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vivante

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Dutreuil Sébastien (2024) *Gaïa, terre vivante*. Paris: La découverte. 512 pages. ISBN 978-2-35925-140-1

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Science being embedded in paradigms that are imposed through struggles is a relatively old idea (Kuhn, 1962). These struggles can be made visible by controversies, a classic entry point for science studies (Collins, 1985). In the book *Gaïa, terre vivante* Sébastien Dutreuil is thus following a well-known tradition, to which he has yet added an original touch. By starting from a controversy, he shows that it is not (only) the result of a debate on the administration of evidence, but a philosophical and political difference. In doing so, he adopts a Latourian perspective, which leads him to extend his analysis beyond the scientific field (Latour, 2004).

The subject of Dutreuil's book is the 'Gaïa hypothesis', introduced by James Lovelock in 1972, with the hypothesis referring to the possibility of considering life as a whole that consists of all the interactions between organisms and their global environment. Three issues interest Dutreuil here. Firstly, the controversy between Lovelock and biologists. Secondly, the gap between a scientific publication, with a modest coverage in the Earth and environmental sciences, and its appropriation by a much wider public. Thirdly, the link between politics and philosophy that Gaïa provides. In the first three parts of the book, Dutreuil successively analyses the scientific proposals on which Gaïa is based and the careers of the researchers involved, mainly Lovelock and, to a lesser extent, Lynn Margulis (their correspondence was also the subject of a previous book (Clarke and Dutreuil, 2022)). In the fourth part, Dutreuil situates Gaïa in the history of Earth and environmental sciences, and in the fifth part, highlights Gaïa's contribution to a new philosophy of science.

For Lovelock, Gaïa relies on the observations that life influences geology, the physical conditions for life are constrained, and external perturbations can lead to conditions unsuitable for life. For Dutreuil, these observations lead to different analyses between Lovelock and biologists, especially evolutionists. In the evolutionists' perspective, natural selection through reproduction allows living organisms to adapt to an environment that is itself changing, including through the involuntary action of living organisms. Yet for Lovelock, the stabilising effect of living organisms on the environment is primary. This debate is discussed in the book through examples and counter-examples used by the various parties, with the case of altruistic behaviour being particularly controversial. In the Gaïa approach, altruism enables the environmental changes necessary to sustain life, whereas for evolutionists altruism is not a competitive advantage in the process of natural selection. Finally, Dutreuil shows that the protagonists of the issue do not share a common definition of life, which can be understood as an individual or global concept; in biology, it is defined by criteria applied to individuals (reproduction, selection), whereas Lovelock's concept is more fluid and general. This can be explained by the fact that Gaïa was addressed less to researchers in biology than to those in the Earth sciences. For Dutreuil, part of the misunderstanding is also due to the use of the term 'hypothesis': Gaïa is not a hypothesis that can be tested empirically, but a new ontology, which explains why life is approached in a broad and not really fixed sense. As a result of thus not only different scientific communities disagreeing, the debate being ontological rather than an empirical, Dutreuil considers that the idea of controversy (shared in the public debate) is not appropriate.

One of the strong points of the book is that it reinscribes Gaïa in the history of the Earth sciences. Dutreuil shows how empirical geology was gradually supplanted by geophysical and geochemical

models in the 1940s and 1950s, before the biological was gradually introduced into the models in a way that was contemporary with Gaïa, as biogeochemistry in the 1970s proposed a role for living beings in the cycles of matter. This latter approach was supported by institutions such as the International Geosphere-Biosphere Programme, which encouraged interdisciplinary research from an Earth system science perspective. In this way, Gaïa does not have a monopoly on the relationship between the biological and the environmental, nor on the perspective that combines complexity and anti-reductionism. Dutreuil succeeds in showing that Gaïa is not an isolated and eccentric project, while at the same time highlighting its specificity, which explains its ambiguous treatment within the scientific community. For Dutreuil, it is not simply a research programme, but a compositionist and vitalist philosophy of nature.

In Gaïa being approached from this perspective, life is an entity in itself, without functional integrations but with internal differentiations. These differentiations are the organisms (p. 277). Dutreuil calls this ontology 'vitalist' in a specific sense. Life on Earth is the central entity, with an influence that extends far beyond the material boundaries of the cells: for the author, the atmosphere is a vital extension of organisms (p. 322). In the same time, he adopts Latour's (2017) notion of 'compositionism', that is, connectivity without holism, where the entity is composed piece by piece, loops after loops. Life is thus an association of properties and processes rather than a presumed big whole. For Dutreuil, these characteristics of Gaïa explain its spread beyond scientific circles, but also its reluctance to be named in scientific publications. The author shows us that Gaïa's approach to the world is the result of a mixture of science, philosophy and politics (in terms of Gaïa's cultural and militant appropriation and Lovelock's public positions). This is as much part of its richness as it is part of its academic contestation – frontal in the case of controversy, more discreet in the case of invisibilisation, i.e. the use of Gaïan concepts without quoting them explicitly.

Despite its value, two critical comments can be made about the book. First, the reader may question Dutreuil's position in this issue. On the one hand, Dutreuil has begun his career in the field of Earth sciences (Dutreuil et al., 2009). On the other hand, he has worked with Lenton, one of Lovelock's two doctoral students (Lenton et al., 2020), as well as Latour, who has played a role in the contemporary popularisation of the Gaïa theme (Latour, 2017; Latour and Porter, 2017). All this background undoubtedly contributes to his analysis of Gaïa, and a reader coming from sociology may then resent the limited explicit self-analysis. Second, following a Latourian tropism, the analysis of the book follows Gaïa more in its epistemological and ontological implications rather than the researchers' social positions. Apart from the figure of Lovelock, researchers are seen primarily in terms of their scientific output and less in terms of their power relations, their social properties, and their day-to-day interactions. It is however possible to argue that the profession of researcher is also characterised by knowledge, skills, experience and a symbolic economy characterised by hierarchies, between disciplines, between networks and between peers (Bourdieu, 1997). Their professional autonomy is supported by the display of peer control and limited to a given field (research). As a result, Gaïa's interdisciplinarity and politicisation can put the researchers' habitus under pressure, but this subject is rarely addressed in this book.

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