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Dossier Georges Canguilhem

Charting Links between Life, Science, and Technique: Georges Canguilhem and Lucien Febvre

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Abstract:

The article explores theoretical convergences between the work of Georges Canguilhem and Lucien Febvre on the theme of science and technique. In comparing the scholarship of both authors from the 1920s through 1940s, we endeavor to show that their critique of mechanistic determinism was rooted in the concept of the genres of life (not only human) and its creative interaction with the environment.

Keywords:

Technique; genres of life; *Annales*; Georges Canguilhem; Lucien Febvre

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Introduction

The work of Georges Canguilhem, philosopher and historian of science, has been the object of serious reevaluation in recent decades. Initiated in 2011, the publication of his complete works has shed light on the shaping and linkages of an extensive oeuvre that had been hard to access, especially prior to 1939. A trenchant writer, during his long life he did not write books but mostly papers, an outliving scholarship that stretches from the period between the two world wars through post-holocaust reconstruction, existentialism, structuralism, and the protests of May 1968. Interpretations that assign Canguilhem's work to the realm of epistemology can now be viewed as unsatisfactory and incomplete.

Working with archives and primary sources, as well as interviews, news reports, and other observations by Canguilhem himself, three researchers – Camille Limoges, Jean-François Braunstein, and Vázquez Garcia – identified a dialogue between Canguilhem and the Strasbourg circle. Vázquez Garcia (2016) investigated the matter in depth and asked if there might not be a subtle relationship between the French history of sciences and the school of the *Annales d'Histoire Économique et Social*. Obscure, complex, and fragmented, not much is known about the former. Maimed by the death of Jean Cavaillès, the field would head in even

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more unexpected directions with Michel Foucault and Michel Serres. The *Annales* school is firmly recognized for its profound historiographic renewal, but it never intersected with the French history of sciences. In reaching his conclusions about this absence of any encounter between the two, Vázquez García thoughtfully portrayed the current evaluation: random observations by Foucault, who is recognized as a disciple or associate of Canguilhem's; observations by historians of philosophy; debates over French intellectual history in recent decades; and considerations by the latest generations that branched out from the *Annales*. He leaves us with the presupposition that these two movements, centered on the investigation of history, were mutually unaware or uninterested in each other. However, the exception lies precisely in Canguilhem, who maintained personal relationships with Maurice Halbwachs and Georges Friedmann, as Vázquez García ascertained in his documental research. We know that Canguilhem frequented the same Strasbourg circle as Marc Bloch and Lucien Febvre, although he began teaching at the *École des Lettres* (which moved to Clermont-Ferrand) only in late 1941, by which time Bloch and Febvre had gone back to Paris. Both movements were also influenced by a number of the same scholars, such as Vidal de la Blache, François Simiand, Henri Berr, and Lucien Lévi-Bruhl, not to mention the French school of sociology.

A quarter of a century ago, Roberto Machado, one of the first commentators on the relationship between archeology and epistemology, asserted that Canguilhem's work presented a remarkably homogeneous reflection on life that, thematically speaking, focused on what the "partisan philosopher" called the "history of life sciences". Machado also affirmed that Canguilhem's goal was the "evaluation of scientific rationality; in short, a judgment regarding scientificity" (Machado 1982, 17). For the first time, this valorization of Canguilhem in Brazil, and likewise in France, evinced his important role in the formation of the issue of knowledge in Michel Foucault's archeology (Machado 1982; 1988). On the other hand, Machado's interpretation might have overlooked the philosophical and historical provenance of the concept of living being (*vivant*) in Canguilhem's work—nothing unusual for the time. In these pages, we argue that life's dynamic normativity, sprung from vitalist roots, guides and interweaves a good share of the author's epistemological reflections on the complex relationships between nature and art, science and technique.

As to Febvre and Bloch, it is worth noting that there has been a major rediscovery of the theme of technique (technology and applied science) in the historiography of the *Annales*. Pamela Long wrote:

[...] seven years after founding their journal, Bloch and Febvre published a special issue titled *Les techniques, l'histoire et la vie*, a collection of empirically based articles, criticism, and prescriptive and programmatic statements. It is a landmark in the historiography of technology. (Long 2005, 178)

Their goal was to fill a gap they could identify as editors in a subject until then neglected by historians. This endeavor encompassed investigations into feudalism, medieval man's relation to the land, the Taylorist assembly line, and the issue of labor and tools. A marked reliance on economic archives in the realm of production seems to have cast special light here. François Dosse delineates the initiative, pointing out that:

They endeavored to adapt their historical approach to the technical, technocratic era of the 1930s in order to prove useful to the economic decision-making centers. It was thus that Bloch and Febvre surrounded themselves with leaders from the international administrative hierarchy and business world. (Dosse 1985³)

³ All citations in French without any English published translation have been translated by the authors from the original text.

It should be underscored that technique was a pioneer issue in the *Annales*, less as something novel and much more as a first effort to address its challenging incorporation in the field of historiography. In the words of Bertrand Gille:

In the *Annales* of 1935, Lucien Febvre and Marc Block do not appear to have just discovered the history of techniques, but rather they were emphasizing the interest of the subject, and the little attention paid to it by historians. This does not mean that it had been completely neglected until this point, but by its very nature it was placed outside the main body of history. It was as difficult to integrate technical history into history as a whole as it was to integrate the techniques themselves into a general economic theory, to take but one example. Lucien Febvre clearly discerned that there was a conflict of spheres. (Gille 1986, 3)

In addition to Gille and Long, other scholars of technique, like Pestre and Edgerton, have stressed the unique nature of this project, as well as its pertinence and prestige (Edgerton and Pestre 1998; Gille 1978; 1979; Long 2000; 2010; Pestre 1995).

We offer the hypothesis that this very specific field of the *Annales* historians was to play a pervasive yet relevant role in Canguilhem's work, influencing his choice of research questions and how he linked them. We call special attention to his notion of "techniques of the living being", which was clearly laid out when he addressed medical therapeutics as a vital technique, starting in 1945. In agreement with Braunstein (2000), we recognize the strategic importance of technique in Canguilhem's thought and seek to identify something common to both projects, shared semantic fields as it were, an argument that gains plausibility through contact with intercessors (places, people, texts). Neither Machado, Cristina Chimisso, nor François Delaporte emphasized technique in Canguilhem's work, probably due to the difficult access to "Canguilhem before Canguilhem". It must be underscored that Rheinberger (2005) and Méthot (2013) – besides Braunstein (2000) – also acknowledged the question of technique in their investigative approach. The cultural roots of concept and techniques is discussed but a proper problematization of the *Annales* is still lacking.

The last text published by Michel Foucault himself explains Canguilhem within a brief history of contemporary French philosophy (Foucault 1985). There are no traces of any discussion of the topic of technique in Foucault's arguments. However, while this matter was not of direct interest to him, it is evident that his remarkable concern with the "materiality of discursive techniques" and "power technologies" tied his genealogical project to his former PhD advisor. Foucault talks repeatedly about political body technology, truth technology, self techniques, and life techniques. As Peter Dews has in fact suggested, "Canguilhem has also influenced Foucault through his interest in the social and technical conditions which intervene in the history of the sciences" (Dews 1992, 10). This lends broader scope to an examination of the relationships between the historiography of the *Annales* and the history of life sciences through a historical and philosophical problematization of technique.

Therefore, the examination of the relationships between the historiography of the *Annales* and the history of life sciences through a historical and philosophical problematization of technique lends broader scope to our subject.

We would like to emphasize that Canguilhem's analysis of scientific discourse, which the French philosopher understood to be processual and historical, centers on conceptual interrelations and thus on intellectual context and notions of discontinuity and recurrence. This reflection conjoins two issues: on the one hand, the relationship between life and norms and, on the other, between life and knowledge. Here life is not only a concept but primarily a philosophical question. This requires a distancing from late nineteenth-century Germanic

philosophies of life (*Lebensphilosophien*), as well as from the positivist or physicalist solutions derived from Auguste Comte in the first quarter of the nineteenth century and acknowledged by Canguilhem's mentor, Alain (Émile Chartier) (Bianco 2009).

Focusing on Canguilhem's early approach, dating from the 1930s through 1950s, we highlight how he sought to redefine the scope of narratives regarding scientific knowledge and their technical dimension (of the living being and life) within the academic debate. Canguilhem calls for a project of the history of the life sciences, defined by strict boundaries and conditions of possibility, that is, a history of the living being, which poses life as a question. Knowledge and technique inaugurated the reflexivity of the living being grappling with life, rather than constituting elements of a philosophy of the subject or of consciousness appended ad hoc. This epistemological and historiographic project was entirely new, concentrated on a conception of life and knowledge as correlates, and it renovated and reshaped the project of a philosophy of life.

Canguilhem chose a number of interlocutors, in addition to the first generation of the *Annales*, to engage in the dialectical construction of his main theses. Let us remember the intellectual context that shaped this generation from Strasbourg, which encompassed sociologists, ethnologists, economists, and geographers. Although relevant, the philosophical realm lies well outside the scope of this paper. It must only be noted that Canguilhem was a disciple of Alain, like Simone Weil; that he and his generation were fascinated by Bergsonian philosophy; and that he was a contemporary of Sartre, Aron, and Nizan, among others. In-depth studies of Kant, Hegel, and Marx were institutionalized in France, and his generation would live out the decision to embrace or reject phenomenology and its developments. The weight of Merleau-Ponty, Ludwig Binswanger, and Eugen Minkowski's phenomenology must of course be recognized in *The Normal and the Pathological* (Canguilhem 1991), albeit circumscribed to issues of perception, psychology, psychopathology, and psychiatry.

The discussion of life as technique certainly requires one to address Nietzsche's philosophy (within the specific framework of how it was received in France), along with Bergsonism, as read by Canguilhem. Moreover, the discussion also depends greatly on layers of interpretation of Darwinism, something else that lies outside the bounds of this paper. Given that the whole of Canguilhem's work has been the object of broad, thoroughgoing analytical investigations, the present paper limits itself to pinpoint the debate over the relationship between human life and technique in the French intellectual context of this particular time.

Philosophy of science kept its distance from the emerging field of technique. On the one hand, we must remember the enormous, unexplored legacies of Pierre Duhem and Émile Meyerson within the history of physics and, on the other, the deep schism between continental philosophy and the *Wiener Kreis*, devoted to a unified, propositional-semantic science or logico-mathematical formalism. A biographical fact relevant to the debate within the history of science was Canguilhem's meeting with Jean Cavailles, which guaranteed the former a road into the teaching of philosophy.⁴ Cavailles was quite close to Canguilhem and was a major partisan leader.⁵ As the author of a singular epistemological renewal, he was a mathematical philosopher concerned with math history and "mathematical becoming", who persistently problematized mathematical institutionism and constructionism while keeping to a formalist path. His (unfinished) approach earned him a place among French philosophers who were discussing mathematics, logic, and physics before WWII. Understanding mathematics to be a science independent from logic, he reserved a special place for

⁴ Canguilhem would take Cavailles's post as professor of philosophy at Clermont-Ferrand.

⁵ Bloch, Halbwachs, Wallon, and Cavailles died as heroes of the resistance, while Canguilhem, Friedmann, and Lautmann occupy even more notable places in the pantheon of Resistance fighters than Jean Rouch, Dina Dreifuss, or even De Gaulle (Sartre, Beauvoir, and Lévi-Strauss being their almost diametrical opposites).



technique. Remarking on the crisis in mathematics, he recognized mathematicians for abandoning “the hope of grounding arithmetic and analysis in a purely logical notion”, while he also hailed them for “the effort through which they transformed a philosophical conception of mathematics into a mathematician’s technical problem” (Cavaillès 2012, 491).

The project *Sur la logique et la théorie de la science* – a posthumous publication rescued from a Gestapo prison by the Resistance and published by Canguilhem himself in 1946 – seems to have permitted a certain distancing from phenomenology and a complete rupture with logical neo-positivism.⁶ This premise aside, we can note that Cavaillès’ archeology still endeavored to engage with Husserl’s “origin of geometry”. This was possible through a re-reading of Kant’s transcendental logic via Ludwig Bolzano and via Cantor’s and Frege’s set theory (Cavaillès 1997).

The intellectual climate of the 1930s echoed the disillusion of the 1920s, deepened by the capitalist crisis of overproduction and the great economic depression (Ory and Sirinelli 2002). As an outgrowth of the paradoxes fostered by the mechanization of productive processes and the dissemination of technological products in daily life (which engendered both positive expectations and frustrations), this newfound sensitivity may account for the emergence of the theme among historians and philosophers alike. Bloch, Lefebvre des Noëttes, Guilleux la Roërie, Friedmann, and Febvre were among the pioneers of these breakthrough approaches in France, as were Lewis Mumford and others in Great Britain (Goff et al. 1990). For its part, rural history drew French researchers closer to Polish historians, such as Franciszek Bujak, Jan Rutkowski, Geremek, and Kula, in the realm of land-use and agricultural labor techniques (Geremek 1986). A historiography of technique emerged during this same period, exemplified by the journals *Blätter für Technikgeschichte* (Vienna, 1932); *Recueil Annuel des Travaux de l’Institut d’Histoire des Sciences et des Technique de l’Université de Paris* (1934); *Annales d’Histoire Économique et Social*, first released in Poland in 1931 (with the support of Bloch); and *Archives of the history of science and technique*, launched in Leningrad in 1933⁷ (Gama 1985, 3-4; Gille 1990, 580). Focused on this same era – during which the image of progress reflected in the mirror was irremediably shattered – exploratory works ranging from Arthur Vierendeel, in *Esquisses d’une Histoire de la Technique* (1921), through André Ducasses, *Histoire des Techniques* (published in 1945 as part of the collection *Que sais-je?*), reveal the dynamic nature of the topic, which by then had reached the public at large.

After the Nazis took power in 1933, anti-Communism and anti-Fascism became the benchmarks of European political engagement. In 1934, against this backdrop, Georges Friedmann published *Problèmes du machinisme en URSS et dans les pays capitalistes* (Friedmann 1935). The book was well received by the editors of the *Annales*, who had parted ways with the circle of ideologies hostile to rationalization and the intensive use of machines in factories. In a laudatory review, Febvre noted that, in contrast with the prophets of the soulless world who viewed technique as a cause of moral and intellectual decay (Henri Bergson, Georges Duhamel, Oswald Spengler, Gina Lombroso), Friedmann argued that the essence of the problem lies in the use of technique in capitalism, where “the products of thought turn against men rather than serving them” (Febvre 1934, 398). From 1933 to 1934, the *Cercle de la Russie Neuve*, founded in 1932 by a group of Sovietophile intellectuals, brought mathematicians, astronomers, biologists, linguists, psychologists, historians, and philosophers together to compare the status quo of these sciences in the USSR and Western countries. Praising the initiative, Febvre noted the affinities between the project of the *Annales* group and these French Marxists’ view of the fragmented way in which the field of

⁶ Cavaillès attended the Davos seminars, along with Levinas, among others, and there met Rudolf Carnap. Cavaillès’ opposition to logical neo-positivism mirrored Canguilhem’s own: both men deemed as inappropriate this degree of hostility towards the metaphysical tradition, especially given its subsequent replacement with a “metaphysics of physics”.

⁷ *Архив истории науки и техники* (Archive of the history of science and technology).

Western science was organized (that is, grounded in biases about schools, sectarianism, and career considerations), while he also called attention to the vast methodological problems raised around a common theme: science and technique (Febvre 1935a, 615-23).

Some authors were tightly associated with the philosophical and historical interrogation of technique. Not only did Friedmann question the limits, dangers, and specificity of technique from a Marxist perspective; we can further identify a deep Heideggerian interrogation (“Frage nach der Technik”, for example), along with a third project, focused on the ontology of technical objects, represented by the work of Gilbert Simondon, who was in fact Canguilhem’s student.

“Techniques, History, and Life”

Our intention is to explore convergences surrounding the theme of science and technique. The title of this section has been lifted verbatim from the 1935 *Annales* dossier that was dedicated to reflections on the history of techniques. The dossier presented a set of theoretical and methodological problems, alongside some monographic studies on the development of certain technologies. Marc Bloch’s famous study on the advent of watermills was published in this issue, as well as studies on vessel rudders; Taylorism; the forge and metallurgy; the origin of cultivated plants; harnesses, horseshoes, and yokes for traction animals in Antiquity; and ogives in Gothic architecture.

The issue is considered a veritable research program. In his brief introduction to the dossier, Febvre offers methodological considerations on the meaning of a history of techniques, laid out in three parts. He begins by linking the notion of technique to the idea of human labor in general, that is, to tasks, activities, and ways of proceeding employed by each trade, occupation, or industry in different eras. His focus is on both the “‘workers’, in flesh and blood, or [tools,] in wood or metal: men or machines” (Febvre 1935, 531). The underlying proposal was to foster an inventory of tools and machinery and the ways they are used and manufactured, through an interdisciplinary approach that called on the expertise of technicians, historians, and ethnologists. And since techniques, like tools, are lent or borrowed, and because secrets always come to light, no matter how well locked up, Febvre felt that the historian should follow them “on their journeys through time and space” (Febvre 1935, 531). Pamela Long also points out that, paradoxically: “This history of techniques must be written by technicians”, yet “even a ‘technical history of techniques’ must be grounded in an understanding of the general conditions (social, economic, political) within which they were used and transmitted” (Long 2005, 178). In a way, the methodological demand made by the new program born in Strasbourg was fulfilled quite precisely by Canguilhem, who obtained his degree in medicine and qualified himself by writing “*Essai sur quelques problèmes concernant le normal et le pathologique*”, a veritable textbook of axiological philosophy (or perhaps history of science), disguised as a concluding medical thesis.

Febvre’s second methodological consideration, related to discontinuity in the development of techniques, bears a resemblance to the Canguilhemian approach in two ways: first, Febvre hesitates to conceive of the history of technique as evolution in the sense of kinship and ongoing refinement. He sees “progress” in the realm of technique as the result of both an amassing of small discoveries and a series of abrupt changes, revolutions that generate radically new situations (Febvre 1935, 532). What matters to the historian is being equipped “to understand the progress of techniques, both their incremental transformation and the precipitous changes or ‘revolutions’ that create radically new situations” (Long 2005, 179). This problem involving discontinuities in knowledge, so dear to Canguilhem, translates immediately into the problem of the relationship between theory and practice, which both authors saw as a major issue. Febvre expressed this second sense as “the problem of science”: “to what extent – certainly varying according to era and technique – do the creation or modification of tools and the development and transformation of procedures depend

either on chance (or on what has come to be called mechanical necessity), or on a strictly technical chain of causes and effects, or on a set of advances that are scientific per se?” (Febvre 1935, 532). When Febvre developed his thoughts on the relationship between science and technique, he rejected any single meaning or causal determinism. He believed that the “problem of science” unfolded at different levels: from cause to effect, from effect to cause, wherein time, moment, and opportunity each played a substantial role. Blending concepts from Marx and Cournot, he conjoined the material contexts needed to solve technical or scientific problems, a necessary but not sufficient condition for discovery, because scientific consequences only come about if chance crosses paths with a prepared human spirit.

It should be underscored that Febvre labeled himself a critic of the self-image of Western science, which he felt was neither as pure nor as disinterested as its spokespeople liked to proclaim. The irrefutably temporal and utilitarian goals of Western science, imprinted on French science institutions like the *École Polytechnique* and *École Normale Supérieure*, revealed how the actions of the State were grounded in practical needs. In his review of *À la lumière du marxisme* – a collection of contributions from the scientists who took part in the event organized by the *Cercle de la Russie Neuve*, mentioned earlier – Febvre seconded a number of the concepts defended by Henri Wallon in the book’s introduction, especially regarding relationships between science and technique: “We shouldn’t believe in easy games – here, technique; there, science; between the two, the tough cable of unidirectional causality”. Therefore, in addition to endorsing the proposition that “technique and science are merely two notions, between which human activity establishes a back-and-forth”, he shared the ideas (“so close to the ones I support”) that saw in man “the craftsman who, in transforming his physical environment, likewise obliges himself to transform the social environment – and thus transform himself” (Febvre 1935a, 618). The view that science and technique enjoyed marked autonomy was pertinent to the first generation of the *Annales* and highly influential in the French social sciences of that day. The relative independence of each complicates the task of studying their relationships. The history of the life sciences in fact gains meaning through this dimension, rejected in the Anglo-Saxon world for a variety of reasons.

Equally important are Febvre’s thoughts on the contribution of Georges Friedmann, who advocated a Marxist approach to the mechanization of work, evincing the role of human will in history, in contrast with the “fatalism of a history that unfolds automatically, without the intervention of human will – men finding themselves purely and simply manipulated by economic conditions, like pieces on a chess board” (FEBVRE 1935a, 619). Evident in both views are echoes of the Vidalian concept of genres of life (*genres de vie*),⁸ as conceived by Febvre, with a rejection of the mesological determinism of life in general and especially of human life, as we will discuss later. It should also be noted that the 1935 *Annales* dossier included a biographical sketch of Taylor, along with comments on his contribution to the scientific organization of work, written by George Friedmann. This Marxist philosopher would publish his findings on the problems of the technical rationalization of work and machinism in *Les problèmes humains du machinisme industriel* (1946), lauded by Canguilhem in his thoroughgoing review (Canguilhem 1947).

Febvre’s third and last analytical consideration derives from a theoretical presupposition dear to the Strasbourg historians, to wit, the conception of a general, or

⁸ The term “genres de vie” should be envisaged as a pregnant concept. It has been translated as “ways of life”, “types of life”, “modes of life”, “forms of existence”, and even “lifestyle”. In this text, it has been consistently rendered as “genres of life” not keeping with “ways of life”, in the 1925 translation of Febvre’s *La terre et l’évolution humaine*, entitled *A geographical introduction to history*. Although the French word “genre” means both gender and genre in English, we believe that the second one keeps the original polysemic array that Vidal de la Blache and Febvre foresaw, such as: biological, philosophical, linguistic and literary.

integral, history that presupposes that technique is subject to the influences of other human activities, with which it interacts. This means that “each era has its technique and each technique displays the era’s style, a style that shows to what extent everything is entwined and interferes in human facts” (Febvre 1935, 533). According to Febvre, whether responding to the needs of religious, artistic, political, military, or any other social group, techniques are human works meant to satisfy many other human needs in a given era. The problem with general history, understood as a totality, is thus made clear, as is the problem of man or of anthropology. This program is meant to be organic and subsumed to a single unit:

These three approaches to a history of technology – the technical history of techniques, the study of both incremental and revolutionary change, and investigation of the relationships of techniques and other human activities – must be inseparable and “perfectly united”. (Long 2005, 179)

Amidst this effervescence, Canguilhem, in an article published in 1937, convokes Cartesian philosophy to intervene in the reigning dispute between science and technique. We should bear in mind the political and intellectual path that led the philosopher to address the matter of technique. As we well know, two things caused Canguilhem to distance himself from his mentor Alain, and also from Jules Lagneau, in the mid-1930s. His rejection of pacifism tightened his ties to the committee of anti-Fascist intellectuals and made him a supporter of peasant struggles, stances taken earlier by Bloch and Febvre. According to Braunstein, Canguilhem viewed Alain’s “integral pacifism” in the face of Germany’s advancing Nazism as both a political mistake and a philosophical shortcoming. Braunstein also argues that it was Canguilhem’s opinion that Alain was absolutely hostile to history: “against the historical spirit, he [Alain] believes in human nature, in Eternal History” (Braunstein 2000, 15). Embracing the same explanation for the split between mentor and disciple, Giuseppe Bianco argues that this political and philosophical distancing fit into a broader framework of transition from one philosophical sequence to another. Canguilhem questioned “both the anthropology of Alain (his theory of knowledge and his physiology) and his sociology (his theory of society and its transformations)” (Bianco 2009, 129). For his part, Renzo Raghianti (2012, 69) presses home the notion of a slower yet quite profound political and ethical distancing, while Georges Navet steers clear of a similar interpretation as he looks for bridges between pacifism and resistance (Navet 2012, 82-83). As stated earlier, Canguilhem was in line with Bergson in this theoretical regard. According to Braunstein, it was Bergson who furnished him with the arguments against the “veneration of facts” and “rejection of values”, arguments borrowed earlier from Alain. As a veritable antidote to Descartes, the key contribution of Bergsonism was the development of a biological philosophy of mechanism, which saw machines as organs of life and laid the foundations of a general organology (Braunstein 2012, 98). Correspondingly, Cartesianism provided an opportunity for an in-depth discussion of the machine and mechanism.

Thus, in *Descartes et la technique*, Canguilhem – the young professor of philosophy who had taken over Alain’s post in Toulouse – asked what possible contribution the 16th century thinker might make to the contemporary theoretical debate: “Is technical activity a mere extension of objective knowledge, as has become the common view, based on positivist philosophy, or is it the expression of an original, essentially creative ‘power’ for which science would subsequently devise a development program, or a cautionary code?” (Canguilhem [1937] 2011, 491). Here Canguilhem was endeavoring to demonstrate the direct yet nuanced way in which the author of *Discours de la Méthode* approached the phenomenon of technique. According to him, theory takes precedence over practice in a good share of Cartesian formulations. However, in *Dioptrique* (1637), we can note an awareness of a relation between knowledge (theoretical) and construction (technique), by which the former depends on the latter. Canguilhem thus finds elements to support his idea that in Cartesian

philosophy, “science proceeds from technique not as if truth were a codification of utility [...] but, conversely, to the extent that technical dilemmas, non-success, and failure invite the human spirit to question the very nature of the resistances revealed by human art, to conceptualize obstacles as objects independent of human desires, and to pursue true knowledge” (Canguilhem 2011, 498). As Canguilhem saw it, the effort to correct and refine technique – which science seeks to govern – lies not in understanding, even if understanding endows the informed man with the means to move beyond the artisan’s practical knowledge. In his words, “technical initiative lies in the demands of the living being” (Canguilhem 2011, 498). Here we see that Canguilhem believed there were deep, inextricable links between technique and the demands of life. This idea displays blatant thematic continuity with his concluding medical thesis, completed six years later.

It should likewise be pointed out that the meaning of vitalism changed radically through Canguilhem, apparently resulting in historical reevaluations of the brands of vitalism prevalent in Montpellier and Paris. We can say that holism/organicism was reconfigured along neo-vitalist lines or into a rational vitalism (*vitalisme rationel*) following World War II. Canguilhem’s exchange with the neurologist Kurt Goldstein is not detached from a translation of the “philosophies of life” into a conceptual history of physiology, a development that played a decisive role. Although, writing in 1937, Canguilhem clearly conceived of vitalism as never reducing living beings to their physical or chemical environment (Canguilhem 2011, 294), he doubted that one could safely and wholly affirm that the analogy between thought and life “goes beyond a metaphor”. A sophisticated reflection on the problem of vitalism and mechanism is woven through his work in the same proportion that he himself believed that this antinomy weaves through the history of medicine. In his view, profound reasons underlay the insistent alternation between mechanistic and vitalist models.

Life, Technique, and Science in Canguilhem

In his concluding medical thesis, “Essai sur quelques problèmes concernant le normal et le pathologique” (1943) – undoubtedly Canguilhem’s most well-known work, as published in 1966 in an expanded version – the philosopher from Castelnaudary explains that his choice to engage in philosophical reflection on a topic specific to medicine was underpinned neither by an interest in producing a narrative of its history nor any intent to renew it through an incorporation of metaphysics, but rather by the fact that medicine provided access to “concrete human problems”. His decision to address the history of both concepts found in medicine (the field being understood as technique or art at the confluence of various sciences) quite explicitly represented an opportunity to address two problems that, as we have seen, were already present in his thought: the problem of the relationships between science and technique and the problem of norms and the normal (Canguilhem 1990, 15-17). As many commentators have noted, Canguilhem’s philosophy of life revolves around the concept of norm and, correspondingly, the concept of norm inevitably harks back to the idea of life. Life is thus the idea that the concept of norm allows one to grasp. Hence illness, understood as a symptom of a pathological state, intervenes concretely (as a matter of existence rather than of knowledge) in the relationship established between the patient’s lived experience and the physician’s art. As illness engenders normative activity, it pushes life to strive towards self-understanding. What Canguilhem does in his essay is precisely to set the organizing principle of norm against the history of its problematization.

Here philosophy is being viewed as a critical attitude that questions a fact of life, because subjacent to, yet distinct from, the scientific problem of the normal and the pathological as reconstructed down through the history of medicine is the concrete question of life as dynamic, creative normativity. As Guillaume Le Blanc (2007, 16-21) reminds us, Canguilhem held that life, in its normative relationships to environmental circumstances,



appears as the unquestioned, the un contemplated, within the art of medicine. The historical, critical construction of the concepts of normal and pathological thus becomes a method for apprehending human life. Clinical experience assesses the types of knowledge from which its applications are drawn, based on therapeutic intervention. Analogously, Canguilhem's epistemological project consists of a practical evaluation of discourses surrounding a recurrent problem. If philosophy directly introduces the question of norm, in a critical, judging attitude, it does so after life, without losing sight of the needs of life and while organizing human experience around the demand for meaning. We will see shortly how these intersections ground Canguilhem's reflections on the advent of technique.

In the introduction to a collection of his writings originally published in 1952 under the title *La connaissance de la vie* (Canguilhem [1952] 2015), Canguilhem notes that “the attention every philosophy preoccupied with the problem of knowledge gives to the operations of knowing distracts it from the meaning of knowledge” (Canguilhem 2008, xvii). There is a clue here that must be unraveled. Our author necessarily emphasizes the meaning of knowledge – such approach poses questions about science and its performance or growth, from a point of view that belongs to life itself. This understanding of the core meaning of the knowledge process poses challenging questions that cannot be avoided neither by the subject of knowledge nor by his own knowledge process as a living being.

In the years immediately following World War II, the intellectual climate opposed (scientific) knowledge to life, where the reciprocal accusation was intellectualism (the destruction of life by rational knowledge) and mysticism (life as a blind, mechanical, ignorant energy). Our philosopher rejected the affirmation that scientific knowledge destroys life. While, on the one hand, science may have proscribed empirical, sensitive experience, on the other, its goal was to abstract out reasons for employing caution, by analyzing failures. Canguilhem redefined the bases of the conflict, which he saw not as “between thought and life in man, but between man and the world in the human consciousness of life” (Canguilhem 2008, xvii). As he argues, if we enjoy “not the laws of nature [that which was decomposed, reduced] but nature itself”, not that which has been quantified, measured, and put into an equation, but rather qualities, relations, and beings, it is because “thought is nothing but a disentangling of man from the world [...] [given] the search for security via the reduction of obstacles [through] the construction of theories that proceed by assimilation” (Canguilhem 2008, xvii-xviii). In this sense – from general method to the direct or indirect resolution of tensions between man and environment – Canguilhem views scientific knowledge as an extension of human technique and art.

Canguilhem's philosophical reflection thus crosses the boundaries established in Aristotle's conception of mimesis and technique as craft or artifice. Knowledge springs from a deep concern with technique and technology, to which historiographic renewal and the Strasbourg environment made a substantial contribution, as we will see ahead. Something quite singular was explored within the relationship between thought and technique. This was a philosophy of praxis but likewise of a history of the life sciences: the technique inherent to the living being is knowledge and intelligence; it is an artifice but also a resource of life itself and, in this sense, inseparable from the experience of the living being.

Therefore, the philosophy of medicine and biology developed by Canguilhem in his oeuvre is better understood if we bear this perspective in mind, where the living being (human) endeavors to understand how knowledge modifies his relation to life. As one interpreter of Canguilhem's work has put it, “this effort to contemplate life and knowledge together is paramount to his philosophy, given that the reasons for knowing life scientifically are not related to any ideal cognitive subject placed outside of life” (Le Blanc 2007, 5). This effort is grounded in the fact that “man is here a living being separated from life by science and attempting to rejoin life through science” (Canguilhem 2008, 62).

In the following years, two essays, which appeared in 1946 and 1947, “Machine et Organisme” and “Le vivant et son milieu” (later published as chapters 4 and 5 of *Knowledge*

of Life), evinced not only the persistence but also the centrality of his concerns about the correlation between life, technique, and science, while they also revealed convergences between Canguilhem's epistemological thought and those concepts of the group he called "Febvre and his school".

In "Machine and Organism", he deals once again with the problematic relationship tying technique and science, arguing that technical phenomena are ancient, original and more fundamentally ontological than any counterparts within scientific realm. Once more developing reasoning against mechanistic philosophers' and biologists' interpretive tradition, who assumed that any problem between technique and science had been solved through machine-organism relationship. Canguilhem stands that technique should never be considered as a by-product of logical or chronological application of science. This text unfolds in three parts: first, a discussion of the relationship between mechanism and finalism; next, the history of both concepts, inverting the traditional relationship between machine and organism; and, lastly, an exploration of the philosophical consequences of this reversal.

Early in the article, Canguilhem hints at the critical path he will follow:

the problem of the relations between machine and organism has generally been studied only in one direction: almost always, the attempt has been to explain the structure and function of the organism on the basis of the structure and function of an already-constructed machine. Only rarely has anyone sought to understand the very construction of the machine on the basis of the structure and function of the organism. (Canguilhem 2008, 75-76)

Canguilhem's presentation is consistently didactic and scholarly. After defining the machine as an artificial construct whose essential function depends upon a mechanism – which is in turn "an assemblage of deformable parts, with periodic restoration of the relations between them", (Canguilhem 2008, 77), such that movement does not destroy the configuration – he stresses that living beings, and their forms (except for vertebrates), rarely display devices that call to mind the idea of a mechanism. Thus, what constitutes a rule in human industry is, for biology, an exception in the structure of organisms. Throughout the time when "kinematic mechanisms were set in motion by human or animal muscular effort [...] it was obviously tautological to explain the movement of a living being by likening it to the movement of a machine" (Canguilhem 2008, 78). Only when the action of devices such as clocks, water mills, hydraulic sources, or automatons (so revered in the 17th century) could forego muscular effort did it become possible to explain the organism through the machine. In the wake of philosopher Pierre-Maxime Schuhl (1938), Canguilhem stated that it was this set of new machines, whose energy source (engine) did not depend on direct human and animal action - condition of possibility allowing the emergence of mechanistic discourses. When taking up Descartes' writings on the human body, in *Treatise on Man* (1664), the epistemologist clarified that the construction of a mechanical model of man presumes a vital original, for the theory of the animal-machine (created by God) is a "rational reconstruction, which ignores only by means of a feint the existence of what it represents" (Canguilhem 2008, 85). It would be such because "the model for the living machine is the living itself". Aristotle's four causes are therefore preserved, albeit concealed, in Cartesian mechanics (Canguilhem 2008, 85).

This is how the mechanical model of automatons, or moving machines, would legitimate the construction of a mechanical model of the living body, including therein the human body. Animals have no souls but do have life, which consists of the warmth of the heart and of sensitivity, in turn dependent on the arrangement of the organs. That is to say, the animal-machine, by relations of pure causality, can only be explained by eliminating the very point of departure that contains a purpose. For this reason, Canguilhem denies that it is possible to oppose mechanism and finalism or mechanism and anthropomorphism. To obliterate all teleology from life, Descartes had to first reassemble it at its point of departure

(God). This mechanization of life and the technical use of the animal are inseparable from the devaluation of the animal-machine, just as Aristotle had construed the slave, turning him into an instrument and denying him (and likewise all Nature) any natural purpose.

It is also in Descartes, in his 1648 treatise “The Description of the Human Body”, that Canguilhem detects the emergence of the complete 19th century theory of automatic and reflex movements, the core of determinism. In this passage, Descartes defends the idea that, on the other hand, “the body obeys the soul only on the condition of first being mechanically predisposed to do so” (Canguilhem 2008, 86). Continuing with this reasoning, Descartes emphasizes that, on the other hand, “when all the bodily organs are disposed for some movement, the body has no need of the soul in order to produce that movement” (Descartes, 1648, cited in Canguilhem 2008, 86). In this regard, Canguilhem inverts the Cartesian equation regarding the relation between machine and organism when he holds, along with Raymond Ruyer, that machines do not produce machinery; to the contrary, they can be deemed organs of the human species. As with the oldest technical inventions, like axes and arrows, machines are organs, and organs are tools or machines. Consequently, there is no opposition between mechanism and finalism. “No one doubts that a mechanism is needed to ensure the success of a given purpose, and inversely, every mechanism must have a sense” (Canguilhem 2008, 87).

Unlike machines, where repair and upkeep require a mechanic’s ingenuity, vigilance, and surveillance, Canguilhem notes that the phenomena of self-regulation, self-construction, self-conservation, and self-repair can be observed in an organism:

In the machine, the rules of a rational accounting are rigorously verified. The whole is strictly the sum of the parts. The effect is dependent on the order of causes. In addition, a machine displays a clear functional rigidity, a rigidity made increasingly pronounced by the practice of [industrial] standardization. (Canguilhem 2008, 88)

In this sense, he observes that there is “more purpose in the machine than in the organism, since the purpose of the machine is rigid [and] univocal” (Canguilhem 2008, 89). In contrast, we observe the possibility of variation in functions, “a polyvalence of organs” (Canguilhem 2008, 89). An organism displays greater lability, less purpose, and more potential than a machine. As our philosopher painstakingly laid out in his concluding medical thesis in 1943, life is experience, improvisation, and the use of occurrences. It is tentative in all senses, and for this very reason endures monstrosities (teratological malformations). There is no pathology in mechanics, nor any distinction between normal and pathological in physics. Therefore, from Canguilhem’s philosophical perspective, explaining the machine matters less than understanding it. “And to understand it is to inscribe it within human history by inscribing human history in life, without, however, neglecting the appearance, with man, of a culture irreducible to simple nature” (Canguilhem 2008, 92).

Inverting Descartes’ mechanistic argument – which identified these same natural, physical (mechanical) principles as acting just as much on the gears of a watch as on a tree that produces fruit – Canguilhem proposes that the gears of a mechanism assembled to produce an effect (a watch, for example) are the product of a technical activity as authentically organic as a tree that is bearing fruit. This principle would be, “in the beginning, as little conscious of the rules and laws ensuring its efficacy as plant life is” (Canguilhem 2008, 92). Relying on examples drawn from archeology and anthropology, he goes on to assert that machines and instruments, in the form of crude tools, emerged before the theories that explain them. Only much later, at a given moment in human history, did the logical anteriority of the knowledge of physics regarding the construction of machines come into play. This fact “cannot and must not allow us to forget the absolute chronological and biological anteriority of the construction of machines to the knowledge of physics” (Canguilhem 2008, 92).

Based on this inflection, which affirms that the organism cannot be reduced to the machine, Canguilhem, grounded in a Kantian argument, insists that art likewise and symmetrically cannot be reduced to science. In the section of *Critique of Judgment* that analyzes teleological judgment, Kant uses the example of the watch to compare the functioning of a machine with that of an organism; he concludes that the machine has a driving force but no formative energy capable of communicating with outside matter and propagating. In the same text, the German philosopher distinguishes man's intentional technique from life's involuntary technique. Still drawing support from Kant, in a passage that reviews aesthetic judgment, Canguilhem asserts that all technique contains a vital originality irreducible to theoretical rationalization.

In completing his robust argumentation, Canguilhem goes on to list the arguments of various other philosophers (Paul Krannhals, Ernest Kapp, Henri Bergson), sociologists (Alfred Espinas, Georges Friedmann), anthropologists (André Leroi-Gourhan), and biologists (Lucien Cuénot, Andrée Tétry, Albert Vandel) in order to corroborate his notion that, unless we take into account that the earliest tools were merely an extension of human organs in movement, we cannot explain the formative movement of technical inventiveness – that is, dexterity in making adjustments and synthesis in the production process, or practical faculty, as distinct from theoretical faculty, like technique in opposition to theory. In this regard, Canguilhem takes the non-contemplatable concrete – the norm of the living being – as the foundation of knowledge.

The rationalization of techniques makes one forget the irrational origin of machines. And it seems that in this area, as in any other, one must know how to cede a place to the irrational, even and especially when one wants to defend rationalism. (Canguilhem 2008, 95)

It is precisely here in this argumentation that Henri Bergson appears, in a note where Canguilhem emphasizes that the author of *Creative Evolution* is “one of the rare French philosophers, if not the only one, to have considered mechanical invention as a biological function, an aspect of the organization of matter by life” (Canguilhem 2008, 174, note 64). And he closes his essay “Machine and Organism” by stressing that, since technique is a universal biological phenomenon (Cuénot, Tétry, Vandel), and not only a human intellectual operation, “one is led [...] to affirm the creative autonomy of arts and crafts from any knowledge capable of appropriating them [...] or informing them so as to multiply their effects” (Canguilhem 2008, 96). Taken together, these studies, according to our philosopher, made it possible to explain that “Science and Technique must be considered not as two types of activities, one of which is grafted onto the other, but as two types of activity, each of which borrows from the other sometimes its solutions, sometimes its problems” (CANGUILHEM 2008, 95). The convergence with the ideas of Febvre (not cited in this work) is obvious. The subsidiary nature of (scientific) knowledge is confirmed here, leading us to the second text, “The living and its milieu”.

The Living, its Milieu, and Febvre's Geo-History

In “The living and its milieu”, a text that is remarkable both for its theoretical breadth and for the breadth of its historical and interdisciplinary references, we will first focus on the meaning of knowledge and the relationship between life, art, technique, and science. We will then compare Canguilhem's argument regarding the meaning of knowledge and the relationship between life, art, technique, and science to the Vidalian notion of “life genres”, as presented and developed by Lucien Febvre, whose book *La terre et l'évolution humaine* is cited in Canguilhem's article. We will try to show how much both authors' critiques of

mechanistic determinism were rooted in the notion of life in general and not only human life, in a creative interaction with the environment.

Our primary interest is in the argument involving an affirmation drawn from the vast literature consulted by Canguilhem: that the environment (*milieu*) on which the organism depends is structured and organized by the organism itself, that is, that which the environment offers the living being is a function of its demands. Man does not escape this general law of living beings. As signaled earlier, the environment proper to man is first and foremost the world of his perception, “the field of his pragmatic experience, the field in which his actions, oriented and regulated by the values immanent to his tendencies, pick out quality-bearing objects and situate them in relation to each other and to him” (CANGUILHEM 2008, 118). The human world is therefore the subjective world of qualia, so that “the environment to which he is supposed to react is originally centered on him and by him” (Canguilhem 2008, 118).

Therefore, “the essential function of science is to devalorize the qualities of objects that comprise the milieu proper to man; science presents itself as the general theory of a real, that is to say, inhuman milieu” (Canguilhem 2008, 119). This objectified scientific world, without reference to the subjective human scale, is the world shared by all living beings and thus peculiar to the experience of each. Abstract scientific realism “can be applied only to the absolute universe, the universal milieu of elements and movements disclosed by science” (Canguilhem 2008, 119), where sensory data are discounted as illusions. The phenomenal reality described by science pursues universal truth as a transcendent value, yet it does not have more reality than that formed from the sensory and technical values proper to the human environment, or to the environment of the “gray mouse”.

This universe of phenomena and laws built by man – that is, in Canguilhem’s words, the science that claims “to dissolve living beings, which are centers of organization, adaptation, and invention, into the anonymity of the mechanical, physical, and chemical environment” – must be understood as “a sort of enterprise as adventurous as life”, as a human need (Canguilhem 2008, 119). Therefore:

[...] if science is the work of a humanity rooted in life before being enlightened by knowledge, if science is a fact in the world at the same time as it is a vision of the world, then it maintains a permanent and obligatory relation with perception. (Canguilhem 2008, 120)

As human production, the (universal) reality revealed by science does not resolve into the environment proper to man, who is not situated within the universal environment of chemical and physical laws. This is why Canguilhem calls for a biology and a psychology that do not submit to the spirit of physics and chemistry, just as a living being, with its adaptive and creative needs, does not mechanically reduce to a “crossroads of influences”. Herein lies the meaning of knowledge and its intrinsic relation with the technique and art of the living.

We need not insist that, in reconstructing the historical phases of the notion of environment and its uses and constitution as a category of contemporary thought, Canguilhem relied heavily on the aforementioned work by Febvre (1922) to narrate the evolution of the tradition of anthropogeography, whose source is the famous Hippocratic treatise *On Airs, Waters, and Places* and its successive appropriations by Bodin, Machiavel, Montesquieu, Buffon, Ritter, Humboldt, Ratzel, Michelet, and Taine. As observed by other authors, Canguilhem’s contact with Vidalian geography and the “Strasbourg school” occurred between 1930 and 1936. Vázquez Garcia (2016) points out that it was during this period that Canguilhem both distanced himself from the intellectualist philosophy of his mentor Alain, who “contrasted spirit and world”, and also shifted towards vitalism, understood here as a philosophy of life rather than a philosophy of the spirit. Vázquez Garcia likewise stresses that this transition was mediated by a “geo-philosophy (philosophy of the

earth), [which saw] the earth, the landscape, not as inert reality but as a product of human activity, particularly of technical activity, an idea embodied in the notion of genres of life, which refers to the set of actions through which man takes advantage of the possibilities offered by nature” (Vázquez García 2016, 43). Imbert (2015), who was also interested in deciphering the multiple circuits that drew Canguilhem toward the notion of genres of life, proposed by Vidal de la Blache in 1903, argues that the mediation of Febvre and Halbwachs was decisive, especially their use of the relationship between way of life and development of techniques: “Febvre employed it in conjunction with the notion of civilization, and Halbwachs employed it when endeavoring to distance himself from the sociologism attributed to Durkheim and to defend the geographic relativism of the norm” (Imbert, 2015).

When Febvre published *La terre et l'évolution humaine* in 1922, he took the side of Vidalian geographers in the dispute initiated by Durkheimian sociologists – Simiand, Mauss, and Halbwachs, in addition to Durkheim himself. They critiqued the Vidalians' regional monographs, deriding their inability to discern any system of causality. Febvre, on the other hand, was enthusiastic about advances in human geography, which responded to the mesological determinism present in Ratzel's anthropogeography. Although Febvre aligned with Durkheim and Mauss in their critiques of telluric determinism as a “*formule passe-partout*”, he valued the Vidalian method even more for its understanding of the geographer's role: “to grasp and reveal, at each instant of their duration, the complex relations of men, the actors in and the creators of history, with organic and inorganic nature, and with the many factors of their physical and biological environment, is the proper role of the geographer when he sets to work on human problems or researches” (Febvre 1925, 61). Unlike the social morphology advocated by Simiand, Febvre argued that “geography makes no claim to be a science of necessities” (Febvre 1925, 73). As François Dosse has observed, Febvre felt that this was the strength of geography, whose richness did not lie in a search for laws of correspondence between physical conditions and social facts: “geographers can only find possible conditions and do not intend to reach exhaustive explanations or simple causal inferences” (Dosse 2004, 117). Instead of passively adapting to the geographic environment, Vidalian human geography perceives man as a geographic factor, whose trademarks are initiative and mobility. In opting for the Vidalian notion of “possibilism”, in opposition to geographic determinism, he rejects the notion that nature is a neutral entity, for it is humanized, having been modified by man from the beginning. There is no mesological fatalism because man is a being endowed with his own activity, “capable of creating and producing new effects, in which case there is an end of determination, in the true sense of the word; and in its place we have only approximations and probabilities” (Febvre 1925, 367).

However, it must be emphasized that this conception of human life as essentially creative and diverse, characterized by the preponderance of technique in an interaction with the environment, is rooted in a broader conception of the relation between organism and environment. Referring to an anti-Lamarckian author revered by Canguilhem – the evolutionary biologist Lucien Cuénot – Febvre had this to say:

Adaptation, in the old literal sense of the word – the idea that any organism placed in a certain environment acquires, by the direct and mechanical action of that environment, characteristics which give it special advantages there and disadvantages elsewhere – this idea has had its day in the domain of science. It is not true of plants. It is not true of animals. It is vigorously combated by biologists versed in physical chemistry. (Febvre 1925, 105)

Opposing the mechanistic conception of life, which he attributed both to Darwin and Lamarck, Febvre joined with Cuénot and Bergson in asserting that living beings possess a spontaneity, an ability to create something new within an environment that remains unaltered and that “truly constitutes life, is a convenient artifice” (Febvre 1925, 366). Thus he

salutes Cuénot's theory of preadaptation, which he views as a form of vitalism that stirred a great scandal in circles of mechanistic intellectuals and scientists because it affirmed the notion of "the fruitful and by no means unscientific idea of chance" (Febvre 1925, 366).

According to the historian of the *Annales*, there was a clear analogy between life, as studied by biologists and naturalists, and human societies, because both rejected finalism. Ideas would always lie between man and his natural environment, "always creeping in and intervening". If there are no human facts that are "simple facts", likewise "natural facts" never exercise a purely mechanical, blind, and fatal action on the life of man" (Febvre 1925, 363). Ergo, Febvre insists on linking the theory of preadaptation in biology to the geographic theory of genres of life, whether its author, Vidal de la Blache, was "fully conscious of it or not", since both were fitting translations of "intellectual needs of just the same, or at any rate, of very similar character" (Febvre 1925, 367).

Currently available texts can better enlighten and instruct us about Henri Bergson, an unquestionably inescapable shadow. Bergson's primary question in *Creative Evolution* – the intelligence of life in the genitive case – was tightly connected to an interpretation of the evolution of species of Darwinist bent. This intelligence-thought, understood as an evolutionary factor, is problematized through the living continuity of the "interior milieu", organism, and geography. Canguilhem returned to this understanding of the environment throughout his writing. Recent publications (Abiko et al. 2012) have begun to focus on Canguilhem's academic commentaries about the third chapter of this singular work by Bergson. We know that these observations constituted a painstaking exegesis that informed the various courses taught by the philosopher. The meaning of Darwinist evolution, in a hostile, competitive environment, is developed through a correlation between geography (understood from the perspective of Vidal de la Blache) and organism, with Claude Bernard on the horizon. In a memorable issue on techniques, from 1935, Jules Sion's sheds light on the matter: "The history of technique bears a relationship to the physical environment. This idea, so simple, conveys the professional misconceptions of the geographer", but why, after all, flee from its truth (Sion 1935, 633)? We can suppose that this alliance between the new geography and the new history stirred innovative reflections on physiology.

Conclusion

The inversion of the relationship linking environment and living being, in which man, as a historical being, becomes a creator of the geographical configuration and thus does not know any "pure physical milieu" – which Canguilhem attributes to Lucien Febvre and George Friedmann, among others – is a fundamental component of his critique of so-called technological determinism (Canguilhem 2008, 109). As Canguilhem argues, this human environment, in which man is "subjected to a kind of determinism... of artificial creations, from which the spirit of invention that brought them into existence has been alienated" (Canguilhem 2008, 109), this new human environment was already leaving its stamp on the new environment of machinism. The living creates its own environment.

As indicated in writings by Friedmann that were published in *Annales* (Friedmann 1935), the same reversal had already occurred through the psychotechnique of engineers, emerging from Taylor's ideas. This new science was able to recognize, as a shadow – "an irreducible center of resistance, the presence in man of man's own originality in the form of a sense of values" (Canguilhem 2008, 110). The notion that man, even subordinated to the machine, cannot comprehend himself as a machine was further advanced by Canguilhem during the course of his theoretical journey, as he criticized both philosophical pragmatism and behaviorism, but this moves beyond the scope of this paper.

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