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Epidemiology, Social and Human Sciences and integration of sciences

ABSTRACT

The objective of the article was to broach the problem of integration between epidemiology and human and social sciences, within the context of integration of the sciences. Before the emergence of modern medicine, epidemiology held a worldview that conceived of health and disease processes as integrated with their geographic, historical, economic and social aspects. The dissociation that marked its subsequent development resulted from concepts of the body and disease that were constructed by the life sciences and modern medicine. To reflect on the integration between human and social sciences and epidemiology in relation to their connection with biology, the nature-culture divide inscribed in the development of the sciences needs to be questioned. The concept of normativity of life, proposed by Canguilhem, and the discussion by Bohr on the relationships between atomic physics, biology and unity of knowledge are dealt with from the perspective of reflecting on contemporary challenges for integration among the sciences.

DESCRIPTORS: Philosophy. Science. Health Sciences. Epidemiology. Social Sciences. Science, Technology and Society.

The purpose of epidemiology is to analyze the distribution and determinants of health and disease processes in human populations. Its history has not been linear, given that diverse theoretical conceptions and technical constructions permeated by different worldviews and social and political positions have contributed to its development.

The profound link between historical, geographic and social conditions and the emergence of diseases was present at the origin of modern epidemiological thought. Epidemiological studies contemporary with the birth of modern medical knowledge were shaped by a theory whose roots predated the process of fragmentation of knowledge that began in the seventeenth century. According to the so-called theory of epidemic constitution, which was predominant until the mid-nineteenth century, different aspects of reality were not dissociated from each other within an analytical perspective based on distinct epistemologies. In this theory, the Hippocratic legacy maintained a synthetic way of thinking in which epidemics and diseases were understood as imbalances in nature's harmony, which was perceived as an entirety that surpassed the geographic dimension.[8]

In the historical development of epidemiology, the worldview of the theory of epidemic constitution remained present and, based on different concepts, the idea of reclaiming an integrated approach was ever-present, even as a minority position. This characteristic of epidemiology has an important meaning in the contemporary world, since the value of synthetic elaboration is becoming more pronounced in scientific and social thinking.[8]

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Integration is part of the very nature of the purpose of epidemiology. At the same time, dissociation has marked its development, resulting from the process of constituting the modern sciences and the fragmentation of knowledge about humankind and its relationships.

The present article had the aim of broaching the problem of integration between epidemiology and the human and social sciences, given that this problem is rooted in the broader issue of integration among the sciences as a whole. It cannot be resolved without considering the question of natural sciences in relation to human sciences. Man is biological and social; organic and psychological; physicochemical and symbolic. What integration can be possible without considering the profound divide between nature and culture that is present at the root of the development of modern science?

The life sciences emerged during the same period as the human and social sciences. According to Foucault, life, labor and language were introduced as categories at the turn of the nineteenth century, at the time of the second discontinuity in the episteme of Western culture that marked the threshold to modernity. In Foucault's view, man became a figure of knowledge within the context of this discontinuity.[9]

The life sciences and the human and social sciences took shape with distinct epistemological foundations. Broadly speaking, the life sciences developed through the study of visible body structures and sought their identity in keeping with natural sciences, while the human and social sciences focused on the study of phenomena mediated by language and intersubjective, economic and social relations.

Epidemiology was closely linked to the development of medicine, with the life sciences as its epistemological base. It was also at the interface between health and society, taking shape as a discipline linked to medicine, while maintaining a particular tie to the social dimension.[13]

The circumstances of this development meant that epidemiology became tied to the mechanistic perspective of medicine regarding its understanding of the human body and to the idea that the sciences deal with objects that can be known predominantly through mathematical language. From the point of view of human resources training and the development of investigative techniques, epidemiology tended to move progressively away from the knowledge that formed a specialty of the field of human and social sciences.[1-3]

Epidemiology tends not to work on concepts from the human and social sciences at the same level of complexity that is given to them in their original fields,[11] but tends to quantify the relationship between health and society. Economic, social and cultural issues are dealt with models as components of causal sets whose importance in the process will be ascertained by means of measurement. The link between epidemiology and the social sciences has tended to be reduced to an instrumental level of attributes, to the detriment of the theoretical elaboration underlying the relationship between socioeconomic and health phenomena.[4]

This tendency has posed the challenge of integration with the human and social sciences, for all facets of the discipline and especially those that seek to overcome these limits. In this respect, the efforts undertaken within the facet of social epidemiology, beginning in the second half of the twentieth century, can be highlighted.[4]

Nevertheless, there is an epistemological limit to greater effectiveness of integration that cannot be resolved from within the discipline alone. In the present study, it is considered that the propensity of epidemiology to take a limited approach to the human and the social dimensions results from reduced conceptualization of the body and disease. The concepts defining the body's material basis are not linked to the ways of conceptualizing human characteristics that are studied by the social sciences.

The human body is envisaged as composed of different levels of organization with increasing complexity. Different disciplines describe these levels of reality using languages that do not enable easy dialogue with each other. The body itself is not dissociated, but it appears dissociated within the different perspectives from which it is studied. The greatest challenge for effective integration among the sciences, and thus between epidemiology and the human and social sciences, is to find a link capable of epistemologically uniting these distinct levels of reality, without disregarding the discontinuities, emergences and originality among them.

The criteria for demarcating different disciplines draw on the attributes of quantity and quality, among others. One important issue with regard to conceptualizing the desired integration is to question the reason for the tendency to identify the dimension of quality as essentially a social sciences approach and the dimension of quantity as the study of biological disease. Quality and quantity are two inseparable sides of the phenomena, prior to delimiting the jurisdiction of the disciplines. There is a value difference between health and disease, and this variation is simultaneously social, cultural and biological.

Within this context, the philosophical contribution by Canguilhem touches on a crucial aspect of the nature-culture divide. He viewed quality as a characteristic inscribed in the vital condition. The thesis that Canguilhem defended in the 1940s[7] shows a depth that needs to be retrieved, in the sense that it points towards a potential link between life's different levels of organization.

According to Canguilhem, as a therapeutic technique, medicine represents an extension of the biological capacity to grasp certain states or behavior as negative (pathological). With medicine, human beings expand on a spontaneous and particular effect of life to struggle against what appears as an obstacle to its own maintenance. He states:

"...that life is not indifferent to the conditions within which it is possible, that life is polarity and therefore even an unconscious value position; in short, life is in fact a normative activity. The term 'normative' is applied in philosophy to any judgment that assesses or qualifies a fact in relation to a norm, but this type of judgment is fundamentally subordinate to the person who institutes the norms. It is in this sense that we propose to speak of biological normativity"[7] (p.96)

The concept of biological normativity is essential to Canguilhem's thinking. In his view, inquiring into the vital meaning of the behaviors and norms of living beings is part of biology.[6] This concept is at the root of the problem of integration between the human sciences and biology and also causes dialogue with the questions of the natural sciences in their attempt to explain life.

In the text "*The Problem of Normalcy in the History of Biological Thought*",[6] Canguilhem engages in a dialogue with the work of Schroedinger in "What is Life?" According to Schroedinger, life is a peculiar behavior of matter in which a preexisting order is capable of being preserved. Life contradicts, albeit provisionally, the principle that physical matter tends towards entropy. He gave the name "negative entropy" to life's capacity to maintain order starting from order.[16]

In Canguilhem's view, physics and chemistry would not be capable of responding to this property of vital organization. Biology would account for this original quality of a "certain physical quantity". Considering this original property, biology would be unable to dispense with the concept of normalcy. It would not be possible to explain life's capacity to persevere and the maintenance of negative entropy through the notion of systemic improbability, without linking these to the normative capacity. The capacity for self-preservation would be due not to some type of physical improbability, but to a capacity to make certain physically improbable 'choices'. "Will we have to associate the definition of total negative entropy with the improbability or, rather, to the value?"[6] (p.121)

Canguilhem was accused of vitalism, through ascribing evaluative capacity to the simplest living being and proposing the definition of an epistemological region particular to biology, distinct from physical and chemical regularities. This controversial side of Canguilhem's thinking deserves greater reflection, since it is at the core of questions that remain unresolved.

Value as something inscribed in the biology and originality of living beings does not rule out the possibility of a physical explanation for life. As will be seen later on, physicists have admitted these characteristics in their research. Canguilhem's vitalism could be attributed to his attempt to demarcate epistemology that is proper to biology, through the concept of normativity. The problem with this proposition is that biological normativity itself cannot be solved by biology, either.

Biologists described life by dividing it into constituent parts, through increasing miniaturization of its objects.

"Indeed, have the preceding analyses not confused the level of the known and experienced phenomena with the level of the explained phenomena? Normalcy appears as a property of organisms, but disappears at the level of the elements of organization"[6] (p.121)

The concept of normativity of life relates to the living being's property of self-preservation, referred to by Canguilhem as a fact of life. Life has the property of persevering in a physically improbable condition, flowing between preservation and plasticity. This characteristic of life is highlighted in such concepts as self-organization and autopoiesis,[12,14] which attempt to describe but also do not fully succeed in explaining the living being's fundamental property.

By stating that self-preservation is due to a normative capacity, is Canguilhem attributing a peculiarly human condition to every living being? By stating that therapeutic techniques are an extension of biological conditions present in the simplest life forms, is he contending that a single-cell being has characteristics equivalent to those of man?

Language demarcates humans. Is it radically new, or is it rooted in some essential attribute for the preservation of life in its simplest form? Is attributing value to living beings an anthropomorphic extrapolation? It is difficult to conceive of biological normativity, independently of the human way of experiencing this circumstance. Is it hypothetically possible to conceive of an unconscious biological choice that is not mediated by the complexity of the human symbolic condition?

From the point of view defended here, normativity of life is a key concept in the search for answers to the challenge of integration between body and mind, and consequently of integration between the sciences. Canguilhem left open a problem with which twentieth and twenty-first century physicists have increasingly been grappling. Questions produced by twentieth-century physics have enabled advancement in the dialogue between physics and biology.

The classical mechanistic model is the basis for the epistemic structure of biology. In the early twentieth century, this model was questioned within physics on the grounds that it was incapable of explaining phenomena described more adequately by quantum mechanics. Within the context of the new theories of physics, the theme of life appeared more sharply in the midst of major questions raised in this process of theory construction.

In articles during the first half of the twentieth century, Bohr proposed a reflection on life and atomic physics, dealing with the unity of knowledge and raising the possibility that life would one day be explained by physics.[5]

Bohr proposed the principle of complementariness to explain one of the aspects of the quantum theory: wave-particle duality. In experimental situations, a given measurement only reveals either the wave or the particle nature of an object, and thus it is impossible, in the same experiment, to demonstrate its dual nature. In order to achieve a complete understanding of a system, complementary information is needed, according to the experimental apparatus constructed:

"...the data obtained under different experimental conditions cannot be understood within a single frame, but should be considered complementary, in the sense that only the totality of the phenomena exhausts the possible information on the objects"[5] (p.51)

The principle of complementariness was not limited to atomic phenomena. Bohr proposed that it could provide the basis for describing the organization of living beings:

"...strictly speaking, the essential characteristics of living beings should be sought in a particular organization, in which characteristics that can be analyzed by classical mechanics interweave with typically atomic characteristics, to a degree which finds no parallel in inanimate matter"[5] (p.11)

Bohr recognized an analogy between the analysis of atomic phenomena and typical characteristics of human psychology. In descriptions of psychological experiences, there is a relationship of complementariness that is similar to descriptions of the behavior of atoms and subatomic particles, obtained under different experimental situations. Thus, he highlighted "an epistemological question that is common to both fields"[5] (p.34)

There is no discourse linking psychology to quantum physics, but the epistemological proximity Bohr identified between the two suggests that the principle of complementariness could have correspondence with biological, psychological and social phenomena.

Could biology be expanded if there were a better understanding of its relationships with atomic physics? This hypothesis has possibly now been better explored better than at the time when Bohr was writing. However, the problem he raised, that the construction of an adequate experimental arrangement for observing quantum phenomena in living substances is incompatible with maintaining such life, is an obstacle to theories of greater precision. The recognition that atomic physics is important for explaining the characteristics of living organisms has not yet been sufficient to achieve comprehensive knowledge of the biological phenomenon. Bohr himself had already posed the question:

"The question at hand is thus whether fundamental aspects are still lacking in the analysis of natural phenomena for us to reach an understanding of life based on physical experience. ... On the one hand, the marvelous characteristics constantly revealed by physiological investigations, and that differ strikingly from what is known about inorganic matter, led biologists to believe that no adequate understanding of life's essential aspects is possible in purely physical terms. On the other, it would be difficult to give an unambiguous expression to the view known as vitalism, whose point of departure is that a peculiar vital force, unknown to physicists, rules all of organic life"[5] (p. 12)

Bohr did not accept that life could be independent of physical regularities that were capable of description in nature, but he did not restrict them to physical and chemical processes that were described only within the context of classical mechanics. Moreover, he recognized that organisms exercise power of choice:

"...the general lesson of atomic physics, and in particular of the limited reach of mechanistic description of biological phenomena, suggests that the capacity of organisms to adapt to the environment includes the power to choose the most appropriate path to this end"[5] (p. 99)

The ongoing discussions among physicists concerning the nature of life highlights the importance of the concept of normativity of life in dealing with one of the greatest challenges for science in the twenty-first century, linked to the problem of integration between body and mind, and consequently to integration of the sciences. Roger Penrose, in the late twentieth century, asked:

"Neurons are cells and cells are very elaborate things. In fact, they are so elaborate that, even if you had only one of them, you could still do very complicated things. For example, a paramecium, a one-celled animal, can swim towards food, retreat from danger, negotiate obstacles and, apparently, learn by experience. These are all qualities which you would think would require a nervous system but the paramecium has no nervous system. The best you could do would be if the paramecium were a neuron itself! There are certainly no neurons in a paramecium – there is only a single cell. The same sort of statement would apply to an amoeba. The question is 'How do they do it?' "[15] (p. 139)

A problem arises when considering that the integration between epidemiology and the human and social sciences is related to a debate that involves the philosophy of biology in its relationship to the natural sciences. The thinking needed to combine knowledge from such diverse fields cannot be constructed without collaboration among researchers with different backgrounds.

For example, there was no consensus regarding the principle of complementariness, among the interpretations of the epistemological consequences of descriptions of the atom. The debate established between Bohr and Einstein[5] remains controversial to this day. It is impossible to discuss it in depth in the present article, but it is worth drawing attention to the existence of open questions regarding the epistemology of both physics and biology.

Historical clashes like those than divided mechanicists and vitalists may be only two ways of dealing with ignorance. It may be that the question faced should be answered in a way differing from than merely ensuring a "victory" for one of the two currents of thought. Examples from the past show that major strides and turning points in knowledge have occurred in connection with profound changes in the nature of the discourse, perception and knowledge, as analyzed by Foucault[10] in relation to modern medicine.

Epidemiology is linked to the life sciences and modern medicine, but its historical development was marked previously by a worldview in which health and disease processes were conceived of as integrated with geographic, historical, economic, social and cultural conditions. The challenges for contemporary integration between epidemiology and the human and social sciences are linked to those of integration among the sciences as a whole. Biology, medicine and the human and social sciences, i.e. the sciences that emerged at the threshold to modernity, may be transformed within the context of changes in the natural sciences. It is thus important to accompany the direction of their inquiries and discoveries.

With regard to epidemiology, it is important to reclaim the legacy of synthetic thinking that is capable of overcoming the limits of the dichotomous, fragmented knowledge that has characterized modern science. There is no easy formula for establishing a rigorous dialogue among sciences with hermetic languages that are so different from each other. One way of attempting to overcome this difficulty is to dare to establish dialogues than can be complemented, corrected and transcended in successive attempts. Integrated thought in the twenty-first century is a collective effort, and academic discourse needs to be more open to this challenge.

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REFERENCES

1. Almeida Filho N. O problema do objeto de conhecimento na epidemiologia. In: Costa DC, organizador. Epidemiologia: teoria e objeto. São Paulo: Hucitec/Abrasco: 1990. p.203-20.
2. Ayres JRMC. Sobre o risco: para compreender a epidemiologia. São Paulo: Hucitec-Abrasco; 1997
3. Barata RCB. Epidemiologia e saber científico. *Rev Bras Epidemiol*. 1998;1(1):14-27. DOI: 10.1590/S1415-790X1998000100003
4. Barata RCB. Epidemiologia social. *Rev Bras Epidemiol*. 2005;8(1):7-17. DOI: 10.1590/S1415-790X2005000100002
5. Bohr N. Física atômica e conhecimento humano. Rio de Janeiro: Contraponto; 1995.
6. Canguilhem G. Ideologia e racionalidade nas ciências da vida. Lisboa: Edições 70; 1977. O problema da normalidade na história do pensamento biológico; p.107-22.
7. Canguilhem G. O normal e o patológico. Rio de Janeiro: Forense-Universitária; 1978.
8. Czeresnia D. Constituição epidêmica: velho e novo nas teorias e práticas da epidemiologia. *Hist Cienc Saude-Manguinhos*. 2001;8(2):341-56. DOI: 10.1590/S0104-59702001000300003
9. Foucault M. As palavras e as coisas: uma arqueologia das ciências humanas. São Paulo: Martins Fontes; 1995.
10. Foucault M. O nascimento da clínica. Rio de Janeiro: Forense-Universitária; 1987.
11. Goldberg M. Este obscuro objeto da epidemiologia. In: Costa DC, organizador. Epidemiologia: teoria e objeto. São Paulo: Hucitec/Abrasco: 1990; p.87-136.
12. Maturana HR, Varela FG. El árbol del conocimiento. Santiago de Chile: Editorial Universitária; 1984.
13. Mendes Gonçalves RB. Reflexão sobre a articulação entre a investigação epidemiológica e a prática médica a propósito das doenças crônicas degenerativas In: Costa DC, organizador. Epidemiologia: teoria e objeto. São Paulo: Hucitec/Abrasco; 1990. p.39-86
14. Morin E. O método II: a vida da vida. Porto Alegre: Sulina; 2002.
15. Penrose R. O grande, o pequeno e a mente humana. São Paulo: UNESP; 1998.
16. Schroedinger E. O que é a vida? São Paulo: Unesp/Cambridge; 1997.

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