduction

In 1932, a relatively unknown French engineer named Jacques Lafitte published a short book called *Réflexions sur la science des machines* (1972). In this treatise Lafitte presents the foundations of the new science of "Mechanology", a discipline centred on the study of machines, defined as "organized bodies built by man" (1972: 24). This science, Lafitte insisted, should not be merely speculative, but based on the *scientific* observation of the "the differences they display in the characteristics of their organization" (1972: 24). Lafitte's point of departure for his novel scientific approach to machine classification is the taxonomic method (familiar to biologists). He emphasizes that these groupings, in terms of internal organization, are provisional and imperfect, and can be improved as more properties of organisms and machines are known (1972: 91). An important aspect of this approach is that machines are seen in organismic terms, under a similar light, and in terms of certain convergences (organizational and energetic aspects, for example) and their articulation in the context of human–machine systems.

A notable aspect of Laffite's thought is the way later philosophers would take these ideas in the context of more systematic and ambitious proposals. The most prominent philosopher in this line is Gilbert Simondon. There is still some debate on whether there was a direct influence of Lafitte on Simondon (a question we shall examine later), whereas the influence of Simondon on later philosophers, such as Bernard Stiegler, is prominent and explicit; however, the resonances between Lafitte's and Simondon's work are undeniable (Thibault & Hayward, 2017; Guffroy & Bontems, 2018; Marrat, 2021). Perhaps the most striking aspect of Lafitte's thought is the way he articulates "hard", empirical and technical aspects of the machines (as seen from a "pure" engineering perspective) with a range of other concerns that encompass the ethical, the political, the social and the anthropological.

Regarding the ethical and political aspects of technology, Lafitte is concerned with the integration of machines into society (as social beings) in a manner that does not affect traditional values; the general spirit of his thought can be described as utopian-humanist, in the vein of Charles Fourier and Saint-Simon (Marratt, 2021: 205). The question here is how to live well with "others" that include not only humans but also machines. In this context, Lafitte is reacting against anti-industrialist tendencies that dominated the French scene and in much of Europe (Guchet, 2017) in the interwar period. According to the Marxist point of view (a dominant tradition at the time), machines were a symbol of alienation for workers. Lafitte, however, observes that societies were becoming increasingly dependent on machines, and that machines (rather than an alienating Other) are a "primary force of integration" (Marratt, 2021: 203). In this sense, Lafitte is part of a wave of thinkers who first recognized technology as the central philosophical concern of our times (for example, Oswald Spengler and, on the other side of the Atlantic, Lewis Mumford, who was deeply affected by his reading of Spengler). Among others, Lafitte's concerns will be taken up by a sector of French Catholic humanism, especially Emmanuel Mounier, who will make Lafitte a valid interlocutor in the debates of the time (Thibault & Hayward, 2017: 452).

Lafitte believes that it is not possible to separate a theory of society from a theory of machines, to the point of affirming that "sociology itself [presents itself] as the typical form of the science of machines" (Lafitte, 1933: 145). Lafitte further develops these insights into a conceptual view of machines (as parts of a "Mechanosphere") that articulates epistemological, ontological and anthropological aspects in a strikingly original way.

However, Lafitte saw his own work (quite rightly) as a development of a relatively recent tradition in the engineering sciences. Lafitte was aware that his mechanological project was not an original idea; in fact, the title of his main work alludes to previous theoretical developments, most of them from the nineteenth century. First, there was a booming genre of literature concerned with industrial machinery, in the shape of prospectuses, catalogues, specialized magazines and technical reports. Secondly, we can identify a line of pioneering authors in mechanical engineering (Sandrone, 2021) at the end of the nineteenth century, most importantly Franz Reuleaux, Robert Willis and the father of modern computing, Charles Babbage. Also, architects such as Eugène Viollet-le-Duc (Lafitte, 1972: 9) also appear in the bibliographic notes of the *Reflections*. Lafitte perused and had at his disposal a vast corpus of literature on industrial machinery, ranging from simple tools to large engines and buildings (anticipating Le Corbusier's idea of buildings as machines for living). In this context, part of Lafitte's intent is to impose some order on this somewhat chaotic proliferation of artifacts. To this end, he recognized that mechanology required strong *epistemological* foundations based on the "hard" sciences (physics, chemistry and biology). As a corpus of knowledge, mechanology had to carve a space at the intersection between the empirical and formal sciences.

Another important point of reference is Samuel Butler, an English journalist and writer who first saw machines in evolutionary terms. Lafitte says that Butler, together with other authors, "can cast a strange light on machines" (1972: 9). Just three and a half years after the publication of *The Origin of Species*, Butler wrote an article in a New Zealand newspaper entitled "Darwin among the machines". There, he stated that the organs of our machines come from ancestral types of machines that have become extinct or modified (Butler, 1863); years later, he would develop these ideas in a novel called *Erewhon*, first published in 1872. The story is set in a country where machines are banned because of the possibility that they could, one day, replace humans: "Are we not ourselves creating our successors in the supremacy of the earth?" (Butler, 1970: 237). There is no doubt that this work stimulated Lafitte, since he addresses two problems arising from Butler's ideas. On one hand, the issue of a competition between machines and humans, and the need to establish social mechanisms that ensure peaceful, harmonious and synergic coexistence between them. On the other hand, a central topic of the *Reflections* is the relationship between biological and machinic evolution, where Lafitte applies the notion of "lineage" to the history of technology (Clarizio, 2021; Guchet, 2005).

In this article, we examine the central role of the machine in Lafitte's work in terms of three dimensions or theses: *epistemological*, *ontological* and *anthropological*. Lafitte's brief elaborations do not constitute a fully developed philosophical thesis but contain the germ of strong ideas that announce a novel approach to a combined philosophical approach to the relations between machines, organisms, humans and social systems. These concerns would later find echo in the work of other thinkers. Above all, Lafitte considered himself an observer or student of machines who did not set out to create a unified theory, but to advance some reflections on the multiple and diverse fields of knowledge around the machine, including the engineering and the social sciences. In the course of this search, we can highlight the originality of certain interdisciplinary crossings; most importantly the application of biological concepts to the study of machines. Lafitte's perspective was that of a naturalist who establishes taxonomies and classifications in terms of observed regularities in the functioning of machines and the logic behind their "evolution", or historical development. But Lafitte also saw clearly that there were powerful phenomena that related somatic, technical and social organizations, in ways that were not yet understandable, and that required empirical study. In a striking way, Lafitte's project anticipates the need for what Bernard Stiegler has termed an *organology* (Stiegler, 2020) that determines the transductive relationships between somatic and technical organs (on one hand) and social organizations (on the other), which would lay the foundations for a better understanding of organism-machine relations, based on exchanges of energy and matter (the concept of "information" was not available to the science of Lafitte's time). In this way Lafitte's work acknowledges the deep kinship between technical, psychical, social, and ecological processes. This was an important step towards the study of the ethical and political dimensions of technology, in the context of the "technological society" (Ellul, 2021) that emerged in full force around the middle of the twentieth century.

The first three parts of this article tackle, respectively, the three dimensions mentioned above. According to the epistemological thesis (Section 2), the science of machines must delimit a specific methodology and object of inquiry (distinct from the natural and social sciences). Secondly, we discuss the ontological thesis (Section 3), which affirms that machines are entities capable of being classified by intrinsic aspects, unrelated to their practical or social purposes (or intentional function). In Section 4, we evaluate the anthropological thesis, which states that machines are (in a way to be determined) an extension of humanity. In the last section, we briefly summarize how some of Lafitte's ideas find echo in the work of two French Philosophers (Simondon and Stiegler), and also in other ambits.

2 The epistemological thesis

Lafitte's mindset is that of an engineer who takes a naturalistic approach to his object of study. Lafitte begins by identifying the types of "intellectual disciplines" concerning the study of machines (1972: 33). The first distinction Lafitte makes is between art and science. For Lafitte, the art of machine building is a subjective and creative form of knowledge. It does not study existing machines but projects machines that do not yet exist. For this reason, it is an intellectual human enterprise prior to machine science, and develops in parallel with it (1972: 33). The art of construction "translates plastically, in machines, the creative aspirations of man, the needs that he experiences and the possibilities that he creates for the sustained application of his technical work" (1972: 33). The art of construction is, in turn, subdivided into three human operations: a) conceiving; b) building; c) ensuring operation (1972: 34). Each of these human operations brings together a series of specialized tasks that give rise to professions such as "architect, engineer, craftsman, builder, businessman, repairman, driver, etc." (1972: 34).

There are also machine sciences that are not concerned with *creating* but *knowing* the principles of existing machines. Within this category, Lafitte makes a distinction between two types:

On one hand, there are *descriptive* sciences whose purpose is "the rigorous description of the observed phenomena" (1972: 31). Lafitte christens this type of endeavour as *mechanography*, the science "devoted to the history, description and classification of existing machines" (1972: 31). Mechanography encompasses: a) all historical, archaeological, ethnographic research on machines; b) descriptive research on the behaviour, construction and use of machines, including all written, graphic and symbolic representations applied in machine design and construction; and c) investigation on modes of classification, how to refine them and the tools to achieve this, such as nomenclatures and measuring instruments (1972: 34).

Secondly, there are normative sciences that study "the laws of these phenomena and the causes that produce them" (1972: 31). Lafitte calls this type of scientific activity *mechanology*. The task of mechanology is not the conception of possible machines (as in the art of design and construction), but rather the investigation of existing machines. Unlike mechanography, which is descriptive, mechanology is a normative science of machines "dedicated to the study of the differences found between them, to the explanation of those differences, to the explanation of the causes and laws that they rule them" (1972: 34).

Further, mechanology is not merely concerned with classification, but with what we may call their mode of existence: explaining how machines exist and why they exist that way:

> The science of machines or mechanology, a normative science, has no other purpose than the study and explanation of the differences that are observed between machines. And, since science is only interested in the real, it can have no other object than the really existing machines. It must put aside all imaginary products of that construction and use have not brought into existence. It must explain the formation of the varied types that are offered to our observation in the set of machines; it must, in a word, address the very problem of its [the machine's] existence (1972: 31).

Mechanology studies different aspects of machine-types. It studies the differences observed in their (a) forms, (b) structures, (c) operations, (d) their general organization, and (e) it seeks to explain the genesis of each type (1972: 34). Now, due to the similarities between mechanology and the basic sciences, in terms of the law-like nature of their statements, Lafitte needs to defend the epistemological specificity of a science of machines, avoiding, for example, its reduction to the fundamental laws of physics. Lafitte affirms that mechanology "is located elsewhere within the series of scientific disciplines" (1972: 54). Lafitte's central argument is that, although the machine is an object constituted from a multiplicity of natural phenomena, these occur *in* the machine, but *are not* the machine.

> Under the influence of the advances of mechanical and physical sciences, and of a generalized application in construction, the machine, which had first been considered as a transformer of motion, is seen successively as a transformer of force and later of energy. It is easy to see that these different definitions are based on the consideration of certain phenomena of which the machine is the seat, and not because of the machine itself as a phenomenon. (1972: 30)

Each class of machine, in itself, cannot be reduced to an exclusively mechanical, electrical, chemical, or computational phenomenon. The task of mechanology is not to explain how physical or chemical phenomena are produced, but how certain phenomena allow, and are allowed by, the existence and permanence of machine operations belonging to a certain class and lineage. Mechanology explains the success of the art of construction of certain machines because it explains the *existence* of those machines. In other words, mechanology explains the existence of the artificial object in the physical world, under the laws of the physical world, but without reducing it to them. Quite importantly, it does not appeal to human practices or conventions of use, nor to the intentions of the designer or the user (intentionalism). That is why the object of mechanology is the genesis of machines, that is, the history of forms, structures, organizations, and functional schemes, which have converged into lineages of machines that persist in their existence. This approach comes from the influence of biology (Le Roux, 2009: 9) since it applies to the machine "the language of organization […] and inheritance" (Lafitte, 1972: 30).

3 The being of machines: Lafitte's ontological thesis

According to Lafitte, machines are organized bodies built by humans (1972: 24) whose internal organization shows sufficient plasticity to manifest different properties. The machine is a generic term that spans "the vast set of mechanisms, instruments, devices, tools, toys, architectural constructions of all bodies" (1972:28). Despite this broadness, all machines can be characterized and classified according to two criteria: (1) the relationship that they emplace to an external energy source and (2) the way in which that relationship determines their operation. Thus, a machine can merely support the flow of energy from an external energy source while not performing any operation; or receive that energy, transform it, transport it, and distribute it—and thus perform a function. Alternatively, a machine can do all of the latter and, furthermore, regulate interactions with that external energy source in order to change its operation over time.

These two criteria are not only ontological, in terms of a description of a machine's mode of being, but also methodological and epistemological. First, they allow Lafitte to classify machines into types. Secondly, they also condition our cognitive access to them, providing us with knowledge of how effective their functioning is, according to the complexity of their internal organization. This knowledge is the object of a general science of machines, or mechanology, as we have seen. Based on these considerations, Lafitte proposes three primary types of organization (Lafitte, 1972: 68): *reflective*, *active* and *passive* machines. In turn, the set of machines that make up each of these types can be further subdivided into classes (1972: 83). The set of all machines, classified according to their types and classes, makes up what Lafitte calls the "mechanological series" [*série mécanologique*] (1972: 89), the ultimate object of study of mechanology. The task of this science of machines is precisely to determine, based on the empirical study of each of its members, to what primary type of organization it belongs and what kind of machine it is. The classes of machines are the basic building blocks of Lafitte's ontology, ranging from the most complex to the simplest:

a. Reflective machines. These machines regulate their operation through their interactions with the environment. They have a main transformer of the energy coming from an external source, and are characterized by the presence of a frame, a regulation system and distribution organs. In addition, they have an organized, sensible system in tune with the variations of the environment. These machines show cyclical, irregular functions, modifiable by man and by themselves. Lafitte cites as examples engines with a device to regulate their operation, automatic torpedoes and motors (1972:68). As if it infers directly from the cases, each one of them differs in structural complexity, giving rise to subclasses.
b. Active machines function thanks to the transformation or transport and transmission of an external energy flow; however, unlike reflective machines, they do not regulate their operation in accordance to changes in the milieu they interact with. Lafitte cites as examples, the magnifying glass, the tool in general, and the grapple. The internal structure of the active machine is configured for the transformation, transport, distribution, regulation and transmission of energy. The changes that its operation supports depend on the changes in the energy sources that impact them. Of course, this can be regulated externally by human intervention.
c. Passive machines. Lafitte mentions the following entities as examples: the pole, the column, the float and the raft. This class of machines supports energy flows that they neither transform nor transmit, being completely and internally independent. They do not admit external regulation by human activity and do not manifest any internal functioning; therefore, they are essentially aperiodic and acyclic. However, they present useful properties (from a human perspective) that derive from their fixed condition in space, their mass and the resistance of the materials that constitute them.

The category of "machine" partly overlaps with the category of "artifact", as is widely used in the literature on philosophy of technology. A machine, as well as an artifact, is an entity made intentionally for some purpose (Hilpinen, 1992). This characterization is elaborated by Lafitte (1972) against the background of the distinction between organized bodies built by men (machines) and bodies produced by nature, whether the latter are organized (for example, a zebra) or unorganized (for example, a stone).

Although the notion of machine reflects the dependence on the intentional doing of man, Lafitte's own notion, to say it in current philosophical language, comes close to subscribing to an *essentialist realism*, as is evident in Lafitte's criteria of classification. The class of machines would constitute a class similar to a natural class, whose essence is given by its mode of organization. In turn, this organization involves a double relationship, namely, the relationship of each machine with an external source of energy and the way in which this relationship characterizes its functioning. Lafitte's taxonomy of machines develops from the ontological reality of machines, and its discovery is an achievement of mechanology, the science of machines. This discipline attributes to each class of machines, different behaviours, expressed in empirical laws not reducible to the laws of the basic sciences. This characterization supposes a robust realism behind the organization of the basic cartography of machines, and for the identification and re-identification of specimens in their respective classes. Their respective mode of organization functions as an internal Aristotelian principle of activity for each class, that is, it explains how each exemplar comes to being, is, and ceases to be a member of their class (Aristotle, 1984). On the other hand, the operation of each specimen belonging to a machine-type is explained by the description of its behaviours and empirical regularities uncovered by mechanology. Thus, based on this essence, we could predict the behaviours and compare the operations of various machines; this predictive aspect introduces a strong dimension of *normativity*: norms to evaluate performance according to expected functions, based on the characteristics of internal organization.

As a quasi-natural class, machines have an evolutionary history. Mechanology should account for this evolutionary process, through a method that establishes distribution, orders of appearance, degrees of internal organization and exchange with the environment. This also allows to identify technical ancestry and descent within the series, that is, to decipher the lineages of machines. These are transversal to the general classification of the series; indeed, for Lafitte, each individual belonging to a particular lineage contains the technical features of the series or part thereof.

> Then, the general order of the series is recapitulated in the lineages; there is, moreover, a less recognized fact and, therefore, more remarkable: every machine in the processes of its composition reproduces the great stages of the development of the types that have preceded it and thus also reproduce, sometimes very quickly, the history of its lineage. (Lafitte, 1972: 94)

For example, Watt's steam engine is, in a way, a reflective machine, since it has a centrifugal regulator that allows it to "read" information about its operation and modify it based on that information. But this engine also contains structures, organizations and functioning schemes typical of its ancestor, the Newcomen engine, which was not reflective but active. On the other hand, the principle of operation takes us back to the aeolipile of Heron of Alexandria, more than two thousand years ago. In this manner, Watt's engine reproduces, while recapitulating, its entire lineage. The idea of a "lineage" is based on a realistic conception of technical objects because it identifies the identity and permanence of the organizing principles that underpin the real existence of artificial classes. These principles persist in machines regardless of the use-plans found in different eras, cultures and traditions. The concept of lineage runs against the (correlationist and intentionalist) notion of an artifact as merely instrumental, a local, contextual and intentional manifestation of a material organization. The concept of lineage, as opposed to that of artifact, refers to an extra-instrumental reality that remains robust through cultural contexts and the shifting intentions of designers and users. A realist perspective affirms the existence of a set of primary technical qualities that normatively define what a machine is. In this sense, from a realist point of view, an artificial lineage is determined, not by the way it mediates between humans and the environment in specific situations, but by that set of invariant, schematic and independent characteristics that are its own.

4 Lafitte's anthropological thesis

Lafitte's mechanological project raises the issue of the relation between humans and machines, and of the role of technology in the development of the human itself (technogenesis), in a philosophical context where machines are given ontological autonomy and their own evolutionary history. In Lafitte's mechanological anthropology, machines play the central role. In line with thinkers such as Ernst Kapp, Lafitte departs from the premise that machines are extensions of the human, outgrowths from certain physical, biological, psychological, and social aspects that are crystallized in artificially organized material structures.

> Man, a vertebrate constructor, while he transmits life in his progeny, he transmits it in his works. Under the impulse of a life that grows in vitality as its intensity diminishes and the world advances towards its end, the series of living beings impel a collateral ramification in their constructions. And this branch, our works, our machines are ourselves, because they are a part of our own functions externalized by a kind of overflow of our own life. (1972:12-13)

The machine is an aspect of life. Here, Lafitte's remarks are in line with some vitalist current of the time (such as the Lebensphilosophie), characterized by an effort to think technology as a phenomenon arising from life (an idea echoed in Spengler's *Man and Technics*, published in the same year as the *Reflections*). For Lafitte, the human species extends beyond its biological envelope into the network of artificial bodies and machines it creates. Lafitte calls this the "anthropomechanical complex", an organism of which humans and machines are manifestations; the term "mechanosphere" grasps this complex in its planetary scale (Hayward and Thibauld, 2021: 15). The task of ethics is deeply tied with the fate of our common co-evolution, both as expressions of life. Yet Lafitte introduces an original thesis. The machine does not wholly originate in the human, as a kind of secretion from its organic dispositions, but has its own form of development, an internal necessity. Like societies or cultures, machines are human creations that gain independence following their own operating rules. Body and machine are coextensive, one builds the other. Consequently, the development of machinery is not only the evolution of a technical milieu (as Marx thought), but also an instance of the process of self-construction of the human species.

Lafitte carves a third path beyond substantivist pessimism and technophilic praise, in search of a new humanism that grants machines full philosophical citizenship without suppressing human agency—a philosophy that resists mechanization while embracing technology. “We must shed both hatred and admiration: we must understand. We must know and understand the machine, and this is where I may be able to help you” (1972:13). The task is to articulate an ethics and politics (as key fronts of the anthropological question) on the premise of a deep kinship between machines and humans.

> Machines? Extensions of man, integrating into himself, extensions of social structures and integrating himself in them; they are at all times identical to ourselves. They are us, they are like us; they are beautiful, like us, and ugly, like us. Developing them, building them, is building ourselves. (1972: 119)

Some have gleaned in Lafitte’s approach an anticipation of later posthumanist ideas of the late twentieth century (Iliadis, 2015, 134). In a sense, Lafitte anticipates the “co- constitution” thesis that holds that humans and technology are products of a process of mutual causality, a biotechnical evolution. The question of the relation between humans and machines, for Lafitte, begins with knowing the machine.

5 The Laffitian circle: philosophical core and ramifications.

The tree theses we have discussed above operate in a complementary manner, giving rise to a robust realism about machines, an ontological unity grounded on internal organization. The philosophical core of Lafitte’s proposal is the claim that machines are organized bodies that have their own internal laws, both in synchronic (internal structure) and diachronic (historical) aspects. Machines manifest an independence from the human mind; historically, they depend on intentional human creative activity (they exist because they are designed and built by humans), yet they are “there” as organized units independent of our thoughts and concerns about them. The internal organization of the machine constitutes its essence, existing independently of human activity. This organization shows various degrees of openness to external sources of energy and determines the behaviour of each machine. Internal organization is both an ontological and an epistemological criterion: it classifies existing machines and conditions our knowledge of how they work. In turn, this body of knowledge can be divided into mechanography (descriptive science) and mechanology (normative science).

Lafitte also proposes a more general discipline, Organology, which studies the principles of everything resulting from a process of internal organization to integrate into an environment, regardless of its artificial or biological origin. This requires a collaboration between all the disciplines that pursue “explanations that are typical of everything organized”, and which use the conceptual tools and the “instruments of measurement” of biology, and vice versa, since it is “the study of the machine that maintains disciplines most closely comparable to the organic” (Lafitte, in Le Roux, 2009:9).

In this scheme, Mechanology is the branch concerned with the artificial objects of Organology. In the same way that Lafitte does not reduce the machine to a set of physical or chemical phenomena, he does not reduce it to a biological phenomenon either; the machine is a peculiar, specific phenomenon. Thus, as he points out in the Reflections: "[i]f the organized bodies constructed by us differ from the brute and lifeless bodies found in nature, they differ in another way, but are also different, from living beings" (Lafitte, 1972:25).

We can see here a strong anti-intentionalist stance that conceives of the anthropo-mechanical complex as an organization with its own laws of becoming. Organology explains the integration of humans and machines as an articulated, interdependent whole. The process of creation and innovation are not deliberate, intentional processes, but are largely prescribed by the possibilities of machine organizations (the normative aspect of mechanology): "many observations made on machines give us compelling reasons to think that man in his creation proceeds according to a specific order, constant and unintentional" (1972:30). Although it would be an exaggeration to say that Lafitte considers humans entirely irrelevant to the course of machine evolution, their role as inventors is limited by the laws of Mechanology, which do not allow humans to direct technological evolution (Le Roux, 2009: 10). On the other hand, humans provide the context that enables the construction of machines and, with it, the insertion of innovations and inventions in artificial objects, that is, "he directs the conditions of his creative acts" that require "consideration of the social environment and its variants" (Lafitte, 1972:61, 109). In short, while the construction of machines is an art that is based on heterogeneous prior knowledge—physical, intentional, social and cultural—mechanology is an empirical science that obtains knowledge a posteriori, in the form of nomological statements about successful operating schemes. Its object is the organization of the internal elements of the machine with each other and with the elements of the environment. A typology of machines, from the perspective of mechanology, must use these two factors as classification criteria: internal organization and exchange with the geographical environment.

Some of the spirit of Lafitte's ideas would animate the work of later thinkers. The most striking case, without doubt, is that of Gilbert Simondon, whose work shows (among other aspects) the same concern with machine classification, applying biological notions such as genesis and lineage to the study of technology.

Although in the interview that Jean Le Moyne conducted with Simondon in August 1968 (Simondon, 2009), the philosopher claims to never have heard of Lafitte's thought, in *The mode of existence of technical objects* (2012), published ten years earlier, Simondon proposes to lay the foundations of "a general technology or mechanology" (2012:48). It is likely that these notions circulated in his academic circles, even though Simondon had not read Lafitte first-hand. However, at the end of the same year (1968), Simondon taught a course in which he incorporated Lafitte's classification of machines in some detail, so it is not unreasonable to assume that he read Laffite's *Reflections* after the 1968 interview (Bontems, 2015). This extensive course, in which Lafitte was explicitly incorporated, was entitled "L'invention et le développement des techniques" [The invention and development of techniques] (Simondon, 2005: 75–226) and was dictated from late 1968 to mid-1969 at La

Sorbonne, at the request of Georges Canguilhem (2005: 11). The content developed there was later recovered and supplemented in a conference that Simondon gave in 1971 under the name of "L'Invention dans les techniques" [Invention in techniques] (2005: 227). These expositions, both the course of 1968 and the 1971 conference, modify, complement and further refine the ontology elaborated in *The mode of existence*. Thus, Simondon's philosophy of technology cannot be reduced to *The mode of existence*, since the philosopher continued to elaborate, modify and expand the ideas presented in that seminal work.

In the fourth part of the 1968 course, Simondon outlines a classification that is identical to the 1971 lecture, where he explores some continuities between his *The Mode of existence* and Lafitte's *Réflexions*. According to this new classification, technical individuals are subdivided into *passive* technical individuals [objets techniques individualisés passifs], *active* technical individuals [objets techniques individualisés actifs] and *informational devices* [les dispositifs à information]. It is noteworthy that in this course Simondon also included, in line with Lafitte, architectural structures as a type of technical individual, something that he had not taken into account in *The Mode of existence*.

However, in *The mode of existence*, we can recognize some Lafittean terms, such as genesis [*genèse*] (1972: 103): "from the criteria of genesis we can define the individuality and specificity of the technical object: the individual technical object is not this or that thing given hic et nunc, but that of which there is genesis" (2012: 20). Simondon also includes the notion of lineage (2012:40) to explain the phenomenon of convergence: "Why, having an infinite variety of human practices in relation to production and uses, do artificial objects evolve towards a small number of specific types?" (2012: 24). In line with these reflections, Simondon rejects the criterion of social use to establish a taxonomy of technical objects. In this ontology of lineages, Simondon shares Lafitte's view that every artificial object, belonging to the higher classes of machines, does not exist as an individual object, but as the crystallization of all the features of its technical ancestors; what Simondon calls the *technical object*. The more real the artificial object is, the more it owes its mode of existence to an evolutionary process, and less to a specific designer or intention. In Simondon's genetic and processual view, nature, the human, and technology are marked by different regimes of individuation. Concretization is the specific regime of individuation proper to technology, a process of functional and structural convergence in which a technical object progressively gains complexity by "informing" itself.

Generally, Simondon's approach can also be reconstructed in terms of the three theses outlined earlier. Simondon also defends an ontological specificity of artifacts based on their mode of individuation; if anything, Simondon's account introduces more dynamic modes of self-causation in which internal structures unfold and give rise to new internal dispositions. In terms of the epistemological thesis, both thinkers promote a similar view of technical knowledge, as derived from internal structures and empirical observation, and requiring its own specific mode of inquiry (the machine as locus of physical process, to which the machine cannot be reduced). There is something in the machine (and the technical object in general) that exceeds human knowledge, in the manner of a "natural" phenomenon (Lafitte, 1972: 30; Simondon, 2012: 35, 42, 54).

Finally, both Laffite and Simondon are concerned with the role of machines in sociotechnical complexes, as integrators of human activity. The human–machine relation is a two-way process in which machines are modulators of human activity and, in turn, humans are like the orchestra conductors of the machine ensemble: the human is "the permanent coordinator and inventor of the machines around him. He is among the machines that operate with him" (Simondon, 2012: 11–12) and acts as the interpreter of human–machine dynamics, "the sociologist and psychologist of machines, because he lives in the midst of a society of technical beings of which he is their responsible and inventive consciousness" (Simondon, 2012: 13).

The human being is an operator (rather than creator). He is an operator not just in terms of human–machine relations, but also between the machines themselves, between them and the natural environment and between their internal elements. This supposes an ontology that is not anthropogenetic, but technogenetic. As Bernard Stiegler writes in the context of industrial objects, for Simondon"the industrial technical object, although being realized by humans, nevertheless results from an inventiveness that comes from the technical object itself" (1998: 67-8, emphasis in the original).

Why didn't Lafitte's ideas find a larger audience? According to Thibault and Hayward (2017), cybernetics was an important obstacle to the acceptance of Lafitte's ideas. To begin with, the notion of machine undergoes an important conceptual change with the distinction that cybernetics makes between energy and information. Unlike Lafitte's energy-based machines, cybernetics focused on computing machines and other complex calculating systems (Thibault & Hayward, 2017: 457). However, from a certain -perspective, Lafitte can also be considered a precursor to cybernetics. The notion of "reflective" machine (devices that regulate themselves in relation to the environment until achieving stable operation) already incorporates the notions of feedback and homeostasis, central to the first wave of cybernetics.

Simondon took these insights into another direction, developing concepts such as metastability, circular causality, and associated milieu to account for the way machines become proper technical individuals. Although it is true that notions of information and communication are absent from his scientific horizon, Lafitte applies the language of organization and inheritance in analogy with the life sciences, at a time when the concept of information was not fully grounded in the study of genetics.

Starting in the 1940s, cybernetics presents itself as a general theory of machines that would eventually also be concerned with human–machine relations; specially in the lost-war period, where thinkers such as Norbert Wiener (specially in *The human use of human beings*, first published in 1950 [1989]) extended the scope of cybernetic thinking to social systems, and the ethical and political aspects of human–technology relations.

In his *An introduction to cybernetics* (1999), W. R. Ashby claims that cybernetics provides a new concept of "machine", as Guchet has pointed out, it is not a theory about certain objects (i.e. machines), but a mathematical formalism about how these objects behave, independently of their materiality. Cybernetics "is not interested in real machines but in classes of machine classes, in logical classes defined by possible behaviours and not the behaviour of this or that individual machine" (Guchet, 2017: 71). Both Lafitte and Simondon are not that concerned with this kind of logical-mathematical approach, and choose a more qualitative approach that departs from empirical observation (for example, of technological linages, such as Simondon's lengthy discussion of the diode and its successors). In Marrat's words: "This bottom-up approach is dedicated to capturing the phenomenal existence of machines, not a final idealized form" (2021: 206).

Cybernetics was interested in the identification of informational patterns within systems. The last crucial difference between Lafitte and cybernetics was their posture towards humanism. While for Lafitte the machine is an extension of the human, mechanology upholds a distinction between human intentionality and machine operations, and this is why, according to Thibault and Hayward, we are in the presence of an "extended humanism", while cybernetics tends towards posthumanism (Thibault & Hayward, 2017: 457). However, in certain versions of posthumanist theory (for example, in Rosi Braidotti [2013]), we find references to the notion of *zoe*, or "life", that echo the general spirit of the *Lebensphilosophie,* to which, as we have seen, Lafitte makes reference. This life principle or force is an aspect that precedes the constitution of the natural-artificial division and flows through and across all forms of organization (living and nonliving). Lafitte's remarks in his *Reflections* clearly sketch the co-constitution thesis, central to posthumanism: the thesis of a "technogenesis" (Stiegler, 1998: 26–27; Hayles, 2012):

> Without man, no machine; no man without machine… Just as earth and water form rivers, each continuously conforming to the other, from primitive times, mechanical structures and social structures have composed … through time, the course of our destiny, have woven the networks of our human life. (Lafitte, 1972, 119)

In the light of these observations, it is not that far-fetched to imagine a form of mechanology that could have survived and adjusted to the culture of cybernetics (and, indeed, posthumanism). The spirit of Lafitte's mechanology and organology lives on in the work of later thinkers, and it is time he is given his due place in the history of the philosophy of technology.

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