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Digital Anthropocene: Artificial Intelligence as a Nature-Oriented Technology?

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Abstract
In recent years, technology's orientation toward, and even imitation of, natural models have experienced an enormous upswing. These nature-oriented technologies are often linked to the ethical promise of sustainable as well as ethically and socially responsible technologies that promise an answer to the challenges of the 21st century. Think, for example, of artificial intelligence as an assisting technology for climate protection in the debate on the "Digital Anthropocene." But the fulfillment of this promise is not automatic. This article aims to provide some answers to the theoretical as well as practical-ethical questions that arise with regard to nature-oriented technologies in the present age, especially the role of artificial intelligence in the Anthropocene.

Keywords: nature-oriented technologies, ethical standard, sustainability, dissolution of dichotomies, Anthropocene

Introduction

In recent years, technology's orientation toward, and even imitation of, natural models have experienced an enormous upswing.[1] Under terms such as biomimetics, bioinspiration, social robotics, or artificial intelligence, technologies are being developed that imitate the functions of plant, animal, or human nature. The resulting products do not limit themselves to a modest orientation towards a supposedly unattainable nature, but also clearly go beyond natural models by attempting to bring together the "best of both worlds," the natural and the technical.[2] Historically, this phenomenon is by no means new. The origins of this development go back to antiquity and the construction of automata, even if in earlier times such orientations and imitations of nature often lagged far behind their natural models and usually existed only in the realm of fiction.[3]

These nature-oriented technologies are often linked to the ethical promise of sustainable as well as ethically and socially responsible technologies that promise an answer to the challenges of the 21st century and especially to the so-called Anthropocene as an epoch in the history of the earth that is dominated by humans and their technologies, often in harmful ways.[4] But the fulfillment of this promise is not automatic in the case of such technologies. The simple, unquestioned orientation to plant, animal, and human nature can even be dangerous, for example, when natural functions and mechanisms are imitated with artificial materials whose sustainability is by no means assured.[5] On the one hand, this calls for a differentiated ethical evaluation of these technologies, which does not make nature the sole yardstick, even if an orientation towards nature has advantages. On the other hand, the underlying concepts of nature and orientation to nature must be questioned on a theoretical level. It is not

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[1] Cf. Werner Nachtigall and Charlotte Schönbeck (ed.), *Technik und Natur* (Berlin and Heidelberg: Springer, 1994); Alfred Nordmann, *Converging Technologies—Shaping the Future of European Societies* (Luxemburg, 2004). https://op.europa.eu/en/publication-detail/-/publication/7d942de2-5d57-425d-93df-fd40c682d5b5; Rinie van Est et al., *Making Perfect Life. European Governance Challenges in 21st Century Bio-engineering* (Brussels, 2012).
https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/471574/IPOL-JOIN_ET%282012%29471574_EN.pdf; Olga Speck et al., "Biomimetic bio-inspired biomorph sustainable? An attempt to classify and clarify biology-derived technical developments," *Bioinspiration & Biomimetics* 12, no. 1 (2017): 1-15. https://doi: 10.1088/1748-3190/12/1/011004; Philipp Höfele, Oliver Müller and Lore Hühn (ed.), *The Anthropocene Review,* Special Issue 9, no. 2 (2022): *The Role of Nature in the Anthropocene.*

[2] Cf. the slogan of the Cluster of Excellence *liv*MatS: https://www.livmats.uni-freiburg.de/en

[3] Cf. e.g. Pascal Weitmann, *Technik als Kunst. Automaten in der griechisch-römischen Antike und deren Rezeption in der frühen Neuzeit als Ideal der Kunst oder Modell für Philosophie und Wirtschaft* (Tübingen: Wasmuth & Zohlen, 2013); Bianca Westermann, "The Biomorphic Automata of the 18th Century," *figurationen* 17, no. 2 (2016): 123-37.

[4] Cf. Paul J. Crutzen and Eugene F. Stoermer, "The 'Anthropocene,'" in *Global Change Newsletter* 41 (2000): 17-8; Paul J. Crutzen, "Geology of mankind," in *Nature* 415 (2002): 23.

[5] Cf. Martin Möller et al., "Re-actions of sciences to the Anthropocene: highlighting inter- and transdisciplinary practices in biomimetics and sustainability research," *Elementa: Science of the Anthropocene* 9, no. 1 (2020): 9-11. https://doi: 10.1525/elementa.2021.035.

only necessary to ask to what extent these technologies are oriented towards nature and what implications this has for the human-nature-technology relationship. At the same time, it must be considered that the underlying concepts of nature have normative connotations that flow into nature-oriented technologies.

This article aims to provide some answers to these theoretical as well as practical-ethical questions that arise with regard to nature-oriented technologies in the present age of the Anthropocene, especially the role of artificial intelligence. I will examine three theses: (a) From a theoretical point of view, the idea of nature-oriented technology can be found as early in philosophical reflections on technology as Aristotle, but it is only in the present age that it has acquired a prominent importance—on the one hand with regard to the technical possibilities of imitation, especially in the fields of biomimetics and artificial intelligence, and on the other hand with regard to the need for sustainable solutions oriented towards nature. (b) This implies a second practical-normative hypothesis: in the present age, a technical orientation towards nature is often accompanied by practical-normative assumptions, namely that these technologies offer "better" solutions compared to "traditional" technologies, especially in the context of the Anthropocene and its problems. Think, for example, of artificial intelligence as an assisting technology for climate protection in the debate on the "Digital Anthropocene." [6] (c) Finally, nature-oriented technologies, and especially AI systems, tell us something about the relationship between nature and technology in general. They help to learn something in theoretical and practical-ethical terms regarding the nature-technology relationship as a whole.

The article is divided into four sections: (1) First, I will discuss some paradigmatic interpretations of technology as essentially oriented toward and in continuity with nature in the history of philosophy and in the present age of the Anthropocene. (2) Against this historical background, the second task is to determine what nature orientation means in the case of technology and, in particular, artificial intelligence. Defining the concept of nature orientation will already reveal some of the problems and challenges associated with these technologies. (3) Third, these problems or challenges need to be discussed in terms of environmental ethics, which is often neglected in the case of AI systems: To what extent can one speak of a nature orientation as an ethical standard with regard to artificial intelligence? Nature can by no means be used unquestioningly as a yardstick in the sense that, for example, theorists of a philosophy of biomimicry often do, by simply regarding the imitation of nature and its functionality as sustainable and thus "good."[7] Such an approach, if taken without reflection, runs the risk of a naturalistic fallacy. In the case of artificial

[6] Cf. e.g. Jessica McLean, *Changing Digital Geographies Technologies, Environments and People* (Cham: Springer, 2020). https://doi.org/10.1007/978-3-030-28307-0_1; Felix Creutzig et al., "Digitalization and the Anthropocene," *Annual Review of Environment and Resources* 47 (2022): 479-509. https://doi.org/10.1146/annurev-environ-120920-100056.

[7] Cf. Janine M. Benyus, *Biomimicry* 2nd ed. (New York: Harper Collins, 2002); Arnim von Gleich et al., *Potentials and trends in biomimetics* (Heidelberg et al.: Springer, 2010).

intelligence, there is also a tendency wherein it is increasingly viewed not as an imitation of human intelligence, as was the case in Turing's time, but rather as an attempt to develop other forms of intelligence.[8] Orientation to nature therefore plays a role here primarily in the sense of a limiting framework or standard that is brought into the field on the basis of sustainability. (4) However, nature-oriented technologies also pose a further challenge on a theoretical-ontological level, as I will try to show in the fourth section: nature-oriented technologies have fundamental implications for the nature-human-technology relationship, which in turn has ethical implications. As an entity that cannot simply be characterized as natural or artificial in the classical sense—for example, in Aristotle—nature-oriented technologies, and especially AI systems, irritate the classical nature-technology dichotomy and the hierarchies that go with it. Last but not least, they demand that the alternative between anthropocentric and physiocentric ethical approaches be broken up and further pluralized.

Technical Orientation to Nature in the History of Philosophy and the Origins of Artificial Intelligence Research

The fact that technology does not necessarily have to be understood as the other in relation to nature, but can be understood as standing in continuity with it, is not a new idea.

(1) Already Aristotle remarks in his lectures on *Physics*: "[G]enerally art (*technê*) in some cases completes (*epiteleî*) what nature cannot bring to a finish, and in others imitates (*mimeîtai*) nature."[9] In this way, Aristotle defines the relationship between nature and technology, or more precisely between *physis* and *techné,* insofar as the Greek term has a much broader range of meanings than the English word and ultimately encompasses the entire field of the artificial as well as the non-natural. Unlike Plato in the 10th book of the *Politeia,* Aristotle does not connect imitation *per se* with the subordination of the artificial to the natural.

In *Physics* II, 8, Aristotle is certainly interested in integrating the realm of *techné* into that of nature almost to the point of identity. To prove this structural equality of *physis* and *techné,* Aristotle gives the example of a house: if one imagined that the house was a natural object that had grown of its own accord, the parameters for considering its constructing would still be the same as those for a work of art. The purposefulness present in both cases guarantees this structural equality between the artificial and the natural; both share a "why (*hoû héneka*)" as a cause that structures the process of creation or production; in other words, its goal.[10] Ultimately, Aristotle advocates here

[8] Cf. Nick Bostrom, *Superintelligence. Paths, Dangers, Strategies* (Oxford: OUP, 2014), 22-51.
[9] Aristotle, *The Complete Works of Aristotle: The Revised Oxford Translation,* ed. Jonathan Barnes (4th ed., Princeton: Princeton University Press, 1991), vol. 1: *Physics*, 32, bk. II, par. 8, 199a15f. Cf. Philippe Lacoue-Labarthe, *L'imitation des Modernes (Typographies 2)* (Paris: Galiliée, 1986), esp. 23f.
[10] Aristotle, *Physics,* 32, bk. II, par. 8, 199a32.

for a union of *physis* and *techné* that makes perfection possible. Even in passive imitation, this position does not ignore the difference and the added value of each for the other.

(2) In a very similar way, even 2000 years later, namely in 1877, Ernst Kapp, in the first work ever dedicated to the *Outlines of a Philosophy of Technology* (*Grundlinien einer Philosophie der Technik*), argues for an understanding of technology as an imitation of nature or, more precisely, of human nature. In general, technology is "organ projection (*Organprojektion*)." Here Kapp understands by projection "more or less the projecting or highlighting, emphasizing, transferring out, and relocating of an internal into the external (*mehr oder weniger das Vor- oder Hervorwerfen, Hervorstellung, Hinausversetzen und Verlegen eines Innerlichen in das Aeussere*)."[11] "Organ projection" thus describes a projection or—better—imitation of human organs by means of external objects for the purpose of reinforcing the former. Kapp uses the genealogical explanation of the hammer as a basic example. For this is "like all primitive hand tools an organ projection or the mechanical reproduction of an organic form":

> So if the forearm with the hand clenched into a fist or with its reinforcement by a graspable stone is the natural hammer, the stone with the wooden handle is its simplest replica (*einfachste Nachbildung*). For the handle or grip (*der Stiel oder die Handhabe*) is the extension of the arm, the stone the substitute for the fist (*der Ersatz der Faust*).[12]

But according to Kapp, it is not only the "primitive hand tool" that is to be interpreted as such an organ projection. Rather, this description could also be applied to more recent and much more complex technologies. The key technology of the 19th century, the steam engine, is also interpreted by Kapp as an organ projection: "Many machine parts, originally isolated tools, are united in the steam engine externally to a mechanical collective action (*Gesammtwirkung*), like the members of the animal series internally to a highest organic life unit reached in man (*innerlich zu einer höchsten im Menschen erreichten organischen Lebenseinheit*)." [13] Kapp even goes beyond this in a certainly not unproblematic way, in that he even understands the "unification of the railroads and steamship lines" and thus "the network of traffic arteries (*Netz von Verkehrsadern*)" as "the image of the network of blood vessels in the organism (*Abbild des Blutgefässnetzes im Organismus*)."[14]

(3) The French philosopher Georges Canguilhem, like Aristotle and Kapp, assumes that nature in the form of the organism is imitated by the technical machine. In the chapter *Machine et organisme* of his book *La connaissance de la vie* (1952),

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[11] Ernst Kapp, *Grundlinien einer Philosophie der Technik. Zur Entstehungsgeschichte der Cultur aus neuen Gesichtspunkten* (Braunschweig: George Westermann, 1877), 30.
[12] Kapp, *Grundlinien einer Philosophie der Technik*, 42.
[13] Kapp, *Grundlinien einer Philosophie der Technik*, 133.
[14] Kapp, *Grundlinien einer Philosophie der Technik*, 135.

Canguilhem tried to reveal the history of the multi-layered interrelationship between nature and technology, which was partly characterized by suppressions and abridgements. At the same time, Canguilhem takes a second relationship into account, insofar as "one cannot understand the phenomenon of machine construction if one falls back on concepts of nature from biology (*notions de nature authentiquement biologique*) without at the same time asking where technology comes from in relation to science."[15]

Canguilhem concludes by characterizing the relationship between technology and science in the following way: "The one does not graft itself onto the other, but each sometimes borrows solutions, sometimes questions from the other. The rationalization of techniques makes the irrational origin of machines fall into oblivion."[16] Canguilhem's statement is by no means a plea for irrationalism, but rather for a rationalism freed from the dominance of scientific necessity, following the suggestions of Ernst Kapp.[17] For Canguilhem, the freedom of technical developments and innovations seems to be guaranteed precisely when technology is not degraded to a simple application of scientific reasoning. Canguilhem believes that this freedom of technology is guaranteed by its mimetic integration into the space of possibility contained in the natural world, technology being "a universal biological phenomenon (*un phénomène biologique universel*)," [18] which, like the natural, can also dispose of the space of possibility inherent in nature, its potentiality.

(4) However, the modern understanding differs from these selective historical perspectives on the essence of technology as a general imitation of nature insofar as technology here is largely no longer understood as an imitation of nature. Rather, only certain areas of technology such as biomimetics, artificial intelligence or the results of synthetic biology are understood as imitating nature or orienting themselves towards nature. This is done in a way that distinguishes these areas of technology from technologies that are not understood as being oriented toward nature. This opens up the possibility of understanding the technical imitation of nature, for example, in the form of the biomimetic promise, as better in a normative sense, that is, more innovative or sustainable than other technologies.

The development of artificial intelligence in particular could claim to be innovative, and this precisely in its attempt to imitate natural, human intelligence. In his article *Computing Machinery and Intelligence* (1950), Alan Turing elevated the concept of imitation to a benchmark for the development of artificial intelligence. To get around the difficult question of what "machine" and "thinking" mean when talking about a "thinking machine" in the sense of artificial intelligence, Turing advocates an "imitation game": "It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of

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[15] Georges Canguilhem, *La connaissance de la vie* (Paris: Librairie Hachette, 1952), 125.
[16] Canguilhem, *La connaissance de la vie,* 157.
[17] Cf. Kapp, *Grundlinien einer Philosophie der Technik*, 136-38 and 155-64.
[18] Canguilhem, *La connaissance de la vie,* 158.

the other two is the man and which is the woman."[19] This simple game now becomes a test for an artificial intelligence if A is replaced by a machine and the interrogator is given the task of deciding who is natural and who is artificial intelligence. This would replace the original question "Can machines think?" with the following, more easily answered question: "Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman?"[20] For if the interrogator would decide wrongly, this would be a strong indication that we are dealing with a "thinking machine" that truly imitates natural intelligence.

(5) Certainly, artificial intelligence has been significantly developed since Turing and can no longer be generally understood as an imitation of human intelligence. Nevertheless, it has played a not insignificant role in another, broad form of nature imitation in the Anthropocene, which is linked to the concept of the technosphere. The term "technosphere," which has been taken up as a "global paradigm" by Peter Haff and Jan Zalasiewicz, describes a form of imitation taken to extremes, understood as a habitat equal to the biosphere, albeit with serious problems regarding its sustainability:

> The technosphere, the interlinked set of communication, transportation, bureaucratic and other systems that act to metabolize fossil fuels and other energy resources, is considered to be an emerging global paradigm, with similarities to the lithosphere, atmosphere, hydrosphere and biosphere. The technosphere is of global extent, exhibits large-scale appropriation of mass and energy resources, shows a tendency to co-opt for its own use information produced by the environment, and is autonomous.[21]

The established analogy between the technosphere on the one hand and the lithosphere, atmosphere and hydrosphere on the other hand is, despite all similarities, at the same time accompanied by an essential difference between these spheres. The technosphere is not completely self-sufficient and self-contained, but lives at the expense of the natural spheres, which is essential to the problems of the Anthropocene. Thus, Zalasiewicz et al. also note with regard to the negative sustainability balance of the technosphere, with which it clearly differs from the self-sufficient biosphere, that it "includes . . . a growing residue layer, currently only in small part recycled back into the active component."[22] Non-recycled waste is also a central problem of the technosphere, which is cited in the context of the "Digital Anthropocene" discourse as the negative side of digitalization and artificial intelligence, which have contributed significantly to the co-construction of the

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[19] Alan M. Turing, "Computing Machinery and Intelligence," *Mind* LIX, no. 236 (1950): 433.
[20] Turing, "Computing Machinery and Intelligence," 434.
[21] Peter K. Haff, "Technology as a geological phenomenon: implications for human well-being," *Geological Society, London, Special Publications* 395 (2014): 301. https://doi.org/10.1144/SP395.4.
[22] Jan Zalasiewicz et al., "Scale and diversity of the physical technosphere: A geological perspective," *The Anthropocene Review* 4, no. 1 (2017): 1. https://doi.org/10.1177/2053019616677743.

technosphere.[23] Here, different, both positive and negative-imperfect forms of nature orientation play into each other, which first have to be distinguished and put into a relation to each other, before they can be ethically evaluated in a further step.

The Nature Orientation of Technology: A Definition of the Term Using the Example of Artificial Intelligence

(1) If one speaks of nature orientation, first of all the exact reference object of this orientation must be named, insofar as nature and the natural can denote quite different things. Thus in the case of the technical orientation to nature, the reference point is usually living nature, as terms such as bioinspiration, biomimetics, biomimicry or bionics already indicate from their Greek root "*bios*" (life). The research fields just mentioned all refer (a) to non-human, plant or animal nature, whose forms and functions they seek to imitate by technical means. Robotics, on the other hand, focuses primarily on the (b) physical nature of humans, while artificial intelligence (c) attempts to emulate the mental nature of humans, their ability to learn, judge or solve problems, unless the development of entirely different, "posthuman" forms of intelligence is aimed at. At the same time, however, it can also be about the (d) imitation and implementation of social concerns and normative demands of human societies, which is the focus of social robotics in particular, but also of AI systems.

(2) From the point of view of an ethical assessment, however, the formal-relational side of nature orientation is far more interesting and important. The term "nature orientation," chosen here to describe technical developments in the Anthropocene and especially in the context of research on artificial intelligence, is a relatively broad term that covers a vast number of nature-technology relationships.

Formally, this includes first of all any form of technical orientation to nature in which this orientation plays a role during production, but after which the technical entities created no longer necessarily have to stand in a relation to the natural models. This can be the case (a) in the exact technical imitation of a natural model—for example, in the production of an artificial cell in synthetic biology, even if it is already advisable here from an ethical point of view to keep an eye on the relationship to the natural environment after production and to reflect on it. However, this first category of nature orientations in a formal sense also includes (b) more abstract forms of technical imitation of nature, which, for instance—as in biomimetics—focus on the morphology or functional principles of plant or animal entities. In a broader sense, however, nature orientation can also be understood as (c) any inspiration from nature to solve human problems, also related to larger structures such as ecosystems or the entire biosphere. In all these cases, the traditional dichotomy of the natural and the

[23] Cf. Jennifer Gebrys, *Digital Rubbish: A Natural History of Electronics* (Ann Arbor: University of Michigan Press, 2011), 1-17. https://doi.org/10.2307/j.ctv65swcp.4.

technically and artificially generated cultural is not touched, even if the realm of the cultural directs its gaze to the former realm for its shaping.

This perspective, which is often only theoretical and ideal, is expanded in the following forms of nature orientation. In addition to the orientation to nature during the production of technical entities, the aim here is to ensure a permanent orientation to nature. Certainly, all objects that have been created within the framework of a nature orientation never behave without reference to their natural environment, even after their production, but are always in a relationship to it in one way or another. However, this nature orientation is not always consciously reflected and certainly not considered in terms of sustainability. A central way of reflecting nature orientation, especially in the context of the Anthropocene, has turned out to be (d) the adaptivity of technical objects to the natural environment. One example, albeit not an uncontroversial one, is the engineering idea of "stratospheric aerosol injection," in which, following the example of volcanic eruptions, sulfur particles are released into the atmosphere in order to reduce global warming.[24] However, this perspective also includes any form of (e) responsiveness between technical entities and their natural and social environment, whether in the form of acceptance research with regard to the human environment or the AI-supported collection of data from the natural environment in order to be able to adapt human-technical behavior to it in the sense of sustainability.

For the technical object and its development, however innovative it may be, are always bound up in contexts. This was emphasised above all by Canguilhem's student Gilbert Simondon in his 1958 work *Du mode d'existence des objets techniques,* systematically following his teacher's reflections on the concept of the natural "milieu." Just as, according to Canguilhem, living things in general, from the cell to the organs to the entire organism, are integrated into a "milieu," form a unity of mutual constitution with it and are therefore to be characterized by the basis it presents,[25] Simondon also seeks to understand the technical object in relation to its environment. Against this backdrop, Simondon understands the human-machine relationship as an "inter-individual coupling (*couplage*) between human beings and machines": "Human beings can be coupled to the machine as a being that participates in its regulation, not as a being that merely directs and uses it by incorporating it into the ensembles, or as a being that serves it by supplying it with material or elements."[26] Simondon assumes here a symbiosis between human beings and machines, so to speak, which leads to the fact that neither of the two interaction partners can exist on their own.

Martina Heßler rightly emphasises the proximity between Simondon's approach to the philosophy of technology and Bruno Latour's network theory, which

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[24] Cf. Will Steffen et al., "The Anthropocene: conceptual and historical perspectives," *Philosophical Transactions (Series A)* 369 (2011): 858-61. https://doi.org/10.1098/rsta.2010.0327.
[25] Cf. Canguilhem, *La connaissance de la vie,* 160-93.
[26] Gilbert Simondon, *Du mode d'existence des objets techniques* (Paris: Aubier, 1989), 119-20.

sees the biosphere as being made up of irretrievably interwoven actors and agents.[27] The buzzword, "Digital Anthropocene," is increasingly being used to draw attention to this reciprocal entanglement between the natural and social environment on the one hand and AI systems on the other. However, this raises the question of which forms of nature orientation can be described as good in an ethical-normative sense and according to which ethical criteria this is to be evaluated.

Nature Orientation as an Ethical Standard in the Case of Artificial Intelligence?

Demanding nature orientation as an ethical standard in the case of artificial intelligence is not easy to justify from a metaethical point of view and is quite problematic. The argument in the ethics of nature calling for an orientation towards nature goes back to Aristotle and the ancient Stoa.[28] But this so-called following nature argument was vehemently criticized, especially in the 19th century with the advent of Darwin's theory of evolution, for example by John Stuart Mill in his famous 1874 essay *Nature*. Following Mill, Angelika Krebs has succinctly summarized and convincingly renewed the critique of the following nature argument in her work *Ethics of Nature*:

> The imperative to follow nature is either superfluous or morally objectionable. [1] It is *superfluous* if it means that we should follow the natural laws where we are subject to them, because where we are subject to natural laws we cannot but "follow" them. [2] It is *morally objectionable* if it asks us to imitate what we see in nature, for a lot of "cruelty" and destruction goes on in nature.[29]

On the one hand, it makes no sense to speak of following nature in the case of processes or actions that are subject to natural laws anyway—be they of physical or biological nature—since here there is no alternative to following, and therefore one cannot behave freely in the course of such an obligation. Similarly, on the other hand, if we had this freedom of action, we would also have to reject this second case as morally questionable, since in many cases, given the frequent cruelty of nature, it is questionable and even reprehensible to follow nature. This ambivalence would not disappear even if one were to cite certain criteria, such as the complexity of natural processes, the stability of certain states of equilibrium in ecosystems, or the age of certain natural phenomena, because all of these criteria exhibit ambivalence.[30]

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[27] Cf. Martina Heßler, "Gilbert Simondon und die Existenzweise technischer Objekte. Eine technikhistorische Lesart," *Technikgeschichte* 83, no. 1 (2016): 3-32, esp. 27.
[28] Cf. Aristotle, *The Complete Works of Aristotle: The Revised Oxford Translation,* ed. Jonathan Barnes (4th ed., Princeton: Princeton University Press, 1991), vol. 2: *Nicomachean Ethics*, 32; bk. X, par. 7, 1178a. Cf. also Anna Schriefl, *Stoische Philosophie. Eine Einführung* (Stuttgart: Reclam, 2019), 138-41.
[29] Angelika Krebs, *Ethics of Nature. A Map* (Berlin and New York: De Gruyter, 1999), 128.
[30] Cf. Krebs, *Ethics of Nature*, 127.

I fully agree with this argument. However, it should be noted that it only considers the extreme cases, namely a complete lack of freedom to disobey the laws of nature, which renders the concept of "following" meaningless, as well as a complete and uncompromising following nature based on freedom. However, in the case of the nature-oriented technologies, it is by no means a matter of following nature in its entirety and under all circumstances. Only *individual* moments to be found in nature can function as maxims (*Maxime*) for action, to use Kant's vocabulary. But these, in turn, must first be tested for their suitability as generally acceptable principles of action or orientation, whereby they can only be considered generally valid in relation to a particular realm of nature—such as human nature or non-human animate nature.

An examination of those maxims derived from nature can be carried out from different angles. It can be *anthropocentric,* for example when natural models for technologies are examined for their compatibility with societal goals such as the "Sustainable Development Goals,"[31] when their societal acceptance is questioned, or when their compatibility with intergenerational justice is examined. It can also be carried out from a *biocentric or physiocentric* perspective, when the focus is on the influence of certain natural or artificial mechanisms on the ecosystems into which they are to be integrated.

Nature orientation as an ethical maxim in the case of artificial intelligence can therefore enrich certain anthropocentric or physiocentric ethical approaches in terms of material content. However, they cannot be considered as ultimate ethical principles themselves. (1) This becomes particularly clear in the case of AI systems that imitate the morally ambivalent natural intelligence of humans. In the course of such imitations, they can, for example, also reproduce racist biases peculiar to humans.[32]

As has been noted on various occasions in the discussion about the "Digital Anthropocene,[33] AI systems can also contribute directly or indirectly to environmental protection through their orientation towards nature. (2) It is often forgotten that AI systems not only generate immaterial capabilities comparable to the human mind, but also have a material basis that is taken from the natural environment in the form of resources (such as rare earths) and will at some point flow back into it as waste. AI systems and their material basis should therefore also follow the principles of the circular economy, which is derived from the natural cycle.[34] (3) Furthermore, AI systems can also be subject to a positively evaluated nature orientation in the sense that they can be used to collect data sets that can be processed exclusively by them,

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[31] Cf. on the 17 "Sustainable Development Goals" (SDGs), ratified in 2015 by all members of the United Nations in the *2030 Agenda for Sustainable Development*: https://sdgs.un.org/goals

[32] Cf. Christoph Bartneck et al., *An Introduction to Ethics in Robotics and AI.* Cham: Springer, 2020), 34-5, where this problem is discussed with regard to AI-driven lending.

[33] Cf. Creutzig et al., "Digitalization and the Anthropocene," 479-509.

[34] Cf. Bernadette Bensaude Vincent, "Of Times and Things. Technology and Durability," in *French Philosophy of Technology. Classical Readings and Contemporary Approaches,* ed. Sacha Loeve, Xavier Guchet, and Bernadette Bensaude Vincent (Cham: Springer, 2018), 291-4. https://doi:10.1007/978-3-319-89518-5_17.

which contribute to a holistic understanding of the earth system and, in a second step, can be used to develop sustainability strategies.[35] (4) But AI systems should not only be used for data collection regarding the non-human environment in terms of sustainability. AI systems, on the one hand, also have considerable influence on informed decisions of humans, for example, through social networks, and, on the other hand, can also have an impact on social inequalities, for instance through AI-based decision-making processes. These influences of AI on societies can, in turn, have repercussions on the treatment of the natural environment, so that an orientation towards the standards and norms of human societies is required, which in turn ensures an adequate indirect influence of AI systems on the natural environment.[36] (5) In addition, artificial intelligence should continue to be oriented to natural, human intelligence from an ethical point of view, despite all the possibilities for development, which will possibly go far beyond the latter. Artificial intelligence is primarily focused on data processing as only one aspect of human thinking. In doing so, specific distinctions of human thought, such as "practical wisdom" or "virtuousness," which have ethical relevance, are often neglected.[37] The resulting ethical demand can either be that artificial intelligence should be self-limiting, with humans guiding and regulating it, or that these aspects of human thinking should be imitated.

(6) All of these points are based on sustainability theory and thus on an anthropocentric argumentation. Artificial intelligence—so one could describe the ethical approach—should be committed to contributing to sustainability and thus to preserving an earth that is also habitable for future human generations. What is usually neglected is the question of what artificial intelligence could contribute to the well-being of non-human entities on earth *for their own sake.* Insofar as artificial intelligence is sometimes also discussed in posthumanist discourses as something that could "overcome" humans[38] and thus ontologically represents a novel entity, it could also open up perspectives for physiocentric ethics.

Summary and Outlook: Dissolution of Dichotomies as an Ethical Challenge and Opportunity

If we look back at the history of the development of artificial intelligence, we can see that its claim is to imitate natural, human intelligence. This is especially true for the approach of "strong artificial intelligence," which initially claims to produce systems

[35] Cf. Creutzig et al., "Digitalization and the Anthropocene," 498.
[36] Cf. Creutzig et al., "Digitalization and the Anthropocene,"485-90.
[37] Cf. Mark Coeckelberg, *AI Ethics* (Cambridge and London: MIT Press, 2020), 200-2.
[38] Cf. Philipp Höfele, "Zwischen Moralphilosophie und Anthropologie. Zum Spannungsverhältnis von Natur und Bestimmung des Menschen bei Kant und in der Debatte um 'Human Enhancement,'" in *Anthropologie in der Klassischen Deutschen Philosophie*, ed. Christoph Asmuth, Simon Helling (Würzburg: Königshausen & Neumann, n.d.), 215-234.

that are on a par with humans in terms of their problem-solving abilities. However, this claim does not necessarily have to be pursued in general. For example, future AI systems may also have cognitive abilities that are completely different from those of humans. The same applies to "weak artificial intelligence," which is geared towards individual, concrete problems, in the solution of which it can proceed much more effectively as well as differently than human thinking.

However, as mentioned above, this is only one form of nature orientation that plays a role in the production of AI systems and is limited to them, for example in order to be able to ensure the autonomy of the technical system after the production process has been completed. It is precisely here, however, that a further, continuous form of nature orientation is increasingly being called for, one that concerns AI systems in particular. According to the thesis of the "Digital Anthropocene," only a permanent orientation towards nature in the five aspects 2-6 mentioned above will ensure the sustainability and environmental compatibility of AI systems.

AI systems do not dissolve the boundary between the natural and the artificial, as is the case with many other technologies in the Anthropocene that are oriented toward nature. Unlike biomimetic products or the "biofacts" described by Nicole Karafyllis, which include genetically modified corn,[39] AI systems still maintain the boundaries to the natural. The nature orientation of AI systems will not, at least in the main, lead to the dissolution of the boundary to human nature. We will not get AI systems where we will have to ask ourselves—in the sense of the Turing test—whether we are dealing here with natural or artificial intelligence. As autonomous technologies, AI systems would possess what Aristotle describes as an essential characteristic of *physis*, namely, they would have the origin and the principle of motion in themselves.[40] Nevertheless, a "genetic naturalness" in the sense of Dieter Birnbacher[41] can only ascribe to them conditionally, insofar as these systems, even in the case of a possible future self-reproduction, will still have their historical origin in a human invention. Nor would "qualitative naturalness" apply, insofar as these technologies are unlikely to adopt the appearance or behavior of their natural models. In this respect, a concept that assumes a gradual difference between the natural and the artificial is also not applicable with regard to these technologies.[42] The idea is not to construct something between nature and technology, but something qualitatively better or at least different. A slavish or at least gradual imitation of natural intelligence is—beyond a possible research interest and curiosity—often rather uninteresting from an economic point of view. Thus, technical imitation of nature usually does not aim at a mere reproduction

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[39] Nicole Karafyllis, *Biofakte. Versuch über den Menschen zwischen Artefakt und Lebewesen* (Paderborn: Mentis, 2003).
[40] Cf. Aristotle, *Physics,* 19; bk. II, par. 1, 192b-193b). Cf. also Henry State, *Techne Theory: A New Language for Art* (London et al.: Bloomsbury, 2019), 65-84.
[41] Cf. Dieter Birnbacher, *Naturalness. Is the "Natural" Preferable to the "Artificial"?*, trans. David Carus (Lanham et al.: University Press of America, 2014), 7-15.
[42] Cf. Krebs, *Ethics of Nature*, 5-7.

of the natural, but at creating something new and better by pursuing the goal of "combining the best of two worlds—nature and technology," as is the motto of the *liv*MatS cluster of excellence, for example, which is dedicated to the development of biomimetic technologies.[43]

Given the forms of nature orientation in AI systems described above, it is likely that a third class of objects will emerge that will be situated beyond the natural and the artificial. As noted above, these new entities are not simply unrelated to the traditional dichotomy of the natural and the human-artificial. On the one hand, AI systems should always serve societal needs and norms that are manifested in them without being absorbed by them.[44] On the other hand, AI systems should also show an orientation towards the natural environment in the above-mentioned respects, whereby they can represent a corrective to a narrow anthropocentric perspective. In their autonomy, AI systems will not simply be absorbed into the role of anthropocentrically oriented instruments. As systems that will exceed natural human intelligence, at least in some respects, they are likely to call into question the traditional, dominant hierarchy in which humans are at the top. As a third class of objects, AI systems are also likely to dissolve the classical dual coordinate system of natural and human-artificial. Neither will simply lead to an ethical physiocentrism, but it should at least relativize the ethical anthropocentrism.

AI systems oriented towards nature can thus be seen as a real-world counterpart to Donna Haraway's concept of cyborgs, which she understands "as an imaginative resource suggesting some very fruitful couplings;" just as Haraway sees us all as "fabricated hybrids of machine and organism," as imagined hybrid cyborgs,[45] in order to undermine traditional dichotomies. For it is precisely in the Anthropocene that the wild, the primordial, the immediate usually turns out to be pure illusion, insofar as everything in the biosphere has already been reshaped by humans. Conversely, there is also nothing purely artificial, since it is always already part of nature. The classical antipoles of natural and artificial do not apply here, not even in the sense of a gradual difference, but are rather to be seen as interpretative settings that at the same time have normative implications.

The introduction of a third entity beyond the dichotomous relationship between the natural and the human-artificial should thus provide for the elimination of this dichotomy and its normative implications and thus possibly lead to an equal or at least more differentiated ethical appreciation of the natural and other hybrid entities in relation to humans.

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[43] Cf. https://www.livmats.uni-freiburg.de/en

[44] Cf. Mark Coeckelbergh, "Three Responses to Anthropomorphism in Social Robotics: Towards a Critical, Relational, and Hermeneutic Approach," *International Journal of Social Robotics* (2021): 10. https://doi:10.1007/s12369-021-00770-0.

[45] Cf. Donna Haraway, *Simians, cyborgs, and women: the reinvention of nature* (New York: Routledge, 1991), 150.