Controlling the planet's health: From homeostasis and geophysiology to the planetary health watch

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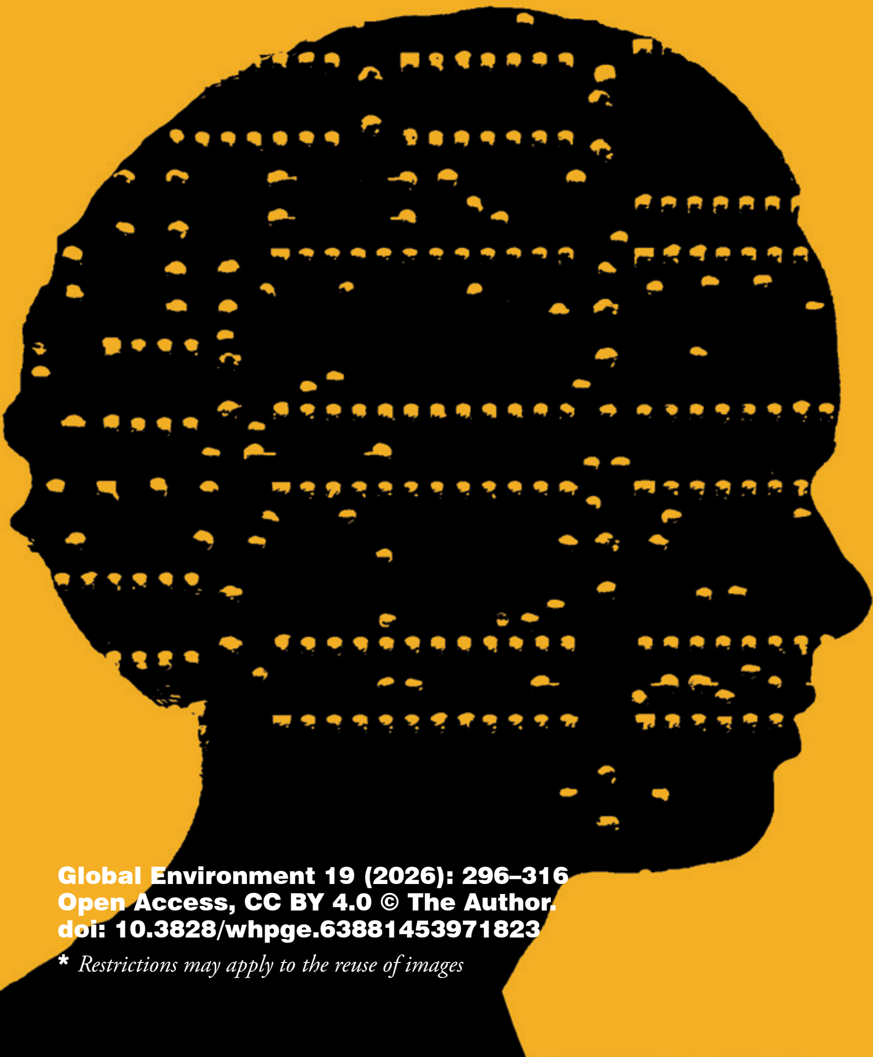

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abstract

This article demonstrates how the diagnosis of the planet as sick in the discourses on planetary health draws from a physiological understanding of health as an objectively definable 'normal' or 'optimal' state of an organism. The following traces a genealogy of this understanding through the development of the concept of homeostasis, which first emerged in early twentieth century physiology, was then applied to cybernetic machines and ecosystems by mid-century and reappeared in Lovelock's notion of 'geophysiology'. It argues that the prominent focus on measuring and monitoring in contemporary propositions on governing planetary health relies on a specific understanding of the Earth as a self-regulating, more-or-less homeostatic system. This view is based on a cybernetic paradigm, which argues that the world can be understood and controlled through information: a disembodied type of information, as Katherine Hayles has argued, that 'exists independently of the substrate that carries it'. My aim is to show the limits of this physiological model of health, and the political imperative that the most viable strategy for taking care of the planet in crisis is through global Earth system governance. A strategy that depends on the accumulation of vast amounts of data, while obscuring the lived realities from which this data is extracted.

keywords: *planetary health, homeostasis, cybernetics, geophysiology, planetary governance*

In 1972, the first United Nations Conference on the Human Environment took place in Stockholm, which catapulted concerns for the integrity of the planet's biosphere into the spotlight of public and political discourse in the West. Under the motto 'Only One Earth', the conference marked the beginning of a global environmental governance agenda, which posited that human development cannot continue to be in conflict with the well-being of the planet's biosphere. In the same year, James Lovelock first introduced the notion of the Earth as a living entity he named 'Gaia'.[1] This entity 'with properties greater than the

[1] The Gaia hypothesis took shape in a series of publications (1972–1979) by Lovelock, largely in cooperation with microbiologist Lynn Margulis. See J.E. Lovelock, 'Gaia as seen through the atmosphere', *Atmospheric Environment* **6** (8) (1972): 579.

simple sum of its parts', was presented as having a distinct physiology and self-regulating capacities, which, at the time were increasingly perceived to be under threat because of human activity. The newfound public and political attention to the ailing planet ultimately raised the question of how best to take care of the biosphere 'that the whole of mankind must share'.[2]

This was the context in which Anthony McMichael, a future pioneer of 'planetary health' thinking, began his journey as a medical student, reading the books of Paul Ehrlich, René Dubos and Joseph Boyden.[3] Inspired by Lovelock and system ecology, McMichael aimed to shift the focus of epidemiology from the local health effects of pollutants and demographic changes to their effect on the biosphere at a planetary scale. In *Planetary Overload*, published in 1993, he warns that pressures on the biosphere through increased waste production and resource extraction threaten to 'reduce[s] the stability and productivity of the natural systems that support life'.[4] Rather than looking merely to empirical evidence of what *is*, McMichael writes, 'the health sector must lift its gaze to bigger, ecological horizons' and epidemiologists must "'anticipate the future'" to influence of what *ought* to be.[5] It would take another two decades until the Rockefeller Foundation and the *Lancet* commissioned a group of researchers from the health and development sectors to assess the impact that anthropogenic changes to the Earth have had on human and non-human life. Chaired by McMichael's successor Andy Haines and citing *Planetary Overload* as a key reference, the commission concluded in their foundational 2015 report that the destabi-

[2] B. Ward and R.J. Dubos, *Only One Earth: The Care and Maintenance of a Small Planet* (New York: Norton, 1972), p. 195.

[3] P.R. Ehrlich, *The Population Bomb* (New York: Ballantine Books, 1968); S. Boyden. 'The environment and human health', *The Medical Journal of Australia* **24** (1) (1972): 1229–34.; R.J. Dubos. *Man Adapting* (New Haven, CT: Yale University Press, 1965).

[4] A.J. McMichael, *Planetary Overload: Global Environmental Change and the Health of the Human Species*, (New York: Cambridge University Press, 1993), p. xvi.

[5] J. Dunk et al., 'Eco-anxiety and environmental history: A forum', *International Review of Environmental History* **10** (1) (2024): 781.

lisation of ‘Earth systems’ indeed constitutes a health crisis.[6] In the commission’s report, the tool for ‘anticipating the future’, following McMichael’s demand, is given by the concept of the ‘planetary boundaries’ which attempts to quantitatively define the thresholds that would demarcate a ‘safe operating space’ for human activity.[7]

Dunk et al. place the emergence of the planetary health framework in the historical context of epidemiology and a ‘long history’ of physician advocacy.[8] This article traces a different but complementary genealogy of planetary health. Rather than focusing on the work of ‘radical epidemiologists’,[9] I investigate the underpinnings of their ‘planetary thinking’ that sets them apart from similar frameworks, such as One Health and Global Health. I am particularly interested in how the common description of the planet as ‘sick’ draws from a physiological understanding of health based on a hegemonic modern determination of the standard functioning of a living organism, characterised by a dynamic stability within narrow limits. I trace a genealogy of this understanding through the development of the concept of *homeostasis*, which first emerged in early twentieth century physiology, before being applied in cybernetic and mid-century ecological discourses, and reappearing in Lovelock’s notion of ‘geophysiology’ that formed the basis of the ‘Gaia Hypothesis’. While the meanings and applications of homeostasis vary in each of its articulations, a physiological definition of health returns that also holds certain prescriptions for politics and society. In reference to

[6] S. Whitmee et al., ‘Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health’, *The Lancet* **386** (10007) (2015): 1979.

[7] J. Rockström et al., ‘A safe operating space for humanity’, *Nature* **461** (2009): 472–75. First articulated in 2009 by a group of scientists at the Stockholm Resilience Centre, the since updated planetary boundaries model draws on a vast amount of environmental data to define nine boundaries, including climate change, biodiversity, land-system change, and phosphorus and nitrogen cycles, amongst others. Planetary boundaries mark a limit beyond which earth systems will be unable to return to a state of Holocene stability, upon which the habitability of the planet for human life depends.

[8] Dunk, ‘Eco-anxiety’, 779.

[9] Ibid., 780.

Katherine Hayles' feminist critique, my analysis seeks to test the limits of this physiological model of health, that seems to falter when scaled up to the planetary, following the demand to measure and monitor the planet as a way of bringing the planet in crisis back under control. Such a strategy might become untenable, if the accumulation of data and increasingly automated prediction fails to respond to the far smaller scales of singular localities, the situated worlds from which this data is extracted.

The physiological model of health

While the contemporary concept of planetary health draws much of its currency from its supposed 'novel way of thinking', the linkage of ecological concerns with human health and medical theories has a far longer history. As environmental historian Gregg Mitman has shown, the physiological notion of the body's 'normal self-regulating functions' significantly shaped the American conservation movement in the early twentieth century.[10] Frustrated by the medical and practical limitations of the then-dominant germ theory, which focused on single, isolated causes of disease, physicians and biologists became interested in physiology as a theory of health that presented a more integrated view of the individual and its environment, underpinned by the notion that nature is 'naturally' self-healing. This neo-Hippocratic discourse, as Mitman argues, would inform not only the idea of human pathology but also of 'Land Pathology'. Such would be demonstrated, for example, in a speech by the famous American conservationist Aldo Leopold, which equated the pathological with the functional imbalance between society and land.[11] This imbalance was understood to be caused by humans and, at the same time, rectifiable through forms of human intervention in the form of wildlife management or conservation.

[10] G. Mitman, 'In search of health: Landscape and disease in American environmental history', in J. Krige and D. Pestre (eds), *Science in the Twentieth Century* (Reading, UK: Harwood Academic, 1997), pp. 303–16.

[11] Mitman, 'In search', 187.

Leopold's search for health in stability reflected a larger trend following the crisis years after the first World War and the Great Depression, during which scientists focused on the relations between science and society, hoping to discern a scientific foundation for a peaceful integration of the individual and society.[12] Among them was the American physiologist Walter B. Cannon, who coined the concept of 'homeostasis' to explain how biological and, by extension, social organisms could maintain their internal stability under unstable external circumstances.

Throughout his career, Cannon favoured laboratory experiments on animals and vivisection as scientific methods for uncovering the internal mechanisms of physiological health. He reasoned that ingenious mechanisms must constantly operate within the 'fluid matrix of the body' to keep disturbances to the stability of the whole 'within narrow limits'; limits whose values could be scientifically determined.[13] Such a distinctive interplay between reciprocally regulating organs in a living organism – the tendency of which was to always return to a harmonious equilibrium – required its own designation: 'homeostasis', named after the Greek expression *homoiostásis*, meaning as much as 'staying the same'.

The concept of homeostasis quickly gained prominence across disciplines, as it delivered a common principle by which different kinds of organisation could be explained. Cannon also made concerted efforts to write for a general public, for instance in his landmark publication *The Wisdom of the Body* (1932), in which he tried to apply his laboratory findings to a wider socio-political context.

[12] J. Tanner, 'Weisheit des Körpers' und soziale Homöostase. Physiologie und das Konzept der Selbstregulation' (Wisdom of the body and social homeostasis. Physiology and the concept of self–regulation), in P. Sarasin and J. Tanner (eds), *Physiologie und industrielle Gesellschaft. Studien zur Verwissenschaftlichung des Körpers im 19. und 20. Jahrhundert* (Physiology and Industrial Society. Study on the Scientification of the Body in the 19th and 20th Century) (Frankfurt am Main: Suhrkamp, 1998), pp.129–69.

[13] J. Tanner, 'Organisation for physiological homeostasis', *Physiological Reviews* **9** (3) (1929): 399-400; C. Bernard. *Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux* (Paris: Baillière, 1878).

If, in an organism, self-regulating mechanisms of mutually dependent cells ensure stability – where each cell maintains its own welfare while supporting the whole – could not the same principle be applied to the benefit of a social organism? As he writes in the epilogue on 'the relations of biological and social homeostasis', 'the welfare of the larger community and its individual members are reciprocal' and this is the case in the body *politic* just as in the body *physiologic*.[14] In a quite literal transposition of physiological mechanisms, Cannon describes social systems as 'naturally' fluctuating between hot and cold – or in political terms 'radical revolt and conservatism' – with the 'nearest equivalent to the fluid matrix of the animal organism' being the transportation system (the infrastructure) of a state and nations; streets, canals, roads and railroads functioning like blood and lymph, transporting goods to specific distribution points like oxygen and sugar are transported around the body.[15] According to this physiological model of health, an organism, social or living, is healthy if it is able to maintain stability of the whole – homeostasis – under unstable environmental conditions.

As he would elaborate in his memoirs *The Way of the Investigator* (1945), for Cannon, stability, liberty and democracy are necessarily linked. Only in a democracy where individuals are free to do what they wanted based on solid education can science flourish and serve the protection of democratic freedoms and stability.[16] Yet, when drawing parallels between biological and social homeostasis, Cannon also intuited the limits of this analogy. For one, the establishment of the interdependence of the individual and the collective gave rise to a fear that these stabilising mechanisms of the whole might endanger the freedom of the individual. With this risk in mind, Cannon emphasised that social organisation, like the physiological division of labour, first and foremost frees the individual from having to tend to its physical needs alone, thus freeing the 'lib-

[14] Cannon, *Wisdom of the Body*, p. 310.

[15] Ibid., p. 312.

[16] W.B. Cannon, *The Way of an Investigator: A Scientist's Experiences in Medical Research* (New York: W.W. Norton & Company, 1945), pp. 164–65.

erty of action'.[17] As he wrote in a later text, 'Control is only tolerable if it results in greater human freedom'.[18] Freedom, here, is understood in a negative and anthropocentric sense, as the freedom from the 'animalistic', bodily needs of pain, hunger, fear and rage. Despite Cannon's own inhibitions to the application of homeostasis across disciplines and contexts, over the course of the twentieth century, the concepts he used to describe physiological functions of healthy organisms would influence fields far beyond medicine.

Homeostasis in man, machine and ecosystems

In the following decades, the physiological concepts of 'homeostasis', 'self-regulation' and 'control' became central to emerging theories of cybernetics and system ecology. Following the end of the Second World War, homeostasis played a fundamental role in the development of the cybernetic paradigm pioneered by the American mathematician Norbert Wiener and further developed during the Macy Conferences (1946–1953). Cannon's long-time collaborator, the Mexican physiologist Arturo Rosenblueth, is credited with introducing Wiener to the concept of homeostasis.[19] An early paper, co-authored by Rosenblueth, Wiener and Julian Bigelow, of whom the latter two had worked together during the war on building an anti-aircraft predictor machine,[20] proposed to study the behaviour of different orders of complex entities through the common lens of self-regulating mechanisms.[21]

[17] W.B. Cannon, 'The body physiologic and the body politic', *The Scientific Monthly* **79** (1) (1954): 24.

[18] Ibid.

[19] A. Pickering, 'The birth of cybernetics', in *Foundational Papers in Complexity Sciences* (Santa Fe: Santa Fe Institute Press, 2024) pp. 115–27.

[20] P. Galison, 'The ontology of the enemy: Norbert Wiener and the cybernetic vision', *Critical Inquiry* **21** (1) (1994): 228–66.

[21] Pickering, 'The birth of cybernetics'.

In 'Behavio[u]r, Purpose and Teleology', the authors suggest that complex systems, whether organic or artificial, could be studied comparatively if only behavioural output were considered – rather than their internal structure or essence – and the purpose of their behaviour is understood to be oriented towards a single goal.[22] Commonly framing complex systems as homeostatic systems that regulate themselves via negative feedback loops tending towards a homeostatic state dissolved the distinction between animal, human and machine; this rendered them operable and predictable via the same functional approach.

In describing the cybernetic apparatus of his time, Wiener explicitly uses a physiological analogy:

> They contain sense organs, effectors, and the equivalent of a nervous system to integrate the transfer of information from the one to the other. They lend themselves very well to description in physiological terms. It is scarcely a miracle that they can be subsumed under one theory with the mechanisms of physiology.[23]

However, it was the joining of feedback loops – which belong to the ancient theme of cycles and circulation[24] – with information theory that gave rise to the cybernetic paradigm.[25] In what Katherine Hayles characterises as a the first wave of cybernetics, information was key.[26] It is that which the system transmits to the environment and back, allowing the system to measure the difference between the current state and the programmed goal and self-correct, precisely, through a feedback loop mechanism. Accordingly, thought, communication and control were assumed to be essentially information-

[22] A. Rosenblueth et al. 'Behavior, purpose and teleology', *Philosophy of Science* **10** (1) (1943): 18–24.

[23] N. Wiener, *Cybernetics or Control and Communication in the Animal and the Machine*, Reissue of the 1961 2nd edition (Cambridge, MA: MIT Press, 2019), p. 62.

[24] N.D. Hopwood et al., 'Cycles and circulation: a theme in the history of biology and medicine', *History and Philosophy of the Life Sciences* **43** (3) (2021).

[25] N.K. Hayles, 'How we became posthuman: Ten years on. An Interview with N. Katherine Hayles', *Paragraph* **3** (33) (2010): 323.

[26] For an overview of the 'three waves of cybernetics' according to Hayles, *Posthuman*, pp. 17-19.

al processes – that is, processes which were technically expressible in mathematical terms.[27]

As Hayles has shown, this version of cybernetic theory relies on a specific definition of disembodied information, 'as an entity distinct from the substrates carrying it'.[28] Formalised in Claude Shannon's 'mathematical theory of communication', information was here defined as a statistical pattern of variations that has no dimension, materiality or connection to meaning. Meaning is produced when a pattern is recorded and encoded; until then, however, information is free-floating, decontextualised and therefore at hand to those who possess the intellectual and technical capabilities to measure it. Still, even Shannon was sceptical about the application of his theory beyond theoretical engineering and 'frequently cautioned that the theory was meant to apply only to certain technical situations, not to communication in general'.[29]

Similar to Cannon, who had worried about the freedom of the individual in a social system that tends towards stabilisation, Wiener was concerned what this new science of control could become in the wrong hands. Writing in the wake of 'Belsen and Hiroshima' he was acutely aware of modern technologies' potential for good and evil and warned against the wishful thinking of his social science colleagues that cybernetics could have 'therapeutic effect in the present diseases of society'.[30] In contrast to Cannon, perhaps, Wiener had a less optimistic view on the liberal citizen subject, who uses scientific knowledge to make well-informed, rational decisions in the interest of the social good. As a consequence, Wiener wanted to restrict cybernetics to physiology and psychology, which he believed were disciplines most remote from war and exploitation.[31]

[27] N. Wiener, *Cybernetics or Control*, p. 182.

[28] Hayles, *Posthuman*, p. xi.

[29] Ibid., p. 19.

[30] Wiener, *Cybernetics*, p. 39.

[31] Ibid., p. 42. Given that the optimisation of new forms of management and control, as well as torture, in the twentieth century, significantly built on behaviourist theories, it could be questioned how remote physiology and psychology really are from war and exploitation.

Hayles suggests yet another problem – that the simplified theory of information, initially intended for engineering purposes only, quickly became an ideology that was then reified in the model of 'information as entity' and applied beyond a technical context.[32] Subsequently, information came to be regarded as if it could accurately represent the complexity of embodied reality, despite it being claimed to exist separately from this reality. Understanding not only human thought but the entire universe as informational processes propelled the scientific and literary imagination of a disembodied mind, freed from the constraints of a finite body – a feverish dream of an endlessly extendable organic life, for instance, by uploading one's consciousness to an external hard drive, a dream that still thrives among Silicon Valley's tech elites.[33]

Embodiment, here, is not congruent with a self-contained, fixed 'body' but refers to the situated experience of a constant negotiation between and articulation of inside/outside, self/other, mind/body. Hayles identifies this destabilisation of distinct and fixed bodies in cybernetic systems with two contradictory figures: the cyborg, who defies the preceding dichotomies by neither affirming one or the other side; and the liberal humanist subject, whose locus of identity builds on an imagined autonomy from any outside, other or body by affirming the idea of a self-contained, rational, mind. It is this latter form of disembodiment, the performative erasure of difference, on which the liberal subject bases its supposed universality. [34]

As generations of critical decolonial and feminist scholars have shown, the prescription of an objective meaning a disembodied and placeless gaze as the ideal mode of scientific inquiry has long served to

[32] Hayles, *Posthuman*, pp. 17–18, 74. In Hayles's characterisation of the three constellations of cybernetics, second-order cybernetics is defined in part by its critique of first-order cybernetics' narrow emphasis on stability and machines its failure to include the observer within the cybernetic feedback loops. Second order cybernetics was thus more concerned with questions of consciousness, reflexivity, and 'the study of man'.

[33] A.R. Rosenthal. *Prosthetic Immortalities: Biology, Transhumanism, and the Search for Indefinite Life* (Minneapolis: University of Minnesota Press, 2024).

[34] Hayles, *Posthuman*, pp. 3, 145.

delegitimise the epistemic agency of feminised, racialised and naturalised subjects. Yet, as Donna Haraway has argued, the production of scientific knowledge is always already situated within socio-historical context and power relations that constitute the conditions of possibility of any scientific practice or technological application.[35] Moreover, the obscuring of lived experiences and the physical traces of violence and exploitation in the performance of scientific objectivity often helps to maintain unequal power hierarchies. In the context of climate justice debates, for instance, the effects of treating information as separate from materiality and context are illustrated by the ambiguity of carbon offsetting practices. Often echoing colonial land-grabbing practices, carbon offsetting has allowed rich states and corporations to fund reforestation and conservation projects in countries of the Global South in order to 'cancel' their emissions, while simultaneously continuing or even increasing their investments in the fossil fuel industry, not seldom displacing local communities and escalating conflicts over subsistence farming and hunting, as a result.[36]

On the one hand, the cybernetic paradigm opened a path beyond the essentialist debate between vitalism and mechanics, creating a science that can cope with a dynamically changing and interrelated world. On the other hand, the risk of making everything reducible to information articulates a continued desire to find a unified scientific basis on which things in the world, even though incommensurable and singular, could be governed and brought under the reach of control by a small elite.[37] So, while especially later cybernetic counterculture movements envisioned horizontal and decentralised interconnected systems, the technical application of cybernetics tended to work in the opposite direction, concentrating control.[38]

[35] D.J. Haraway, 'Situated knowledges: The science question in feminism and the privilege of partial perspective'. *Feminist Studies* **14** (3) (1988): 575–99.

[36] N. Redvers et al., 'Carbon markets: a new form of colonialism for Indigenous Peoples?', *The Lancet Planetary Health* **9** (5) (2025): e421–e430.

[37] Hayles, 'How we became posthuman', 325.

[38] F. Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: University of Chicago Press, 2008).

The initial technical application of cybernetic theory quickly found its way into other fields, including social sciences, anthropology and ecology, not least due to the various disciplines present at the Macy Conferences. In 1946, the British ecologist G. Evelyn Hutchinson presented at the conference, later publishing his influential paper 'Circular Causal Systems in Ecology', which laid the foundation for systems ecology. Hutchinson validated Wiener's homeostatic principle for the study of ecosystems, affirming that the same type of 'learning', i.e. negative feedback loops and self-correction within narrow limits, that occurs in cybernetic machines, also takes place in ecosystems.[39] Directly transferring the model of electrical circuits to the description of ecosystems led ecologists, such as Howard T. Odum, Hutchinson's student, together with his brother Eugene, to conceptualise the natural world in terms of 'flows' of nutrients and energy that could be coded into informational patterns and thus, directly transposed from the organism to the computer.[40]

Even though the term 'cybernetics' vanished from the academic stage, its central premise – the possibility of exercising control over homeostatic systems – persisted, along with the technocratic dream to achieve societal stability via scientific means. Especially the early developments of a system's view on the world, which operated largely on mathematical equations with little reference to observations, were motivated by the desire 'to find a theory that might unify the physical, biological, and social sciences, allowing the success of physics to flow into other fields'.[41] This 'technocratic optimism' became increasingly relevant in response to the growing

[39] F. Sprenger, *Epistemologien des Umgebens: Zur Geschichte, Ökologie und Biopolitik künstlicher environments* (Epistemologies of Surrounds: On the History, Ecology and Biopolitics of Artificial Environments) (Bielefeld: transcript, 2019), p. 210.

[40] P. Warde et al., *The Environment: A History of the Idea* (Washington, DC: Johns Hopkins University Press, 2018), pp. 159–160.

[41] P.J. Taylor, 'Technocratic optimism, H.T. Odum, and the partial transformation of ecological metaphor after World War II', *Journal of the History of Biology* **21** (2) (1988): 220.

concerns over the 'diseases of civilization', nuclear proliferation, pollution and overpopulation, and their effects on the stability of the biosphere.[42] Since the mid-twentieth century, it became thinkable 'to intervene in "unhealthy" ecosystems and to repair them with the knowledge of homeostasis, feedback and recursion as well as the technical possibilities of computers, to plan their design and to forecast their development', as Florian Springer writes.[43] The leap in computing power in the 1960s and 1970s enabled the simulation of complex networks and ecosystems, making it possible to digitally reify the 'causal circulations' that had previously been abstracted from analogue electronic circuits. For ecologists like Odum, the possibility of modelling earthly ecosystems on a computer proved the Earth's fundamental programmability, manifesting in the imperative for ecological engineering, management and control.[44] Yet, as Hayles succinctly puts it, 'the idea that feedback can control the uncontrollable has, in ecological contexts, proven to be a tragic illusion'.[45]

A planetary physician for a sick earth

With the convergence of cybernetics, system ecology and a jump in computer technology and a rising attention to global environmental changes, we can see a broad transition to system thinking as an ostensibly all-encompassing epistemic framework that was scalable to the whole Earth.[46] In the 1970s, Lovelock and Margulis co-published a series of papers and books in which they described the Earth as a bio-cybernetic entity in which life actively controls the

[42] Ibid.

[43] Sprenger, *Epistemologien* (own translation), p. 56.

[44] Ibid., p. 226; also see H.T. Odum, 'Ecological potential and analogue circuits for the ecosystem', *American Scientist* **48** (1) (1960): 1–8.

[45] Hayles, 'How we became posthuman', 325.

[46] G. Rispoli, 'Planetary environing: The biosphere and the Earth system', in A. Wickberg and J. Gärdebo (eds), *Environing Media* (London: Routledge, 2022), pp. 54–74.

conditions of the atmosphere.[47] According to the 'Gaia Hypothesis', over billions of years, microbes and bacteria jointly interacted with geochemical cycles to produce an atmosphere and temperate conditions under which life could flourish despite changes in solar radiation.[48] This thought, 'that we inhabit and are part of a quasi-living entity that has the capacity for global homeostasis', constituted the basis of what Lovelock would call 'geophysiology'.[49]

Geophysiology applied a physiological model of health to the Earth conceived as a heterogeneous yet unitary system. With growing evidence of anthropogenic climate change and its ecological consequences, Lovelock mobilised 'geophysiology' to argue what a planetary medicine should look like. In his book, *Gaia: The Practical Guide of Planetary Medicine*, which was meant for a public readership, Lovelock invokes the figure of a planetary physician who can make an accurate diagnosis of the Earth's health condition. Suggesting that incidental pollution should not distract from the overall picture, he asks, '[c]ould it be that our deep hypochondria about the state of the global environment masks a real disease of our planet?'[50] To Lovelock, it was essential to see the 'whole Earth' from above. Only from this top-down view can a planetary scale of health and disease be properly determined, which would require the design of an extensive health monitoring service. Accordingly, '[a] planetary physician needs the skills and practical wisdom of the doctor, as well as those of the engineer, in seeking to understand the health of

[47] For a detailed historical account of Lovelock's early development of the Gaia hypothesis while working for NASA and Shell Company, see Leah Aronowsky, who shows, amongst others, how the argument of Gaia's self-regulating capacity was used by fossil fuel companies to sow seeds of early climate change denialism, by arguing that climate change was not necessarily caused by anthropogenic CO_2 production. L. Aronowsky, 'Gas guzzling Gaia, or: A prehistory of climate change denialism', *Critical Inquiry* **47** (2) (2021): 306–27.

[48] L. Aronowsky, 'Atmospheric homeostasis by and for the biosphere: The Gaia hypothesis', *Tellus* **26** (1–2) (1974): 2–10.

[49] J.E. Lovelock, 'Geophysiology: A new look at earth science', *Bulletin of the American Meteorological Society* **67** (4) (1986): 395.

[50] Lovelock, *Planetary Medicine*, p. 9.

Gaia'.[51] The task is to carefully study the system values of the patient – using a satellite radiometer to monitor its 'body temperature', a barometer to measure its 'blood pressure', or to collect air, sea and soil samples for biochemical tests.[52]

Lovelock frames geophysiology's gift to geophysics as 'a way to look at the Earth mathematically that joyfully accepts the nonlinearity of nature without being overwhelmed by the limitations imposed by the chaos of complex dynamics'.[53] In other words, it is necessary to reduce complexity into an operable form organised by the most 'relevant' aspect of planet's health: its homeostatic capacity. By arguing for planetary health as a quantifiable state of relative stability between narrow limits, geophysiology promises a means of bringing the uncontrollable under calculative control through constant computational monitoring. This reveals a circular logic: life on Earth can be regulated because it is self-regulating. In this framing, planetary health is a matter of managing and optimising this 'natural system' by translating it into computable values. Planetary medicine, thus, follows an escalation logic, similar to large climate models whereby simulating complex systems requires increasingly more and accurate data. However, this data can only be processed if the model also evolves, creating an infinite demand for data production.[54]

Claiming that the 'real' diseases to Gaia's health could only be recognised from a view of the whole 'Earth System' from above, authorises solely the highly technologically mediated gaze of planetary health expert to define the nature of planetary challenges. This obscures the importance of any political question that would take place on a different scale, prioritising this predefined planetary scale over every other, which in theory are to answer to and perhaps be sacrificed for the stability of the whole.

[51] Ibid., p. 13.

[52] Ibid., pp. 13, 57–58.

[53] J. Lovelock, 'Geophysiology, the science of Gaia', *Reviews of Geophysics* **17** (1989): 215–222.

[54] Sprenger, *Epistemiologien*, p. 56.

Planetary health governance?

While 'geophysiology' did not catch on in the same way as 'Gaia' did, Lovelock's 'geophysiological ideas' still were an influential reference point for a group of Earth System Scientists in the twenty-first century, who mobilised the notion of the Earth system physician and of the Earth as a self-regulating system to prescribe guidelines for its research and governance.[55] While the term 'Earth System' was firstly formalised by NASA in 1986 without explicit reference to Lovelock, his work is repeatedly cited in the synthesis project of the International Geosphere-Biosphere Programme (1999–2003). Contributing scientists to the synthesis report were divided over the scope of Gaia's applicability. On the one hand, earth system scientist Timothy Lenton affirms self-regulating 'Gaia' as a subsystem of the broader Earth system with a restricted application of the concept of 'homeostasis'.[56] Atmospheric chemist, Paul Crutzen, who coined 'the Anthropocene' concept, on the other hand, critiques the misleading connotation of homeostasis as implying the idea of a self-healing Gaia.[57] With this, the IGBP synthesis project prepared the path for influential concepts such as the 'Anthropocene' (2000), the 'Planetary Boundaries' (2009), the 'Great Acceleration' (2015), all of which are part of the initial report on planetary health (2015).[58]

Although planetary health encompasses many different and not always commensurable perspectives and disciplines, there is a persistent emphasis on monitoring and control in the literature. This is illustrated by a 2018 paper published in *Lancet Planetary Health*, in which the group of prominent authors including Andy Haines,

[55] H.J. Schellnhuber, '"Earth System" analysis and the second Copernican Revolution', *Nature*, **402** (S6761) (1999): C19–C23; W. Steffen et al., 'The emergence and evolution of Earth System Science', *Nature Reviews Earth & Environment* **1** (1) (2020): 54–63.

[56] W. Steffen et al., *Global Change and the Earth System: A Planet under Pressure* (Heidelberg, Berlin: Springer, 2004/2005), pp. 70–71.

[57] Ibid., p. 72.

[58] W. Steffen et al., 'The trajectory of the Anthropocene: The Great Acceleration', *The Anthropocene Review* **2** (1) (2015): 81–98.

argue for the establishment of a 'Planetary Health Watch'.[59] This proposed integrated monitoring system would have the purpose to 'collect, combine, analyse, visualise, and share health and environmental data at different temporal and spatial scales to assess complex inter-relations, patterns, and trends'.[60] The underlying premise is that the failure of political action to consequentially mitigate climate change is based on a lack of information and knowledge available to decision makers and 'stakeholders', who tend to overestimate the capacity of their ecosystems to recover from extractive resource use and demographic pressures.[61] Only through the constant monitoring and modelling of the whole system, the argument echoing Lovelock follows, can the origin and nature of the planetary scale disease be accurately understood, and decisions be made on how to cure and prevent it, in order to reinstate a 'normal' and 'secure' state, while leaving the epistemic framing intact.

The central problem of planetary health is thus framed as a data-knowledge gap rather than, for instance, a conflict of vested political interests. Subsequently, the best way to address planetary health is to fill this gap with more measuring, monitoring and data. This perspective is illustrated by a recent statement from Erin Hughey, the Director of Global Operations of the University of Hawaii's Pacific Disaster Centre, which in May 2024 announced their joint partnership with the Sunway Centre on Planetary Health to establish the first comprehensive 'Planetary Health Assessment'. In the statement, the director Erin Hughey suggests that data alone does not provide insight, as it must be translated into 'actionable' and comprehensible representations.[62] And yet, she follows this with the seemingly contradictory claim that '[t]his effort will also help identify any potential

[59] A. Haines et al., 'Planetary Health Watch: Integrated monitoring in the Anthropocene epoch', *The Lancet Planetary Health* **2** (4) (2018): e141–e143.

[60] Ibid.

[61] Whitmee et al., 'Safeguarding human health', p. 2012.

[62] Pacific Disaster Center, 'PDC and Sunway University to partner on first Planetary Health Assessment': https://www.preventionweb.net/news/pdc–and–sunway–university–partner–first–planetary–health–assessment. (accessed 20 Sept. 2025).

data gaps'.[63] Put differently, the insight gained from data collection, ultimately, serves the end of more data collection. This is not to say that quantification, measuring and modelling are not useful and necessary to evidence environmental destruction or test for hazardous components. It is not to critique abstraction as an ontological wrong. Rather, I argue that a certain mode of framing health in terms of an overall stability through monitoring and predictive modelling might become impervious to the localised specificities of health and disease. The necessity to have the whole planet in view is what strikes me as difficult to combine with responsive environmental justice, because it assumes a benevolent, yet centralised and detached, locus of control.

However, as Jennifer Gabrys reminds us in her reflection on environmental justice 'Media technologies such as computational sensors and the data they generate produce distinct approaches to environments; they sense a planet in crisis, but they also inform the conditions of the planetary crisis'.[64] In other words, the models and monitoring systems used to sense planetary conditions are not neutral technologies that produce objective information about the condition of the planet, but, in every production and representation of data, there is also a concealment. In every digital or data representation, a decision before the decision of what should be researched, looked at, surveilled or just cared for, has entered, implicitly prescribing who or what can be neglected. They do not represent a world out there but constitute in their necessarily limited fashion the worlds we can engage with and respond to.

What is left out is that which cannot be represented computationally, that is that which is not quantifiable, such as the *longue durée* of colonial extraction and industrial pollution, or the relations of power that shape geopolitical terrains. The challenge then arises: how to prevent mapping and monitoring from becoming a means of surveillance, control and the pretence of further resource extraction? Said differently, how to ensure that planetary health, understood as the stability of the whole, does not overwrite environmental justice?

[63] Ibid.
[64] J. Gabrys, 'Sensing a planet in crisis', *Media+Environment* **1** (1) (2019).

Conclusion

Tracing the development and differential applications of the concept of 'homeostasis' throughout the twentieth century, in physiology, cybernetics and system ecology, demonstrates how the notion of a 'dynamic stability within narrow limits' fundamentally shaped the understanding of health, whether in living or artificial forms of organisation. Framing complex entities, via the concepts of self-regulation and feedback mechanism, as systems created epistemic conditions to integrate the study and surveillance of arguably singular scales of social, organic or planetary organisation. This epistemic synthesis, I argue, provided an intellectual ground for the development of the planetary health framework. It also led to a recognition of the complex and contingent nature of reality – too vast and complex to be represented in a single model – while still sustaining the dream of control: the belief that increasing computational power and data accumulation would eventually render the uncontrollable controllable.

Outlining the history of these ideas raises the question of limits. Not of planetary boundaries, but the limits of a logic where the health and governance of Earth is conceived as a planetary system, focused on risk prediction for the health of human and non-human communities. While it is clear that the consequences of climate change, biodiversity loss and so on, have detrimental and asymmetric effects on the world, it remains contested what their underlying conditions are and how to best address current crises. While the discourse on planetary health is heterogenous, there is a tendency to frame humanity as a universal agent that acts as both the planet's disease and doctor. Yet framing systems through information abstracted from their contexts, and health in terms of a statistical equilibrium, risks occluding the ongoing histories of social and racial antagonisms, according to which some lives, beings and places are deemed more valuable than others. In other words, it risks obscuring the political nature of the differentiation that is being made between those places and entities that are worthy of protection and those that are being sacrificed to maintain the stability of the whole.

Consequently, modelling the planet as an integrated system following the physiological model of health tends to frame social hierarchies and inequality as a product of badly governed flows of goods, rather than the product of a systemic reliance of global capitalism on cheap labour and resources. In a logic of planetary health understood as a dynamic within narrow statistical limit values, boundaries are represented as scientific facts, occluding what they also are: results of economic and political negotiation. A critical reflection on the pitfalls of understanding health *qua* physiological stability demonstrates that planetary health should not be understood exclusively in physiological or systems science terms, for the point is that a medical perspective, while not false, must be differentiated from health. While they may overlap – medicine might be a tool for the mitigation of symptoms – medicine and health are not equivalent. This raises further questions such as: What is health outside a reductive biomedical focus on the functionality of body? Who must live and who must die for 'the population', 'species' or the 'Earth Systems' to count as healthy?

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