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Georges Canguilhem, the Health-Disease Transition and the Return of Organicism

Ana M. Soto[a*] *& Carlos Sonnenschein*[a]

[a] *Tufts University School of Medicine, Boston, United States of America and Centre Cavaillès, Ecole Normale Supérieure, Paris, France*

***Corresponding author:** Ana M. Soto, Email: ana.soto@tufts.edu

Abstract

The Normal and the Pathological is a remarkable book by Georges Canguilhem, originally published almost 80 years ago. It should play a much more important role in medical education and in the study and praxis of biology because of its rich and relevant approach to the knowledge of organisms. Indeed, only organisms can go through sickness and health; these states are axiological categories as they represent values. However, when it was published, the molecular biology revolution introduced the idea of genetic program and that organisms would be a kind of computer. This concept combined the naive 19th-century physicalism with the metaphor of programs and signals borrowed from mathematical theories of information. As a consequence, the main concepts of biology, such as teleology, agency and normativity—the latter, a central concept in Canguilhem's thought—were abandoned by biologists and medical doctors.

Over the last 20 years, the failure of ideas guiding the molecular biology revolution allowed for the growth of organicism, a tradition committed to the autonomy of biology and its irreducibility to physics and chemistry. These developments encouraged theoretical biologists and philosophers to re-examine the aforementioned biological concepts rejected by reductionism. Their critical work produced versions of these concepts that are now compatible with notions of scientific causality, and therefore, an opportunity to present Canguilhem's work to new generations of biologists and physicians.

Canguilhem's work advances the understanding of biological entities by introducing the axiological notion of individuality, the concept of organismal "normativity" (i.e. the capacity of organisms to create their own norms) and, related to these two concepts, the organism's propensity to make mistakes—an exclusive property of biological systems.

Keywords: Georges Canguilhem, axiology, normativity, polarity, health and disease, organicism

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Introduction

About 50 years ago, as a follow up to Monod's dictum that what is good for *E. coli* is good for the elephant, molecular biologists proclaimed that biology could finally be reduced to chemistry and physics. In short, this analogy suggested that development was just a problem of gene expression. At that time, medical students were still learning about anatomy, embryology and physiology in their basic courses. For centuries, medical students were taught to examine patients by taking a medical history and performing a physical examination searching for signs related to the symptoms that brought the patient to the doctor. Indeed, plenty of talking, observing and touching took place before the physician asked for clinical chemistry measurements, x-rays or anything else that could not be accomplished using the doctor's five senses and intellect.

Today, we are concerned about physicians' ignorance of those classical clinical skills and their current dependence on both technology that they do not fully understand and machines driven by proprietary algorithms. Since the beginning of the current century, these trends have become accentuated due to the proletarianization of biological and medical thought (Soto & Sonnenschein 2021). In addition, the failure of molecular biology to provide a causal understanding of disease (in fact, most diseases are due to a constellation of "causal" factors) has led to the introduction of what was initially called "personalized medicine" and then "precision medicine", terms that imply that the "old" way of practicing medicine was neither personal nor precise. Those topics are based on the collection of "big data", namely, genome sequencing, transcriptomic analysis, epigenomics, and additional "omics".

Pragmatically, however, "big data" has not helped to improve medicine. To the contrary, technological tools have not replaced the knowledge that physicians usually gathered during a traditional clinical examination. For example, new tools such as a handheld ultrasound, which was proposed to supplant the 200-year-old stethoscope, have been shown to compromise the accuracy of diagnosis of certain heart conditions (Fuster 2016). This impoverishment of medical competence needs to be corrected. The situation goes hand in hand with the theoretical impoverishment that has been affecting biology in the last century. Canguilhem's contributions to the epistemology and history of biology are even more relevant today than they were at the time of their publication, because they could correct the harm caused by almost a century of dominant reductionist thinking in the biomedical sciences.

1. Canguilhem, Both a Philosopher and a Physician

Canguilhem's work has recently been introduced into the English-speaking world by translations and commentaries of his work. Michel Foucault succinctly described his place in French philosophy in the preface of Canguilhem's, *The Normal and the Pathological*, as follows:

> "... take away Canguilhem and you will no longer understand much about Althusser, Althusserism and a whole series of discussions which have taken place among French Marxists; you will no longer grasp what is specific to sociologists such as Bourdieu, Castel, Passerson and what marks them so strongly within sociology; you will miss an entire aspect of the theoretical work done by psychoanalysts, particularly by the followers of Lacan. Further, in the entire discussion of ideas which preceded or followed the movement of '68, it is easy to find the place of those who, from near or from afar, had been trained by Canguilhem" (Canguilhem 1991, p. 8).

In France, the recent publication of his *Oeuvres completes* is facilitating the work of those who, like us, want to know more about the genesis of the ideas developed in his books.

The Normal and the Pathological is based on Canguilhem's medical doctoral thesis. In the introduction to the first edition, he explains that on the one hand, "philosophy is a reflection for which any foreign matter is good", which implies that the author's interest in medicine was more speculative than professional. On the other hand, he also stated that:

> "Two problems that occupied us, that of the relationship between science and technology, and that of Norms and the Normal, seemed to us to benefit, for their precise position and clarification, from a direct medical culture" (Canguilhem, 2021).

Indeed, his interest in medicine was already evident in 1929, as illustrated by a commentary he wrote on Dr. René Allendy's book, who contrasted "analytical

medicine" (dealing with diseases) with "synthetic medicine" (dealing with the patients and their individuality). In that article, Canguilhem declared:

> "The human body is doubly individuated. It is so as a living being, like any animal; but it is so—and how much more so—as a human being, that is to say inseparable from a mind, from a personality. It is such a person that the doctor must save, and undoubtedly the Humanity in each one. But it is this humanity, in no way abstract, that makes his suffering, his ailment different from those of a dog, of a horse … since they are animals and they do not think" (Canguilhem, 1929).

This comment already showed a concern with the fact that medicine must deal with the sick rather than with diseases, and that the sick are individuals. From this perspective it follows that the sick go to the doctor when they feel ill, again stressing the fact that health and disease are values.

Canguilhem studied medicine amid the German occupation of France during World War II. The school of medicine of Strasbourg had moved to the *zone libre* and continued its activities in Clermont-Ferrand. Canguilhem recognized the influence its faculty had on him. His professors had a philosophical formation that permeated their medical teachings. His medical thesis, later published as *The Normal and the Pathological*, is not only about a medical problem, but also about the very foundations of biology and biological individuality. It addresses some of the fundamental problems in biology that make this discipline different from physics.

2. The Normal and the Pathological

About two centuries ago, Xavier Bichat bluntly stated that, unlike biological entities, planets do not get sick. This truism meant that biological sciences must approach their objects of study in a different way than the one that made Newtonian physics the pinnacle of science up until the end of the 19th century. Canguilhem's central contribution to the understanding of this difference was his conception of health and disease as axiological categories, *i.e.* vital values that cannot be reduced to mere scientific entities. From this, he proposed an axiological conceptualization of individuality.

Axiology and medicine

Axiology (from Greek *axios*, "worthy" and *logos*, "science"), also called Theory of value, is the philosophical study of goodness, or value, in the widest sense of these terms. Its significance lies (1) in the considerable expansion that it has given to the meaning of the term "value" and (2) in the unification that it has provided for the study of a variety of economic, moral and aesthetic questions (Encyclopaedia Britannica 2015). In the context of this article, "value" is positive or good when a person feels well and is negative when the person feels unwell or ill. The patient is not passive regarding these values, *i.e.* just feeling good or unwell. For example, the patient tries to find a position that mitigates a local pain. This action is normative and the norm is to find the hedonic feeling of relief.

Medicine is a good point to start with the normal and the pathological because the patient can communicate with the observer, a physician. Nevertheless, the health-disease transition is not exclusive to humans: it pertains to all living entities. Bacteria can be infected by plasmids, and this forced interaction can result in either death or survival. Moreover, a bacterium that has survived an infection may develop a memory of such an event and gain resistance to a second attack by the plasmid, a phenomenon known as "adaptive immunity" (García-Martínez, Maldonado, Guzmán, & Mojica 2018; Mojica & Rodriguez-Valera 2016).

Let us move back to medicine. In order to address this dynamic health-disease-health transition, it is useful to start with Leriche's idea, namely, "health is life in the silence of the organs" and "disease is what irritates men in the normal course of their lives and work, and above all, what makes them suffer" (Canguilhem 1991, p. 91). The state of health is a state of unawareness. From such a silence, how can one study something that does not seem to give any signs about what it does? Canguilhem states that the following text by Leriche is one of the most profound thoughts on the problem of the pathological:

> "At every moment there lie within us many more physiological possibilities than physiology would tell us about. But it takes disease to reveal them to us" (Canguilhem 1991, p. 100).

Then Canguilhem completes this thought with another equally profound one:

> "Physiology is the science of the functions and ways of life, but it is life which suggests to the physiologist the ways to explore, for which he codifies the laws. ... Health is organic innocence. It must be lost, like all innocence, for knowledge to be possible"(Canguilhem 1991, p. 101).

In the first part of his book, Canguilhem refutes the idea that this transition is a quantitative problem, as proposed by Claude Bernard and others. It should be understood that this is not a quantitative problem but a problem of values. It is the patient that declares that he/she feels unwell and seeks a physician. At this point, it is easy for us, physicians, to say that the reason the patient does not feel well has an underlying physiopathological cause—and then reduce the disease to the anatomical-functional levels that range from tissues to molecules. As an example, Canguilhem presents the case of an autopsy revealing a cancer in a person that was feeling healthy until his sudden death. Was this man ill? This is a fact that requires interpretation. It is because there are patients that there is a medical discipline, and that physicians learn about disease; this knowledge was gathered in the distant past and is still being gathered today to construct medical knowledge. This medical knowledge is in turn applied to new patients. Thus, the physician can relate a given patient's feeling unwell with the presence of a tumor thanks to the patients that felt ill and were examined long ago. A person may have a cancer in an organ and not experience symptoms during his/her lifetime. In the same vein, a person may be SARS-CoV-2 positive but be completely asymptomatic. In both cases the person is not unhealthy because s/he is not experiencing being ill. Thus, where should one locate the disease? Canguilhem's answer is the following:

> "To look for disease at the level of cells is to confuse the plane of concrete life, where biological polarity distinguishes between health and disease, with the plane of abstract science, where the problem gets a solution. We do not mean that a cell cannot be sick if by cell we mean an entire living thing, as for example a protist [unicellular organism], but we do mean that the living being's disease does not lodge in parts of the organism"(Canguilhem 1991, pp. 223-224).

If a disease is located in the organism as a whole, where does the pathologist's diagnostic claims fit in? Canguilhem states that the problem of the pathologist is that s/he cannot eliminate the subjectivity of his/her object of study. But one

> "can practice objectively (impartially), a research whose object cannot be conceived and constructed without relation to a positive and negative qualification, whose object is therefore not so much a fact as a value"(Canguilhem 1991, p. 229).

This health-disease transition, this polarity, could be seen as opposing incompatibles. Canguilhem opted to consider illness as constitutive of health:

> "to be in good health is to be able to fall sick and to get up again ... The healthy man ... measures his health by his capacity to overcome the organic crises to establish a new order"(Canguilhem 1991 p. 200).

3. On Value, Polarity, and Normativity

The central theme of Canguilhem's conception of the normal and the pathological was the axiological notion of individuality that he extended beyond human medicine, and which led to the concept of biological normativity. While developing these ideas he became aware of the contribution to this subject by the German neurologist Kurt Goldstein which he acknowledged extensively in his book (Goldstein 1995). The argumentative part put forward by Canguilhem extends beyond medicine by bringing these three concepts (polarity, value, and normativity) to the very center of biology. Here we will transcribe paragraphs of *The Normal and the Pathological* dealing with these concepts.

> "We maintain that the life of the living being, were it that of an amoeba, recognizes the categories of health and disease only on the level of experience, which is primarily a test in the affective sense of the word, and not on the level of science. Science explains experience but it does not for all that annuls it" (Canguilhem 1991, p. 198).

The biological individual has preferences and thus positive and negative values, a polarity: referring to physical objects and the principle of inertia, Canguilhem states that "... inertia is precisely an indifference with respect to directions and variations in movement". In contrast:

> "Life is far removed from such an indifference to the conditions which are made for it; life is polarity. The simplest biological nutritive system of assimilation and excretion expresses a polarity. When the wastes of digestion are no longer excreted by the organism and congest or poison the internal environment, this is all indeed according to law (physical, chemical, etc.) but none of this follows the norm, which is the activity of the organism itself. This is the simple fact that we want to point out when we speak of biological normativity"(Canguilhem, 1991 p. 129).

> "We do not ascribe a human content to vital norms but we do ask ourselves how normativity essential to human consciousness would be explained if it did not in some way exist in embryo in life. We ask ourselves how a human need for therapeutics would have engendered a medicine, which is increasingly clairvoyant with regard to the conditions of disease if life's struggle against the innumerable dangers threatening it were not a permanent and essential vital need. From the sociological point of view it can be shown that therapeutics was first a religious, magical activity, but this does not negate the fact that therapeutic need is a vital need, which, even in lower living organisms (with respect to vertebrate structure) arouses reactions of hedonic value or self-healing or self-restoring behaviors. The dynamic polarity of life and the normativity it expresses account for an epistemological fact of whose important significance Bichat was fully aware. Biological pathology exists but there is no physical or chemical or mechanical pathology"(Canguilhem, 1991 p. 127).

This certainly applies to the emerging discipline called "molecular" pathology. In fact, although Canguilhem stressed the "hedonic value" of some behaviors that lessen pain, for example, by "freezing" an articulation in a given position to lessen pressure on the articular surfaces, we would like to stress that "hedonic value" also includes playful behaviors. These have been described not only in mammals but in other vertebrates (Burghardt 2015) and also in invertebrates (Zylinski 2015).

4. The Ebb and Flow of Biological Stances: From Physicalism to Organicism

During the 18th and 19th centuries, biologists made explicit their stance regarding whether physical principles could explain biology entirely. While a group known as physicalists thought that biology should be entirely explained by physical principles, another group known as vitalists thought that to explain biological phenomena, in addition to physical principles, it was necessary to invoke a vital force. To these vitalists, this force was comparable to the force of universal gravitation; both forces were equally mysterious but neither contradicted the physical principles current in the 18th century. At the end of the 19th century, progress in organic chemistry tipped the balance between these two stances towards a reductionist physicalism. In other words, they ignored Bichat's insight (see above). In the 20th century, agency, a property of organisms that traditionally served as a quality to distinguish the alive from the inert, was transferred from the organism to other entities, including natural selection (Moss 2003; Walsh 2015), genes, and proteins (Soto & Sonnenschein 2020). This enormous change resulted in the almost complete disappearance of agency, normativity, and individuation from biological language. In addition, from the 1920s to 1950s, classical Darwinian selection theory was merged with Mendelian inheritance in the form of population genetics, resulting in the Modern Synthesis (Huxley 1943). This development led to the disappearance of the organism from the entities useful to this updated version of evolutionary theory. The new useful entities were Mendelian traits and natural selection. By extension, during the ascent of molecular biology (from the late 1950s to today), the organism became just a "readout". In short, while Canguilhem was developing his important work concerning individuality, normativity, health, and disease, the biological mainstream was becoming more physicalist and mechanicist. Meanwhile, an alternative view, namely organicism, was being proposed.

The organicist school emerged between the two World Wars in continental Europe, Great Britain and the United States. Their early proponents rejected the traditional opposite views of reductionism and vitalism and aimed to create a third way that circumvented the limitations of both. They considered organisms as organized systems, rather than an aggregate that can be reduced to physics or chemistry. Thus, they believed that biology was an autonomous discipline that needed its own theories. Accordingly, alternative ways to explore causality had to be constructed (Nicholson & Gawne 2015). Implicit in the organicist view is the idea that organisms are not just "things" but relentlessly

changing objects. However, the introduction of computer sciences and molecular biology "won the day" for a while during the heady times when the DNA structure and the processes of transcription and translation were being described. A few years later both philosophers and biologists started to realize the shortcomings of the "new biology".

5. Organicism: The Return of Canguilhem?

Advances in the understanding of dissipative non-equilibrium physical systems that self-organize gave impetus to those interested in the origin of life (Kauffman 1993; Nicolis & Prigogine 1977). Additionally, starting around 1970, a new wave of organicism inspired by the Kantian concept of biological organization ("a thing exists as a natural end if it is cause and effect of itself") emerged. This explanatory alternative recognized that Kantian organization is dissimilar from spontaneous self-organization, while arguing for a new regime of circular causation (Gánti 2003; Maturana & Varela 1980; Pattee 1972; Piaget 1967; Rosen 1991; Waddington 1968). In this circular organization regime, the parts depend on the whole and vice versa; this organizational regime not only produces and maintains the parts that contribute to the functioning of the whole integrated system, but the integrated system also interacts with its environment to promote the conditions of its own existence.

During the last 20 years, organicists have worked out the conceptualization of teleology, agency, and normativity in ways that are compatible with scientific notions of causality. For example, the cause should precede the effect (Moreno & Mossio 2015; Mossio & Bich 2017; Walsh 2015). These "naturalized" concepts are addressing "minimal" instances of these concepts, as in the case of minimal biological agency in bacteria. They are being re-introduced into biology by way of theoretical principles a century after having been removed by geneticists and molecular biologists (Soto, Longo, Montévil, & Sonnenschein 2016; Soto, Longo, & Noble 2016).

Organicists first addressed the problem of organization as a source of stability through interdependence. However, organisms are relentlessly changing during their life cycle, the novelties they produce are the substrate of evolution (descent with modification). To build a theory of organisms addressing the entire lifecycle, the concept of biological organization is necessary but additional concepts must deal with other features of the living. Thus, we have proposed three founding principles: 1) the default state of cells, whereby cellular agency manifests as constitutive proliferation with variation and motility (Soto *et al.* 2016); 2) a principle of variation generated at the cellular and supra-cellular level during the iteration of morphogenetic processes (Montévil, Mossio, Pocheville, & Longo 2016), and 3) a principle of organization having its roots in circular causation (Montévil & Mossio 2015).

This theory of ontogenesis would complement the theory of evolution that addresses phylogenesis. Additionally, the aforementioned foundational principles frame experimental research and define the proper organismal observables. From this theoretical perspective, morphogenesis would then be the result of the default state producing both the cells and the extracellular matter making the organism, the principle of variation creating novelty and plasticity, and the principle of organization making the organism and its parts interdependent while providing robustness and stability. Additionally, this perspective conceives the organism as an agent that can and does create its own norms rather than just preserve the initial ones. Thus, its organization regime is not just about maintaining the system alive, but to recompose itself as it undergoes morphogenesis or faces illness and/or environmental changes. We posit that this ability is to be found at the points of articulation among the three principles (Soto *et al.* 2016 , Miquel & Hwang 2022).

In conclusion, the time is ripe to progress from the initial successful attempts to further naturalize these main biological concepts by taking Canguilhem's contributions into consideration. Of particular significance is the axiological idea of individuality and normativity and the notion that biological entities are prone to making mistakes. Judging by the renewed interest in his oeuvre, we are confident that we are not alone in this quest.

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