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Relief is Life

by Morgan Jouvenet

We talk about the Earth without truly understanding it. An overview of recent knowledge about the "Earth system" and its concerning state invites us to promote a new way of looking at the environment and the political approaches required.

About: Jérôme Gaillardet, *La Terre habitable ou l'épopée de la zone critique* (The Habitable Earth or the Epic of the Critical Zone), Paris, La Découverte, 2023, 256 p., €22.

Nobody can deny that the question of our planet's habitability – or at least, the habitability of certain areas – is a pressing one for the human race today. As climate disasters become more common and ecosystems are slowly eroded, nearly all the researchers are in agreement and daily debate extends well beyond the scientific world.

As well as articles in specialist journals, these scientists sometimes publish other material targeting the general public. Geochemist Jérôme Gaillardet is part of this trend, with *La Terre habitable ou l'épopée de la zone critique*. The book begins with a description of the familiar view from the author's window in an old country house: Gaillardet, who knows the surroundings well, is pained to observe their current "biomonotony". Butterflies, birds, beetles and glow-worms have "disappeared" and "the crickets of [his] childhood no longer chirp". This dramatic perspective, tinged with acute nostalgia (or "solastalgia"), is the starting point for a global overview, "from the Congo River to the Amazon, from the Alps to the Himalayas, from the island of Réunion to Guadeloupe". The author presents this as an opportunity to summarise the latest knowledge about the "Earth System" and its worrying state, but also as a means

of promoting a new perspective on the environment that is likely to reorient political debates on the subject.

The scientist is presented here as assisting a "necessary reconnection" with nature (p. 11). When the author mentions the harmful effects of glyphosate (p. 10) or the "ugly, thundering agricultural machine" that snaps him out of his daydream (p. 239), we understand that the problem is not so much a general disconnection as a stranglehold on nature that is as dominant as it is short-sighted. To counter this, Gaillardet believes that we need to change the representations associated with a "habitable Earth" to ones better suited to the diversity of temporalities (or "kinetics", as the author calls them1) in nature.

The dynamics of the "critical zone"

In a world where "we talk about the Earth without understanding it", this book helps us overcome our lack of knowledge. Its originality lies in its focus on the "critical zone", i.e. the "heterogeneous environment close to the Earth's surface, where complex interactions between rock, soil, water, air and living organisms (...) regulate the natural habitat and determine the availability of vital resources" (p. 77). Indeed, "humans [and many other living beings] do not inhabit the globe", but rather the "thin film on its surface" (p. 205). In truth, little is known about the dynamics of the critical zone ("a boundary zone, a sensitive interface undergoing constant transformation", p. 121), beyond the few images associated with erosion, for example. Gaillardet's book considerably expands our understanding of this subject and emphasizes the importance of these processes – in particular by showing "how the decomposition of stones helps purify the air and create a liveable world" (p. 25). In this vision, familiar objects are given a new lease of life, in favour of a scientific culture that focuses increasingly on natural cycles. For example, "the slates that cover the roofs of Breton villages are nothing more than the sediments of vanished rivers, deposited at sea, compacted, exposed and lifted by tectonic collisions" (p. 56) and "the little grains of quartz that stick to our skin" when we walk along the beaches of the Atlantic are "all that remains of mountain ranges that have disappeared" (p. 70). We also learn that the cliffs above the town of Ornans painted by Courbet "are past atmospheres, stored

[1] "The kinetics of a chemical reaction is the speed at which it occurs". This "word borrowed from chemistry has not found its way into common language" and "in French, we prefer using *temporalité* (i.e. temporality) which sounds fancier" (p. 61).

there to prevent a greenhouse effect that would otherwise destroy life on Earth" (p. 158). There are many revelations of this kind, and they help us to understand why "an Earth without relief" (i.e. without plate tectonics) would probably be uninhabitable (p. 84). Relief is life.

Delving deeper, the reader gets a better sense of all that has to happen, on many levels, for a square foot of basalt barely cooled from a lava flow to eventually become a square foot of tropical forest (p. 107 ff). The book succeeds in temporalizing the landscape, emphasizing fluxes, rather than the static images we are familiar with. This flux concerns everything from a piece of slate to a leaf that falls from a tree, in an analytical movement that Gaillardet associates with the shift evoked by Bruno Latour from a "Galilean" referent – in which inert objects are transformed according to "strictly mechanistic" laws – to a "Lovelockian" referent, emphasizing the agency of natural elements and their interconnections as considered in James Lovelock's Gaia-Earth ("With Galilean objects, we can exploit nature as a resource; but with Lovelockian agents, there is no point in deluding ourselves: they act and react chemically, biochemically and geologically. Hence, it is naïve to believe that they will remain inert, no matter how much pressure you exert"2). The author builds on this by exploring philosopher A. N. Whitehead's "world of events", in which "our 'environment' is merely a transition, a moment in the maelstrom of the transformations and rotations of matter". Gaillardet further invites us to consider the Ganges, for example, as a "moment" in a water cycle (p. 103).

An introduction to the "language of cycles"

Gaillardet's ambition is not to fuel debate around this philosophy, but to provide an introduction to the "language of cycles" (p. 132), with references to plate tectonics, gas flows and earthworms. This book is a treat for anyone who enjoys learning and understanding, naming things and processes, and in short, rediscovering the "lost art of describing nature" to which Romain Bertrand devoted an astonishing book drawing on "the combined forces of science and literature" to "describe the most banal of landscapes" and "portray the world in its surfaces" (Le détail du monde. L'art perdu de la description de la nature, Seuil, 2019). Beyond these surfaces, La Terre habitable is also full of imagery and metaphors that, according to Gaillardet, have the

[2] Translated from P. Charbonnier, B. Latour, B. Morizot, "Redécouvrir la terre", *Tracés*, 2017.

virtue of giving substance to the knowledge of geochemistry. The critical zone becomes a battleground for Hades and Helios, who represent, respectively, "the inner energy of the planet" and that of the sun (p. 121). Elsewhere, the author opts for a more anonymous personification: the "Andean Mountain" is compared to a "gluttonous ogre" devouring "the remains of the living" and "swallowing them up at the bottom of the sea" (p. 50) via the Amazon River. His explanations sometimes lean towards a form of medical organicism, depicting the Earth as a "sick patient" whose vital signs must be "monitored", and whose critical zone is a "fragile skin" in "perpetual renewal" (p. 143, 219). The author's aim is to draw on all available means to put the spirit of geochemistry into plain language.

From the lab to the field

Other more down-to-earth descriptions shed light on the technical devices that enable scientists of the critical zone to produce data, between labs (that of Ebelmen, a 19th-century chemist, or that of Gaillardet himself) and the "field" (we navigate the Amazon River with the author aboard the Comandante Cuadros). One of the book's strengths is its ability to combine popularisation with an insight into "science in the making" (i.e. the work that scientists do before publishing research). The phrase "science in the making" is associated with Latour's anthropology of science. Gaillardet is therefore embodying an idea that Latour often expressed in his later years, when he urged scientists to take ownership of their political influence by choosing transparency rather than defiance in the face of sceptics on all sides. Instead of confining himself to presenting consolidated results ("ready-made science"), Gaillardet accepts and faces the difficulties encountered in ensuring the reliability of data collection, or the controversies that can arise between experts on the critical zone. This gives the scientific narrative more realism, and allows for stimulating points of contact with science studies (a far cry from the "science wars" of the 1980s, which pitted sociologists and anthropologists of science against physicists and biologists, who were anxious to protect science from their "deconstructions", for fear of losing their legitimacy).

It is particularly interesting to see the extent to which the robustness of the knowledge produced depends on the connecting of lab and field. Gaillardet describes the "ritual" of labelling samples and the "religious care" taken with "precious bottles" (p. 37). Inventiveness is essential when it comes to adapting instruments to the difficulties of the field, be it "geophones" installed "in the pouring rain" (p. 166) or a

250-foot tower erected in the middle of the tropical forest to analyse particles suspended in the atmosphere (which revealed that the Amazon rainforest was fertilised by dust from the Sahara, p. 54).

These descriptions do justice to the techniques that have enabled us to refine our knowledge of the components of the "Earth system" (and of human "forcings") over the last few decades. In the science of the critical zone, this progress is based on historical reconstruction, exploiting the ways in which matter changes during geochemical cycles. Counting the chemical elements present in the samples gives us an idea of the sources and journeys of the sampled elements. For example, by analysing calcium isotopes found in "trickling water", we can assess how much of this calcium "comes from plants" and how much "comes from rocks" and conclude, for example, that "when walking through the mud of the Amazon Delta, one is treading on pulverised Andes" (p. 39, p. 41).

The processual imaginary and the politics of nature

"When the world demands toxic productivity, contemplation is a radical act". At first glance, this slogan borrowed from a British cultural institution could apply to Gaillardet's work. It emphasises the disruptive effect that the view of nature it promotes could have, in a world depleted by the quest for profit. In this respect, the processual lexicon and the depth of vision associated with the observation of the critical zone are already a step towards an active political alternative. This idea is shared by many of the author's colleagues who have written popular works (such as geologist Marcia Bjornerud, with Timefulness: How Thinking Like a Geologist Can Help Save the World, Princeton University Press, 2018). It is not just a question of being satisfied with the emergence of a new environmental "imaginary", however intellectually satisfying, but of investing in its political influence.

This is a gamble and the chances of success are unpredictable. The social world is also permeated by processes that follow different temporalities (or "kinetics") and one can imagine that the elements distilled by this type of work might end up irrigating vast spaces after reaching circles not far from their sources. To achieve this, other reactions and interventions will be needed, in addition to synergies with sociologists and philosophers of science. Another path is that of art: along with a number of these sociologists and philosophers, Gaillardet is part of a network engaged

in a wide-ranging aesthetic quest for the creative expression (through the visual, theatrical and graphic arts, for example3) of a certain image of nature.

The fact remains that these books demonstrate a clear commitment for active participation in producing the politics of nature. For this reason, La Terre habitable can be placed alongside works by the "thinkers of the living world" who have so far given visibility to the aforementioned network. Gaillardet's book cannot be accused of "stigmatising science", as these authors have been (cf. V. Rigoulet, A. Bidet, Vivre sans produire. L'insoutenable légèreté des penseurs du vivant, Croquant, 2023). On the other hand, we can criticise its weak interconnection with the reflection on productive activities. The contrast between the scientist's reverie and the noise of the agricultural machine, the evocation of village life in the past or of places reduced to names written on cultural heritage signs next to motorways, testaments to "a locality that globalisation has tried to erase" (pp. 164-165)… All of these elements hint at a wholesale rejection that it is difficult not to find sociologically naive and politically disabling. But these lingering issues can also be seen as easily identifiable and fixable, rather than as fatal design flaws.

Conceptual inventiveness and interdisciplinarity

La Terre habitable can also be read as an account of the underlying movements of specific scientific worlds today. It shows how these worlds can still be reconfigured and revitalised by conceptual innovations. By drawing attention and funding to a subject that has become consistent, the concept of the critical zone, although not completely new (it was "invented" during a US symposium in 2003), represents "in Europe, and particularly in France, (...) a godsend" – both for creating field observatories and "for linking up old and scattered observation systems into a unified network" (p. 125, p.181). While its spread has not been without hitches, its rapid success (p. 77) has clearly reshaped the network of collaborations and redefined positions.

This conceptual innovation fosters communication between different specialist communities, which previously handled pieces as if they were not part of the same

[3] See for example B. Latour, P. Weibel (eds.), *Critical Zones. The Science and Politics of Landing on Earth*, ZKM & MIT Press, 2020, and F. Aït-Touati, A. Arènes, A. Grégoire, *Terra Forma. Manuel de cartographies potentielles*, Éditions B42, 2019.

jigsaw puzzle (pp. 98-101). It was also the starting point for the collaboration between J. Lovelock and L. Margulis, which led to a reconfiguration of the Earth sciences (and the dissemination of new representations of the Earth) based on their invention of a new object of study, "Gaia". We would have liked to see more than just allusions to Gaia in Gaillardet's book, given that the perspective it promotes echoes it on a different scale (cf. S. Dutreuil, Gaïa Terre vivante. Histoire d'une nouvelle conception de la Terre, Les Empêcheurs de penser en rond, 2024).

This scale enables us to give a detailed account of how the interdisciplinary connections encouraged by the new concept are manifested in the field, on "instrumented sites" specifically for the study of the critical zone. One of the photographs reproduced in the book shows an observatory set up in Jura (France) to study the inflow and outflow of carbon in the peat bog, with its measuring instruments and its pathway on stilts. The networking of these observatories allows global knowledge to be produced. As shown by P.E. Edwards for the "immense machine" of satellites, sensors and computers now monitoring the Earth's atmosphere (A Vast Machine. Computer Models, Climate Data, and the Politics of Global Warming, The MIT Press, 2010), this networking is not a simple connection. It requires a great deal of coordination between scientists, "to agree, through a kind of compromise, on a list of indicators, of observables" (p. 178). This work is also probably dependent on power games that put to the test the epistemic holism promoted by the concept of the critical zone; in other words, differences in status and legitimacy can make it difficult to overcome disciplinary boundaries. Gaillardet does not go into these details. However, he points out that certain disciplines (like chemistry, physics and molecular biology) find it more difficult to leave the labs that have enabled them to establish a dominant position, and join geology, for example, in the dust or mud of the field (p. 221). In his view, however, they have an opportunity to "redeem themselves" after decades of collusion with "the productivist machine that is destroying the planet", by joining the sciences of "repair" and their "sentinel" sites (pp. 193, 241). Investing in the critical zone is also a way of taking part in the power struggles that will define tomorrow's science and the political value of the knowledge produced.

As presented in *La Terre habitable*, these observatories in the critical zone appear to be particularly fruitful sites for contemporary research. In this book, Gaillardet reconstructs the ins and outs of their existence, and enriches the analysis of the in-situ work of "Earth system" scientists. He believes that bringing together the worlds of science, the media and politics is a redeeming step, and he also offers representations

of the environment that are likely to strengthen the ecological culture that these worlds are shaping together.

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