NEW MATERIALISM AND THE PLANETARY TURN: FROM QUANTUM MECHANICS TO PLANT LIFE

The humanities and the social sciences are currently in the midst of taking a 'planetary' turn as they try to come to terms with the causes and effects of climate change and ecological catastrophe.[1] As Bruno Latour and Peter Sloterdijk have pointed out, the shift from a perspective that is 'global' to one that is 'planetary' entails a meta-discourse not only on 'globes' but, more primordially, on 'spheres'.[2] In particular, what poses a crucial problem is how to think critically about the interaction of the bio-sphere with the techno-sphere in the Anthropocene, not forgetting that the concept of the Anthropocene itself has undergone severe critique from the perspective of multi-species ethnology as well as de-colonial discourses.[3] To address this problem of spheres, two distinct discursive fields stand out as being particularly helpful: on the one hand, 'science and technology studies' (STS), and in particular the group congregating around 'new materialisms' where Rosi Braidotti and Karen Barad are crucial figures, and on the other 'biopolitics' as this emerged first thanks to Michel Foucault and later in the Italian variants associated with Antonio Negri, Giorgio Agamben and Roberto Esposito.

Thomas Lemke's more recent work on the 'government of things' has drawn attention to the ubiquity of technologies of power – devices, apparatuses, dispositifs – that make possible our 'metabolism' with nature (to speak in Marx's language), and thus lie 'below' even the most basic of 'base' productive structures that we can associate with capitalism.[4] The concept of device or apparatus is one that is shared by both STS and biopolitical discourses, but this fact, as Lemke shows, can easily cover up the different strategies and finalities pursued by both discourses. Indeed, Lemke criticizes 'new materialism' by emphasising the centrality of the 'spherical' moment, that is, what in biology is called the 'milieu' within which all life takes place. It is precisely on this relation between technological apparatus and biological milieu we will focus our comments.

Lemke's treatment of new materialism suggests that biology and its idea of milieu is irreducible to the quantum mechanical conception of matter with which Barad has so successfully worked to establish her onto-epistemological standpoint. At the same time, and following the STS mainstream, Lemke insists that the dependency of life on a milieu is closely tied up with the possibility of its technological regulation. Our chapter critically engages this point by bringing to bear an other-than-human perspective on life, milieu, and governmentality that is linked to the emergence of plant studies.

For Barad and Lemke, life's dependency on political technologies is necessarily imbricated with the question of ethics, in the sense of the reflexive conduct of life. But whereas Barad leans on Levinasian ideas of 'responsibility', Lemke – drawing from Foucault's engagement with Socratism in his last Lectures at the Collège de France – proposes to recuperate a conception of 'critique' as a form of life. But are these the only options? In this chapter, we suggest that a planetary conception of communities of life underpinned by an affirmative biopolitics may be more suitable to think the interactions between bio- and techno-sphere as well as the kind of responsibility required to respond to our current environmental predicament.

On the apparatus of quantum mechanics and the constitution of the physical world

Barad's version of new materialism shifts attention from 'things', understood as somehow existing prior and outside of the totality of their possible contexts, to 'phenomena' which only exist and are what they are in such relational contexts, without which they lack the capacity for 'phenomenalisation'.[5] For Barad, the 'apparatus' plays an irreducible and constitutive role as condition for each and every phenomenalisation.

Barad's interpretation of quantum mechanics is actually an interpretation of Bohr's interpretation of Heisenberg's uncertainty principle.[6] One of the earliest philosophical interpretations of Bohr's interpretation of quantum mechanics was given by Alexandre Kojève.[7] This interpretation is not considered by either Barad or Lemke. We shall return to its significance below. Barad's interpretation has had such an impact precisely because it sought to bridge the divide between nature and culture from the side of natural science, at a time when the divide, as Bruno Latour has shown, was so effectively deployed to counter awareness of climate change and to mobilize for a new 'climate regime'. The key to her position is the idea of 'agential realism': the term is complex and merits further breakdown. It is a form of realism in the sense that what is at stake is matter's behaviour; it is 'agential' in the sense that this behaviour of matter assumes that matter is somehow responsible for it, without imputing to matter any 'vitalist' or 'animistic' capacities.

Barad sides with Bohr's 'ontological' interpretation of Heisenberg's uncertainty principle, although 'ontological' might be an improper term. What she means is that 'ontological qualities are contingent on the specific experimental configuration designed to observe them' (59). To which must be added two things: the experimental configuration is not necessarily designed by

a human being, and the observer is not necessarily a human subject. What Bohr, according to Barad, meant is that there only 'exist' observation-apparatus-observer systems. Things exist because they relate to each other as such systems, which are thoroughly dialectical, in the sense that what counts as 'observer' and 'apparatus' in one system is 'observation' in another, and conversely. This explains the 'agential' aspect of her realism: it refers to Barad's neologism of 'intra-action' as the being-placed-in-observational-relation in and through a measurement or recording device. We will argue that a shift towards consideration of milieu can also be useful to question these devices, both ontologically and ethically.

Barad's interpretation adopts Bohr's quantum mechanical view of 'phenomena'. The idea is that what 'exists' does so because it is 'entangled' in an observationobserver system, and there is no 'outside' of such entanglements, neither for putative objects nor for putative subjects. Thus, on this view, ontology (just as much as epistemology) reduces to a theory of the apparatus. The key feature of apparatuses is that they make what Barad calls 'agential cuts': not only are they responsible for establishing certain realities of phenomena, for instance determining the momentum of a particle (while being unable to determine exactly the spatio-temporal location of the particle, and vice versa), but their agency is what brings about the existence of this or that phenomenon (i.e., the particle-in-movement or the particle-in-place, but not both). Furthermore, on this idea of phenomenon, neither particles nor waves exist 'as such' prior to the agential cuts that phenomenalise them in one way but not in another.

Barad's interpretation of Bohr proposes a different conception of physical causality, rather than doing away entirely with it. It is worthwhile to contrast this view with the earlier interpretation proposed by Kojève. For Kojève, by demonstrating the impossibility of measuring simultaneously and with absolute precision two canonically conjugated variables, like place and momentum, Heisenberg showed that 'physics cannot demonstrate the existence of an exact causal structure of the world neither by verifying exact predictions nor by attesting that same "causes" have same "effects" (...) This is why Heisenberg ends his article by noting that: "Because all experiences are subject to the laws of quantum mechanics, quantum mechanics has definitively established the non-validity [Ungültigkeit] of the principle of causality [Kausalgesetz]"'.[8] As Kojève understands this result, it means that one has to distinguish the 'world in itself', which is independent of our knowledge, from the 'physical world' given by and through physical experiences which 'are essentially inexact'.[9] The principle of causality means, ultimately, that 'it is possible to make exact and detailed predictions that can be verified experimentally. To negate this causal structure

simply means to deny the possibility of making such predictions'.[10] Where Heisenberg had left open the possibility that to speak of causality in physics after quantum mechanics was a 'matter of taste', Kojève is more trenchant: given the uncertainty principle 'we have to say that it is not possible any more to speak in physics of an exact causal structure of the world, neither in relation to the past nor in relation to the future. The idea of exact causal determinism does not have nor can have any physical application and it must, as a consequence, be definitively abandoned by physicists'.[11]

Bohr's 1928 interpretation of Heisenberg's uncertainty relation (the product of the uncertainties in the momentum and the position of a particle equals h/(4π) or more) turns it into 'an absolutely general principle, according to which no physical observation is possible without the state of the observed being modified by the very fact of having been observed'. From this 'entanglement' of observer and observation, Bohr shows the existence of 'a constant, absolute and universal limit to the precision of physical observations'.[12] It follows that the observed physical reality is 'aworld constructed with experimental givens that have been obtained, in the last instance, by physicists who employ material measurement devices, and which are themselves part of the real world that is investigated'.[13] In other words, for Kojève, the condition that an observer or observing system is itself part of a physical system that it is observing is definitive for what it means to speak of a 'physical' world, that is, the world studied by physics.

Of interest in Kojève's interpretation is that, just like the observer is part of the physical world that they observe and interacts or 'intra-acts' with what is observed, this 'physical' subject needs to be distinguished from what he calls the 'biological' subject. The 'biological'subject has an experience of things that is characterized by 'secondary' qualities that are conditioned by the necessary embodiment of the biological subject. These qualities, though, play absolutely no role in the physical world (and they also have no meaning for the 'mathematical' subject that sets up, for instance, the mathematical coordinates of mathematical reality). The 'physical' subject 'is not so to speak a 'pure consciousness' but an 'experimenter as such [Experimentierer überhaupt]'. It is essential for this subject to employ material devices to know an object or, more generally, its knowing necessarily implies physical processes and depends for its results on the nature and on the immanent characteristics of these devices'.[14] The physical subject as an experimenter is as such not a 'neutral' or 'objective' subject. It is self-reflective and aware of the way in which its experiments modify and manipulate the material world it sets out to explore. In other words, in this view, to know is to create the material world as we discover it. The physical subject as an experimenter is like the artist who creates worlds.

The result is that this physical world now excludes the reality of the causal structure. Since the reality of the phenomenon in the physical world depends on what Heisenberg and Bohr call 'Anschaulichkeit' (that is, depends on the intra-action between observer and observed), the reality of causality is thereby excluded. In Kojève's lapidary formula: 'l'intuitivité exclut la causalité'. Indeed, for Kojève the belief in causality can only be upheld within what he calls a 'biological' world, ultimately because our belief in causal relations stems from experiences tied to our having a body and being embodied, as for instance deciding to get up from a chair to make a cup of coffee. Our 'biological' world excludes, so to speak, that at times our decision to get up and make coffee ends with a cup of coffee while at other times it may end with scrambled eggs, whereas, the possibility that one 'cause' has different 'effects' (namely the exclusion that determinate causes lead to determinate effects) is very much constitutive of the quantum world. For Kojève, the wave/ particle superposition proves that there exists 'an essential difference between the physical and biological worlds': 'the anticausalism of modern physics can also be presented as a consequence of an essential difference between the physical and the biological world'.[15] In sum, on the quantum mechanical view of the world, determinism is thrown out of the window for the physical world. But this does not mean that it is absent in other worlds, such as the world of the living. But what does it mean to be a 'biological subject'? What distinguishes the biological world of the living from the physical world we are the authors of? And what does it mean that we are living and embodied beings inhabiting a physical world? According to Kojève, the physical subject as an experimenter is inseparable from the apparatuses and devices it employs to observe and know the world. They are enmeshed with each other. However, do we need to distinguish these apparatuses and devices from
the 'original technicity' of living things and biological subjects?[16]

For Barad, on Lemke's reconstruction, 'apparatuses are world-making practices that determine what counts as a "cause" or an "effect"' (66). This opens the question whether both Barad and Lemke might not be interpreting the concept of apparatus always already beyond its physical meaning, and rather projecting onto it a meaning that things have within what Kojève calls an 'anthropological' perspective of biological agency. In other words, should one not distinguish between physical and biological worlds, when applying the concept of apparatus? Arguably, the ontological make up of this 'biological' world is irreducible to quantum mechanics and also to a statistical interpretation of quantum mechanical results.

In addition, apparatuses are agencies of meaning: 'apparatuses are the material conditions of possibility and impossibilityof mattering; theyenact what matters

and what is excluded from mattering' (Barad cited on 66). By 'mattering' Barad just means the phenomenalisation of anything as observation in and through an observing system: matter always appears as significant to and for a system of signification (this includes even what is 'noise' for a given system, what signifies as 'non-signifying' for the observational terms of the given system). If not significant, then it does not appear at all: if it doesn't 'matter', it 'isn't' matter.

One thus arrives at the ethical component of Barad's theory. If apparatuses are the condition that anything 'matters' and 'exists', then one should 'accept responsibility for the specific material intra-actions and to permanently review and rework their boundaries' (66). What Barad means is that with quantum mechanics one is, at an ontological level, beyond the distinction between facts and values: 'facts are already value-laden, they embody normative preferences that give rise to some material configurations rather than others' (67). One can say that there is 'mattering' only for an observer who cares about it; something 'is' a signal (carries information) only for an observer who is looking out for such signals. Again, this statement is meant to be understood quantum mechanically, that is, not as an anthropological projection. And yet, it is difficult to make sense of Barad's point outside of the biological world, and of us as living beings among other living beings. Kojève is mindful to distinguish between the physical and the biological world, the techno- and the biosphere. In Barad, these two very different worlds seem to be mixed up. By contrast, we suggest that these statements make sense only within a biopolitical discourse in which 'we' are living beings among other beings, and 'we' (along with all other living beings) are also centres of value-ascription, observers that are looking out for such and such signals as a function of how they conduct their lives. If this is correct, then we can ask whether the Levinasian 'ethics of responsibility' that Barad attaches to the inevitability of agential cuts is the right ethical understanding for this biopolitical outlook. We shall address the question of ethics and biopolitics in the last section of the article when dealing with plant studies.

Given the above considerations, it is not surprising that Lemke's main critique of Barad is due to what he calls her 'material foundationalism'. By this he means Barad's tendency to 'a straightforward transfer of insights from science', namely, quantum mechanics, to the spheres of human life and ethics. Lemke's critique is that there is a problem with Barad's claim that quantum mechanics is 'the correct theory of nature that applies to all scales' (75). What seems to be missing here is precisely a theory of 'world' and 'world-making' – borne out by Kojève's early analysis. That every 'world' is 'made' in and through apparatuses does not mean that all 'worlds' are reducible to one such account of world-making, namely,

quantum mechanics. In other words, quantum mechanics may not serve as a good model to understand the specific features of the biological, living world.

Lemke's critical treatment of new materialism raises the question of why biopolitics is the better discourse within which to take up and articulate the insight of a constitutive entanglement between nature and culture, fact and value, matter and meaning. The reasoning seems to be imposed by the idea of 'government of things' that Foucault advances. Given the 'agential' understanding of 'things' qua phenomena (as result of apparatuses) one must look somewhere in the world for things that show capacity to govern themselves: Foucault was after 'a relational and self-reflexive mode of power that takes into account mechanisms of self-regulation and self-control' (117). We are here in the realm of the biological, living world which according to Esposito is governed by life processes that are always already political. Hence, the shift towards the paradigm of biopolitics. From here it is only a brief step to move towards ideas of feedback control and homeostatic systems which flow into the discourse of cybernetics. Cybernetics refers to the idea of 'government' (kybernetike as art of governing a vessel), and Foucault saw it as applicable across medicine, politics, and ethics (119).

With that one arrives at biopolitics through a series of intermediate steps. The first comes from a Foucault citation: modern 'politics has to work in the element of a reality that the physiocrats called, precisely, physics, when they said economics is a physics' (cited from Security, Territory, Population, 47 at 121). But by 'physics' what is meant is the 'physics' of homeostatic systems, that is, in the last analysis, from biology after the genetic revolution, when life is no longer explained by vitalist forces but by 'an informational understanding of the body and life' in terms of program and code (123), where 'genes and cells are material-semiotic entities: they are organic systems as well as "small machines" and "calculators". This "cybernetic" account of genetics is encapsulated in the surprising idea of a "biology without life"' (125). Still, the indistinction between living being and calculating machine occurs within the realms of living beings composed of parts that form selfmaintaining structures, rather than in the realm of quantum mechanics where individuals are indivisibles.[17] It is with the living that 'mattering' seems to come into its own. We suggest taking a closer look at the living world (or the biological subject in Kojève), rather than capturing the living through the physics of quantum mechanics.

The Spheres of Environmentality

The problem of critically investigating the relation between bio- and technosphere turns on understanding the uses of the concept of 'milieu'. Lemke's work throughout the years has been central to switching the focus of Foucault

studies from a discourse analysis approach (the idea of ‘knowledge/power’) to an approach based on the idea of governmentality, the conduct of conduct. Foucault followed Canguilhem in taking up the latter’s understanding of the biological concept of milieu in order to develop his own idea of governmentality. Governmentality assumes that human beings (but not only them) live by disposing and regulating things around them, in a milieu conceived of as ‘an interactive space, a relational network that constitutes the elements of which it consists, as much as it is itself their endpoint or outcome’ (131). The crucial idea of the milieu is that it ‘conceives of organisms as actively creating and transforming the milieus they inhabit’ (129), and so provides the biological side to the political aspect focused on cybernetics and on problems of ‘circulation’ of humans and things. However, Lemke’s innovative thesis in The Government of Things is that governmentality becomes truly an ‘environmentality’ when it realizes that ‘while the milieu is the object of regulations and adjustments, it also exhibits self-regulatory capacities that have to be respected and fostered. It defines an ‘intersection between a multiplicity of living individuals working and coexisting with each other in a set of material elements that act on them and on which theyact in turn’ (citing Security, Territory, Population 22, on 131). For Lemke, this biological idea of a self-regulating milieu, in and through which living beings attempt to regulate their own lives, that is, engage in the conduct of theirown conduct, is what grounds his claim that Foucault had already taken a kind of ‘planetary’ and ‘other-than-human’ turn: ‘Foucault quite clearly recognizes the idea that agency is not exclusively a property of humans; rather, agential forces originate in relations between human and nonhuman entities’ (131).

In keeping with a Foucauldian spirit, it is always useful to try to avoid doing the history of a concept from a teleological point of view. In this case, a teleological account of the concept of milieu in which the endpoint of the concept’s evolution lies with Foucault’s own interpretation of neo-liberal biopolitics, where government operates on the ‘vital norms’ of individuals (134), and ‘liberalism sets in motion a very specific concept of freedom that privileges mobility and movement and is utterly dependent on mechanisms of security: “Freedom is nothing else but the correlative of the deployment of dispositifs of security ... it is in terms of this option of circulation that we should understand the word freedom”’ (Security, Territory, Population 48–49, cited on 135). We suggest that it may be productive to move backwards from Foucault to Canguilhem and from Canguilhem to the thinkers who influenced his understanding of milieu: in this way one can see that a planetary problematic was always already implicit in the idea of the milieu and that such a genealogy

can offer different lines of flight for what 'environmentality' can mean, in particular, for the question of freedom and of ethics.

The history of the concept of the milieu is itself instructive for it points to a back and forth between mechanical and living understandings of the milieu, and ultimately accounts for the possibility of their conflation under the aegis of cybernetics, where homeostatic systems are taken as models for living beings.[18] Canguilhem's discussion of the concept of milieu was decisively influenced by the work of John Scott Haldane.[19] Haldane, together with the Russian geochemist Vladimir Vernadsky, were the first to propose a conception of life as environmentmaking, and thus laid the basis for the Gaia hypothesis, namely, that the biosphere creates and maintains homeostatically its own environment.[20] Haldane's crucial insight is that both vitalist and mechanical accounts of the phenomenon of life mistakenly assume that an organism can exist 'apart from its environment'.[21] For Haldane, instead, 'life' only makes sense as a continuous process of adaptation between organism and environment, where both display agential qualities: 'We perceive the relations of the parts and environment of an organism as being of such a nature that a normal and specific structure and environment is actively maintained. This active maintenance is what we call life'.[22] Indeed, Haldane's key axiom is that there exists an internal or 'dialectical' relation between organism and environment, between inside and outside: 'the environment is thus expressed in the structure of each part of the organism, and conversely'.[23]

What Canguilhem seems to have taken from Haldane is this 'dialectical' conception of the milieu or environment. Originally, as Canguilhem explains, the concept of the milieu had a mechanical sense, translating the Newtonian idea of 'ether' or 'fluid' as what accounts for action at a distance between bodies. If one were to apply this mechanical model of the milieu to living beings, then it would be like asserting that 'fish don't lead their lives themselves, it is the river that makes them lead it'.[24] There is here no possibility to think what we now know, namely, that not only fish do 'lead their own lives', but how they (as well as all other forms of life within the relevant milieu) lead their lives also 'land-scapes' and 'health-scapes' the river itself. By contrast, Haldane and Canguilhem proposed a 'biological' conception of the milieu that Canguilhem termed 'dialectical' because it is as if organisms pose questions to the environment which the latter then answers in terms that organisms can make sense of, as if life were a process of problemsolving. On this view, the milieu or habitat of an organism is its most favourable surrounding, but the surrounding is not simply 'given' to organisms as much as 'sought out' by them. This entails the idea that organisms move on the planet with a kind of map, looking out for certain places, and this

movement is also one that creates landscapes, that ‘molds’the habitat as a function of the spread of life forms in given geographical zones. As Canguilhem says, ‘if the living does not go looking for something, it gets nothing’, and to look for something requires orienting
oneself, having an image of one’s surrounding/world.[25]

In 20th century biology, it is Üexkull’s idea of Umwelt that best translates the ‘dialectical’ relation between organism and milieu, and its implicit sphericity. Umwelt, the surrounding/world of any organism (which Sloterdijk internally distinguishes through a typology of ‘spheres’, ‘bubbles’, ‘globes’, and ‘foam’) refers not simply to the physical surroundings of an organism (Umgebung) and even less to the ‘scientific world’ (Welt) as pictured, say, by ‘classical’ physics (although perhaps not entirely divorced from the world as pictured by quantum mechanics), but to the set of stimuli that signal to the organism what to do, that is, that turn the organism into an actant. The idea of a signal (more generally, of semiotics) is tied to meaning, and the main point of the Umwelt is that an organism ‘notices’ stimuli because it is ‘interested’ in them – it is ‘looking out’ for specific stimuli which signal it into action.[26] Based on this dialectical relation between organism and milieu (nature as a signifying world) Canguilhem gives his famous definition of the living: ‘a living thing is not a machine that responds by movement to stimuli, it is a machinist who responds to signals byoperations’.[27] It should be noted that Canguilhem’s metaphor of the living organism as a machinist does not imply a mechanistic worldview. Rather, Canguilhem’s machinist resembles Kojève’s physical subject as an ‘experimenter’ insofar as both are like artists that creatively transform the environment or milieu of which they are inseparably a part. The milieu is thus for Canguilhem a kind of ‘home’ or ‘dwelling’, a habitat, to the organism because it signals to the organism when to turn off and on a series of switches to move and get to where it wants to get, namely, to what satisfies a need. For Canguilhem, the way living organisms orient themselves is essentially defined by their needs, where the latter are not a given that determine our way of life but rather the way in which the organism evaluates what it is that it needs and how to satisfy these needs. In this sense Canguilhem was in dialogue with a Marxist understanding of need and how ideologies of need are employed to conduct our conduct, as Foucault would say. It is important to note that Canguilhem at one and the same time employs and deconstructs the analogy between life and machine, thus providing a theoretical platform from which to think the imbrication of bio- and techno-sphere. Living beings are not machines, but they are ‘experimenters’, in the Kojèvian sense, that use devices in order to homeostatically regulate their environments.

We are now also in a position to think anew about the question of free will and determinism that was raised by the revolution of quantum mechanics, and from which Barad draws out a Levinasian ethics of responsibility tied to the role of the experimenter. Once indeterminism is seen to be an essential feature of the physical world, and, conversely, once the observing subject is conceived as being part and parcel of the world they are observing, as determined or as indetermined as any other thing in the physical world, then it is clear that freedom and necessity can no longer be parsed along the division between subject and object, or along the division between living and non-living.

In articles dedicated to the genealogy of the concept of milieu, Florian Sprenger has shown the biopolitical underpinnings of Haldane's theory of environment: given that 'an organism and its environment are one' it is but a small step to see that the technological control of the environment becomes a feature of life itself.[28] In particular, when habitats come under stress, and the habitability of certain areas comes into question, then the techno-sphere becomes part of our living environment as an 'artifact of design'.[29] Relying on, and mimicking the biological features of life mentioned above, Sprenger notes how the design of the technosphere emphasizes the role of sensors 'that are capable of registering information about their surroundings' and act on organisms and their mobility as a consequence. Sprenger calls it 'environmental media', others speak of 'sensory society'.[30] Thus, the techno-sphere generates 'calculated and calculating environments' based on digital networks that map geographical locations: 'as populations move through those spaces using mobile media or other devices, they simultaneously generate knowledge and represent objects of knowledge'.[31] As Sprenger notes, this development was identified by Foucault as essential to the idea of 'security' as the set of dispositifs that seek to assure homeostasis in populations of living beings.

But one should note that when Foucault develops his conception of 'governmentality' as the 'disposition of things' in Security, Territory, Population he also returns to the mechanical conception of the milieu 'needed to account for action at a distance of one body on another'.[32] And when Foucault speaks of governmentality as a form of 'environmentalism', he means the possibility of technological modulation of the milieu.[33] Thus, Foucault departs from Haldane and Canguilhem because he poses the question of whether and how it is possible to alter the milieu through security dispositifs such that it affects the centre of values of the subjects of life. At this point, governmentality becomes a practice of subjection, in which the milieu 'disposes'things in such a way that the subject of life believes it is doing the disposing, it is pursuing its needs, while at the same time it is actually deposed from being an evaluator and becomes a value, a variable in a calculus of government. In this scenario, our technically modulated

Umwelt no longer signals to us as 'machinists' of our own lives, but instead tracks, via sensors, all our movements in order to algorithmically construe their 'significance' in view of conducting our conduct.[34] The digital conception of medium returns us to a mechanical view of the milieu as an in-between of two points ('network'), where the medium conditions both our freedom to speak, and our freedom to move ('the medium is the message').[35] For us, a critique of the mechanistic understanding of the milieu must be part of any emancipatory and affirmative biopolitics.

In the mechanistic worldview, freedom of movement becomes functional to the securitization of the milieus and the disposition of things that make possible human life within the techno-sphere. However, this is not the only possible way to think about freedom, nor the only possible outcome for planetary habitability. We suggest that it is possible to de-securitize Rosi Braidotti's definition of the posthuman as 'technologically mediated emphasis on life as zoe-centred system of species egalitarianism',[36] and in a certain sense invert the direction from technosphere back to biosphere. It is a matter of pursuing 'species egalitarianism' beyond the distinction of species and beyond the primacy of zoe itself.[37]

The first point to make is that the 'dialectical' conception of the milieu never constrains or coerces the organism into this or that movement. On the contrary, the constitution of a milieu allows for the movement of the organism to be the result of normative choices that all living organisms make. 'The animal's Umwelt is nothing other than a milieu centred around the subject of life values that makes up the essential part of what constitutes the living'.[38] For Canguilhem it is the 'subject of life' that disposes its milieu, or for whom its milieu is disposed in a certain way as a result of what can perhaps best be understood as a debate or dialogue (hence 'dialectical') that each organism has with its milieu. The organism brings to the 'middle' or 'milieu' its own values or norms for appreciating the situation or surroundings, while the milieu 'responds'to this laying out of a position or standpoint by pointing out where the organism can best affirm its values and flourish. In this sense, this dialectical or dialogical sense of milieu explains Canguilhem's other definition of life: 'to live is to spread out; it is to organize a milieu starting from a central reference point that cannot itself be referred to without losing its original meaning'.[39] Thus, to each living being belongs a drive to 'spread out', which should not be understood in Darwinian terms, as a Hobbesian struggle for survival, but rather in terms of a 'spacing' in view of constituting habitability or even 'dwelling'.[40] Furthermore, this 'spreading out' or 'spacing' is always already normative: the disposition of a habitat is done by living beings around themselves as centres of value. These centres of value exist by virtue of their continuous 'debate' and 'dialogue' with

their constituting habitat, so one could say that living values are de-centred and de-centring in so far as they emerge within communities of life forms rather than as the values of an isolated and self-enclosed agent. It is in this sense that, from a bio-planetary perspective, freedom of movement is a fundamentally normative conception while at the same time being a more-than-human attribute. Thus, it stands to reason that 'rights of nature', for instance in the case of rivers, speak of the right of the river not to be interfered or even dominated with respect to its freedom to flow, where it is understood that this 'flow' is itself de-signed by a complex 'dialogue' between the river and the other agents, some of whom may also be human, that are habitat-fashioning in that given place on the planet.[41]

The Planetary Turn from the Perspective of Plant Studies

Lemke's The Government of Things opens onto the 'planetary' dimension of the circulation of 'things': 'Life is not a given but depends on material conditions of existence within and beyond biological processes' (137). Planetary conditions for life refer to the idea of 'habitability', a concept that is derived from astro-biology and was operationalized with the Gaia hypothesis.[42] For Chakrabarty, the awareness of the human species as a geological force that risks disrupting the Earth's homeostatic (self-maintaining) capabilities requires a re-definition of the task of politics in relation to habitability: 'political action (...) is that which helps humans to be at home on earth beyond the time of the living'.[43] This time 'beyond'the living is what Povinelli calls the 'ancestral' and is linked with varying conceptions of 'geopower'.[44] In this section we ask what plant studies can contribute to a planetary approach to geopower and biopolitics.[45]

Plant studies refer to 'a broad framework for re-evaluating plants, their representations, and human-plant interactions, much as human-animal studies developed in the 1990s in response to the animal ethics debates coalescing during the two previous decades'.[46] Plant studies offer 'more robust notions of what constitutes "life" beyond the human' because of its intrinsic connection to the planetary dimension of life.[47] Plants were the key players in the transformation of the atmosphere known as the Great Oxygenation Event and it is thanks to them that the earth produces an atmosphere that makes life possible for the vast majority of species. Plants are planetary beings to the extent that they are both earthbound and star gazing. This is why for Emmanuele Coccia plant life 'is the most intense, radical, and paradigmatic form of being in the world'.[48]

If Frédéric Neyrat is correct in defining the planetary dimension in terms, first, of 'the interconnectedness of every terrestrial entity', and, second, of a

'wandering condition ... [that] reveals that the singularity of each terrestrial entity leans on its unavoidable separation', then it seems that plant studies should be at the forefront of the planetary turn in the social sciences.[49] Plants can show us how to break through our artificial environments and connect us to unknown earthly and aerial worlds in virtue of their unique position in the world, holding together both earth and sky. Plant studies can also help us better understand the idea of a necessary separation and concurrent 'drifting' or 'motility' of all planetary life that nonetheless rejects the neoliberal phantasies of 'free movement' associated with the neo-colonial imaginary of new planetary 'discovery' and 'conquest'. Thus, if, as Arendt says, the earth is 'the very quintessence of the human condition' because it gives humans 'a habitat in which they can move and breathe without effort and without artifice', then it seems that focus on how plants manage to 'geo-scape' this habitat is particularly urgent.[50]

Let us first consider the problem of mobility from a planetary perspective. There is no doubt, today, that the Anthropocene is tied with the 'Great Acceleration' in the use of fossil fuels, which are of course the product of plant life, spurred on by globalization and its central principle of 'free movement' on the basis of vehicles propelled by combustion engines. That is why in their book Planetary Social Thought Clark and Szerszynski emphasize the priority of population flows, such that 'even the static parts of the human-made technosphere – the massive infrastructure of building and roads that surrounds and enables modern social life – are in large part created in order to effect these flows'.[51] To think about mobility from a planetary perspective, these population flows must be situated within 'the story of the self-organization of the planet over multiple time scales', a story that privileges, ultimately, the idea of 'drifting' over the rotational movement that was made possible by animals who eat plants and store energy that is employed for locomotion, a process that is mechanically copied in our combustion engines, as well as the idea of remaining 'still' and thus rooted in place, again here with reference to plants.[52] Plant studies, especially in regard to the questions of mobility and intelligence of plants, 'have shifted the paradigm of plant science from a mechanistic approach to vegetal life, reduced to its constituent parts, to a perspective attributing greater agency to plants in dynamic relations to their environments. As such, these studies help disassemble the rigid, long-standing hierarchies separating botanical and zoological forms of life', and in this way are facilitating our re-acquaintance with the old idea of the human being as a plant, as well as undoing the systematic devaluation of plant life in comparison to animal life, liberating it from the being considered the lowest part in the hierarchy of life.[53]

Here, the most suggestive possibility is opened by considering plant life as a radicalization of the unityof organism with habitat proposed by Haldane. Plants are inseparable from their environment such that one cannot delineate an 'autonomous self' or a 'body'that could be ascribed to them, as well as distinguishing between an inside and an outside. This is why Marder claims that 'vegetal being revolves around non-identity'.[54] Completely immersed in their environment, their life is fully enmeshed with the life of others: always exposed and open to the other and always also growing in communities with others.

We thus arrive at the question of ethics, which is ultimately inseparable, following Barad and Lemke, from how one situates oneself in relation to the problem of the apparatus or device. The problem is contained in Braidotti's formula of a technically mediated zoe-egalitarianism through which she captures posthumanism as the simultaneous embrace of two propositions: that there is no originary humanicity and that there is only originary technicity.[55] The discourse of 'originary technicity' is a central feature of recent elaborations of technology-based transhumanism but is also an important element in theories of life from Plessner and Simondon to Derrida and Stiegler. Yet, if one looks at plant studies from a planetary perspective on mobility, one could perhaps say that this belief in an 'originary technicity', or on the dependence of life on devices, is ultimately centred on an undue privileging of animal over plant forms of mobility, and of the physical world over the biological one.

In contrast to the idea defended by Braidotti that humans can enter into community with first nature only by separating itself from it through technology as second nature, we suggest that human life in the Anthropocene is perhaps more plant-like. If, as Marder and Irigaray suggest, the 'vegetal deconstruction of metaphysics' aims for 'an expanded ethics that could grow to encompass our treatment of plants and, consequently, the very uncertain future of life and of care of life ... [is] at stake in it', then an ethics based on plant life may point us in alternative directions than an ethics based on devices and originary technicity.[56] What is interesting about plant life is that plants form communities of growth that are not immunitary, that is, that do not depend on the employment of technology as immunitary devices that preserve and protect forms of life against each other. Instead, with plant life, we find forms of life and ways of engaging with other-than-plant life that are inherently open and exposed to the other to the extent that Marder suggest plant ethics must be a gift-giving ethics where plant life is all about giving itself over to the other.

The problem with Marder's Lévinasian conception of non-economic vegetal generosity and plant ethics is that it assumes an ideal of pre-given harmony and balance between life and its planetary environment. As such they do not fully capture the creativity of life forms in their entanglement for and against their

planetary conditions. Instead, a planetary conception of plant life as we understand it is underpinned by a biopolitical conception of power according to which plants exemplify communities of life that grow for and against each other without having to recur to immunitary and self-referential technologies of identity. Plant studies may allow us to recover an (ancestral) understanding of communities of life beyond all attempts to immunize one species being against another. In so doing, the idea of common or shared life can be further developed without relying on the claim of the human originary prosthetic or assemblage being.[57] On this view, the living body is not a principle of closure and immunity that requires the defensive supplement of technicity, but the place of shared life and connections with all forms of life, human and more-than-human. We need to think about human life as plant-like, that is, embedded within an environment like a plant that is rooted both in its soil while at the same time being oriented towards the starry vault and hence connected to other forms of life both earth-bound and star-gazing upon which it depends and which it deeply cares about.

Notes

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1. Dipesh Chakrabarty, The Climate of History in a Planetary Age (Chicago: Universityof Chicago Press, 2021).
2. Bruno Latour, Facing Gaia. Eight Lectures on the New Climate Regime (Cambridge: Polity Press, 2017); Sloterdijk, Peter, Globes. Spheres II: Macrospherology, trans. Wieland Hoban (New York: Semiotext(e), 2014).
3. See the discussion in Chakrabarty, Climate of History, 4ff of the idea that the technosphere turns the Earth into a ‘spaceship’ in which ‘if technology fails, life faces disaster’. For the concept of technosphere, see Peter Haff, ‘Humans and technology in the Anthropocene: Six rules’, The Anthropocene Review, 1.2 (2014), 126–136. For critical takes on the Anthropocene, see Donna Haraway, Staying with the Trouble: Making Kin in the Chthulucene (Durham, NC:
   Duke University Press, 2016), and Kathryn Yusoff, A Billion Black Anthropocenes or None (Minneapolis, MN: University of Minnesota Press, 2018), among many other interventions. On the Earth as spaceship, see now Mary-Jane Rubenstein, ‘Above Us, Only Sky’, in Mark C. Taylor, Mary-Jane Rubenstein and Thomas A. Carlson (eds.), Image: Three Inquiries in Technology and Imagination (Chicago: University of Chicago Press, 2021), 117–188.
4. Thomas Lemke, The Government of Things. Foucault and the New Materialisms (New York: New York University Press, 2021). In-text citations refer to this volume.

5. The term is found in Reiner Schürmann's work, see Reiner Schürmann, Broken Hegemonies (Indianapolis, IN: Indiana University Press, 2003), and Reiner Schürmann, Tomorrow the Manifold. Essays on Foucault, Anarchy, and the Singularization to Come (Berlin: Diaphanes, 2019).
6. Werner Heisenberg, 'Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik', Zeitschrift für Physik, 43 (1927), 172–98; Niels Bohr, 'Das Quantenpostulat und die neuere Entwicklung der Atomistik', Naturwissenschaften 16 (1928), 245–57.
7. Alexandre Kojève, L'Idée du déterminisme dans la physique classique et dans la physique moderne (Paris: Le Livre de Poche, 1990), written in 1932. For the context of this writing, see Stefanos Geroulanos, An Atheism That is Not Humanist Emerges in French Thought (Stanford: Stanford University Press, 2010).
8. Kojève, L'Idée du déterminisme, 171. All translations from the French original are ours.
9. Kojève, L'Idée du déterminisme, 173. 10. Kojève, L'Idée du déterminisme, 173. 11. Kojève, L'Idée du déterminisme, 176. 12. Kojève, L'Idée du déterminisme, 176. 13. Kojève, L'Idée du déterminisme, 181. 14. Kojève, L'Idée du déterminisme, 191.
15. Kojève, L'Idée du déterminisme, 208.
16. On 'original technicity' see Helmuth Plessner, Conditio humana. Gesammelte Schriften VIII (Frankfurt: Suhrkamp, 2015).
17. This is a point that Kojève already makes in Kojève, L'Idée du déterminisme, 280, footnote 23.
18. In what follows we borrow formulations used in Miguel Vatter, 'Planetary Health and the Biopolitics of Home', in Vanessa Lemm and Miguel Vatter (eds.), The Viral Politics of COVID-19: Nature, Home and Planetary Health (Singapore: Palgrave Macmillan, 2022), 221–246.
19. Georges Canguilhem, 'The Living and Its Milieu', Grey Room, 3 (2001), 7–31. Citations are from this translation.
20. Vladimir Vernadsky, The Biosphere (New York: Springer, 1997); Lynn Margulis and Dorion Sagan, Slanted Truths (New York: Springer, 1997).
21. John Scott Haldane, The Philosophical Basis of Biology (London: Hodder & Straughton, 1931), 4.
22. Haldane, Philosophical Basis, 16.
23. Haldane, Philosophical Basis, 15.
24. Canguilhem, 'The Living', 12.
25. Canguilhem, 'The Living', 19.
26. For the whole discussion in relation to Heidegger, see Giorgio Agamben, The Open: Man and Animal (Stanford: Stanford University Press, 2004). See also Eduardo Kohn, How Forests Think: Toward an Anthropology Beyond the Human (Berkeley: University of California Press, 2013) on forests as sophisticated semiotic and meaning creating assemblages.
27. Canguilhem, 'The Living', 19.
28. Florian Sprenger, 'Environments of Experimentation and Epistemologies of Surroundings. John Scott Haldane's Physiology and Biopolitics of the Living', Grey Room, 75 (2019), 7. See also Florian Sprenger, 'Zwischen Umwelt und milieu: Zur

Begriffgeschichte von environment in der Evolutionstheorie′, Forum interdisziplinare Begriffsgeschichte, 3.2 (2014), 7–18, on the history of the idea of milieu.

29. Sprenger, ‘Environments′, 26.
30. See Mark Andrejevic and Mark Burdon, ‘Defining the Sensory Society′, Television and New Media, 16.1 (2015), 19–36.
31. Sprenger, ‘Environments′, 27.
32. Michel Foucault, Security, Territory, Population: Lectures at the Collège de France 1977–1978 (New York: Picador. 2009), 20–21.
33. Foucault, Security, 261.
34. This is indeed what has happened in the governmentality of the COVID-19 pandemic, seefor instance Warwick Anderson, ‘The model crisis, or how to have critical promiscuity in the time of Covid-19′, Social Studies of Science, 51.2 (2021), 167–88; Vanesa Lemm and Miguel Vatter (eds.), The Viral Politics of COVID-19: Nature, Home and Planetary Health (Singapore: Palgrave, 2022).
35. Not by coincidence, Sprenger also cites Marshall McLuhan in the context of incipientawareness of the planetary dimension: ‘at the moment of Sputnik the planet became a global theatre in which there are no spectators but only actors′, Marshall McLuhan, ‘At the moment of Sputnik the planet became a global Theater in which there are no spectators but only actors′, Journal of Communication, 24 (1974), 48–58.
36. Rosi Braidotti, The Posthuman (Cambridge: Polity, 2013); Rosi Braidotti and Simone Bignall (eds.), Posthuman Ecologies. Complexity and Process after Deleuze (Lanham, MD: Rowman & Littlefield, 2019).
37. Here we find ourselves in sympathy with much in Elizabeth Povinelli, Between Gaia and Ground. Four Axioms of Existence and the Ancestral Catastrophe of Late Liberalism (Durham, NC: Duke University Press, 2021)..
38. Canguilhem, ‘The Living′, 20.
39. Canguilhem, ‘The Living′, 21.
40. Sloterdijk uses the Heideggerian wordplay: Da-sein is ‘De-sign′. Here we can use this wordplay as well, provided it is clear that such de-signing of habitats is done by all living beings, beyond the organic and inorganic distinction, and that there is no specific priority assigned to human de-sign/da-sein. For a discussion of Sloterdijk on de-sign and its Stoic antecedents, see Kurt Lampe and Andrew Benjamin (eds.), German Stoicisms: From Hegel to Sloterdijk (London: Bloomsbury, 2020).
41. For rights of nature construed in this way see Miguel Vatter, ‘Nature′s Law or Law′s Law? Community of Life, Legal Personhood, and Trusts′, in Marc de Leeuw, Sonja van Wichelen (eds.), Personhood in the Age of Biolegality (New York: Palgrave Macmillan, 2020), 225–45, and for flows, see chapter 4 of Margaret Davies, EcoLaw: Legality, Life, and the Normativity of Nature (New York: Routledge, 2022). This does not take away from the pertinence of critiques of planetary biopolitics that are nothing more than a neoliberalization of nature, as argued by Federico Luisetti, ‘Geopower. On the states of nature of late capitalism′, European Journal of Social Theory, 22.3 (2019), 343–62.
42. Vera Kolb (ed.), Handbook of Astrobiology (Abingdon, UK: Taylor & Francis, 2019). For a ‘speculative′discussion of planetary life beyond Gaia, see James Trefil and Michael Summers, Imagined Life. A Speculative Scientific Journey Among the Exoplanets In

Search of Intelligent Aliens, Ice Creatures, and Supergravity Animals (Washington DC: Smithsonian Books, 2019).

43. Chakrabarty, Climate of History, 12, emphasis ours.
44. See Elizabeth Grosz, Kathryn Yusoff, and Nigel Clark, 'An Interview with Elizabeth Grosz: Geopower, Inhumanism, and the Biopolitical', Theory, Culture & Society, 34.2–3 (2017), 129–146.
45. Lemke mentions in a footnote an opening to plant life by reference to Nealon's work, but only in the sense that 'animality is fully incorporated into biopower as the template of life itself' within 'humanist biopower' (Nealon cited in Lemke, Government, n. 26, 235); this leaves open the significance of the 'plant turn' within a planetary turn.
46. M. Gagliano, J. C. Ryan, and P. I. Vieira (eds.), The Language of Plants. Science, Philosophy and Literature (Minneapolis: University of Minnesota Press, 2017), xvi–xvii.
47. Jeffrey Nealon, Plant Theory: Biopower and Vegetable Life (Stanford: Stanford University Press, 2016), xv.
48. Emanuele Coccia, The Life of Plants: A Metaphysics of Mixture (London: Polity, 2018), 5.
49. Frédéric Neyrat, 'Planetary Antigones. The Environmental Situation and the Wandering Condition', Qui Parle. Critical Humanities and Social Sciences, 25.1–2 (2016), 36.
50. Hannah Arendt, The Human Condition (Chicago: Chicago University Press, 1958), 2.
51. Nigel Clark and Bronislaw Szerszynski, Planetary Social Thought. The Anthropocene Challenge to the Social Sciences (Cambridge: Polity, 2020), 127.
52. Clark and Szerszynski, Planetary Social Thought, 128ff.
53. Gagliano, Ryan, and Vieira,, Language, xiii. See Michael Marder, Plant-thinking: A Philosophy of Vegetal Life (New York: Columbia University Press, 2013); Vanessa Lemm, 'Is Nietzsche a Naturalist? Or How to Become a Responsible Plant', Journal of Nietzsche Studies, 47.1 (2016), 61–80; Vanessa Lemm, 'Posthumanism and Plant Studies'. In Stefan Herbrechter, Ivan Callus, Manuela Rossini, Marija Grech, Megen de Bruin-Molé, and Christopher John Müller (eds.), Palgrave Handbook of Critical Posthumanism (London: Palgrave, 2022), 1–18.
54. Marder, Plant-thinking, 162.
55. Vicki Kirby, Quantum Anthropologies: Life at Large (Durham, NC: Duke University Press, 2011).
56. Luce Irigaray and Michael Marder, Through Vegetal Being. Two Philosophical Perspectives (New York: Columbia University Press, 2016), 112.
57. Vanessa Lemm, Homo Natura. Nietzsche, Philosophical Anthropology and Biopolitics (Edinburgh:
    Edinburgh University Press, 2020), 170.