The Environment as the Anthropocene - the Sociotechnical Autopoiesis Machine

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Introduction

This paper provides a systems-theoretical and media-sociological perspective on the Anthropocene. The research question is how the development of media and technology has impacted the Anthropocene and how the age of humans, which is the direct translation of the term, can be observed and understood when a systems-theoretical and media-sociological perspective is applied to the age. As the paper is primarily based in media and communication sociology, it means that it will critically examine the geological term (Anthropocene), as well as when such an epoch can be said to have begun and proceeded. This paper also asks the question of what humans really are and whether it can be meaningfully described without a media-sociological perspective. The question arises because the term Anthropocene is subject to criticism: is it really humans, a concerned mammal in the middle of the food chain, always on guard against predators, that affect the geological condition of the Earth? Some argue that it is not, as there is a coincidence between the end of the Holocene around 1860 and the beginning of the Anthropocene, precisely when capitalism really takes hold and we start using coal to power steam engines. Therefore, the term Capitalocene (the age of capitalism) or the related Econocene (the economic age) according to eco-Marxist thinking, are more correct terms, for as Malm has shown, it was and is a particular system or form of organization (the capitalist) that has caused fossil burning since the 1800s (Malm 2016; Malm and Hornborg 2014). Therefore, it must be the system itself (capitalism) and not humans per se that is the cause of the climate impact that research generally points to, and which is destroying the foundation for much of the life we know today.[1]

The analysis strategy is to follow humans through media socio-evolution from prehistoric times to the present day, with a glimpse of how the future is shaping up. I will especially draw on Luhmann and his theory of social differentiation of society, which in my interpretation follows the development of basic communication media and how humans are subject to a suprasystem, namely the social system of society (Tække 2022a). Therefore, my concept to replace the Anthropocene will be Sociomediacene. In this theorization, we must go far back beyond the 1800s to find the beginning of this period in Earth's history, all the way back to the Pleistocene, which means that humans as we know them, are initially a mix of biology and technology. In addition, the social will be observed, not just as in Luhmann consisting of communication, but inspired by Levi Bryant (2014),[2] as a kind of machine. This

[1] Technocene (the technological age) (López-Corona and Magallanes-Guijón 2020) and Cthulhucene (the age of living beings on Earth) (Haraway 2016) can also be mentioned.
[2] Also, see Paulsen and Tække (2022) the chapter "Big Data" where a range of theoretical and analytical forms of Big Data Machines are developed (free download).

machine is a hybrid, consisting of elements such as consciousness, technology, nature, and communication media, which are organized and structured through communication. It uses the resources of the elements and is self-constituting through the organization of these resources. A machine that with each new technology and each new communication medium expands its communicative (social) capacity to control, organize, and influence humans, as well as its environment (consciousness, life, nature, and climate). The machine is not a trivial machine, but a sociotechnical autopoietic non-trivial machine, where each new social structure (e.g., norm, decision, organization, differentiation) changes the machine's mode and capability.

The structure is such that the text will use a relatively large amount of space to construct an understanding of how the machine started, how it interpellated the human animal, and how it still functions fundamentally. The great media revolution is and remains the emergence of spoken language, which as a medium and/or technique, enables the collection of elements for the machine that communicatively differentiates itself from an otherwise silent environment but consists of, producing itself from, resources from this very same environment. From here, with only a few clues and insights into writing, printing, analog electronic media, the text will move on to use a little more space on the current situation, where the machine now includes digital media.

Human Interaction with the Environment

Approximately 12,000 years ago, the Holocene began, during which the climate became more stable after the last ice age, and humans domesticated both plants and animals. Domestication before the 1800s, however, should not be seen as intentional action but as a long cultivation process in which humans' influence on nature gradually resulted in the shaping of landscapes, animals, and plants. However, humans have always interacted with their environment, and even homo erectus seems to have shaped their environment by hunting animals that subsequently became fewer and changed habits when they began to migrate out of Africa more than one and a half million years ago, where they co-evolved with other animals (Turvey and Crees 2019).[3] Towards the end of the Pleistocene (the long epoch preceding the Holocene), Homo sapiens had spread out of Africa and across all continents except Antarctica. Humans reached Australia 40-65,000 years ago and America at least 15,500 years ago. Wherever they went, they exterminated large parts of the megafauna. Barnosky (2008) estimates that two-thirds of all mammal species and half of all other species weighing more than 44 kg were extinct. Turvey and Crees (2019) estimate that almost two-thirds of the world's megafauna were extinct by the end of the Pleistocene. Also, the other surviving late-Pleistocene hominins died out by the end of the Pleistocene: Neanderthals, Denisovans, H. floresiensis, and H. luzonensis.[4] The extinction of the megafauna had fundamental effects on the structure of ecosystems, seed dispersal, surface albedo, and biogeochemical cycles, such as nutrient transport across landscapes (ibid). Other studies show that humans already burned forested areas in the Pleistocene (Hunt et al 2012). With the transition to the Holocene, the extinction of species continued, which

[3] The megafauna likely survived in Africa because, due to co-evolution, they had developed the ability to be cautious of hominins.

[4] It is uncertain whether Homo sapiens caused the extinction of other hominins, but we still retain their genetic traces, meaning that interbreeding between different hominin species have occurred, resulting in viable offspring.

was regionally catastrophic, with complete loss of most island's megafauna. It is estimated that over 250 mammal species have become extinct during the Holocene, and as many as 8,000 bird species. It is estimated that wild mammals today represent only 4% of the biomass, while the remaining 96% is made up of domestic animals and, especially, humans (Turvey and Crees 2019). In the Holocene, humans burned wild nature and killed the animals while filling the Earth with cultivated plants, domesticated animals, and themselves. In 2023, there is scientific consensus that human-caused CO2 emissions will result in a temperature increase with catastrophic climate change consequences, in addition to a parallel biodiversity crisis with an accelerating irreversible mass extinction, where fundamental ecosystems on which all life, including humans themselves, depend, are at risk of collapse. But how could humans, as a living being, take over all other life and ultimately destroy it, even though it is their own basis for survival?

The Socio-Technical Autopoiesis

To answer the above question, in this section, I will construct a theoretically grounded sociotechnical autopoiesis machine. There are many inspirations and/or sub-functions, which come from a range of theorists, with Luhmann and Bryant being the most important. However, I will start elsewhere, namely with the von Neumann machine, which lets us know that all processes must occur on one and the same level (Neumann 1958). But, as we will see later, this is only within each of the coupled levels of autopoietic systems formations that are involved in the larger machine. The machine is an autopoiesis machine: "An autopoiesis machine is a machine that is organized as a network of processes that produce the components, [...] which through their interactions and transformations continuously regenerate and realize the network of processes that produced them" (Maturana & Varela 1980: 78). Heinz von Foerster's (2003) distinction between trivial and non-trivial machines is also important to understand the machine. Luhmann's (2007: 99) concept of autopoiesis not only describes Maturana's biological self-production but deontologizes the concept and also describes psychic and social systems as autopoietic systems, as non-trivial machines where all processes occur on the same level.

This means that we have three systems formations: the biological, which (re)produces itself in the medium of life, the psychic, which (re)produces itself in the medium of consciousness, and finally the social, which (re)produces itself in the medium of communication (Luhmann 1995). These systems are structurally coupled to each other (and to their environment) and function as each other's conditions of possibility (e.g. no consciousness without a biological brain), to which they are operationally closed in their respective reproduction processes (life, consciousness, and communication).

With regard to technology, the machine is inspired by Donna Haraway's (1985) concept of the cyborg and Bruno Latour's (1999) concept of hybrids. Both concepts describe how humans, through their connection to technology, become a new kind of being with new capabilities. Additionally, much of the inspiration comes from Levi Bryant (2014) and his onto-cartography theory of machines, which allows me to assemble the various autopoietic machines into a larger, coherent machine, and opens up how the environment, through transformation processes, is part of the machine. Bryant sees machines as systems of operations that perform transformations on inputs, producing outputs (ibid 38). This concept of the machine is as abstract as Luhmann's, for example, a tree can be described as

a machine that transforms water, sunlight, etc. into the mass it consists of, oxygen, etc. Furthermore, machines can be coupled to each other and act as a medium for each other. For example, a tree is coupled to the sun, earth, rain, microorganisms, fungi, other plants, animals, etc., all of which provide input to the tree and perform operations in its cellular metabolism. Many of the inputs that a machine performs its operations on come from other machines; one machine acts as a medium for other machines. Moreover, there is a reciprocal coupling between machines that are plastic and pluripotent, in the sense that they both affect their environment and are affected by their environment (ibid 52).

Figur 1 The Maschine[5]

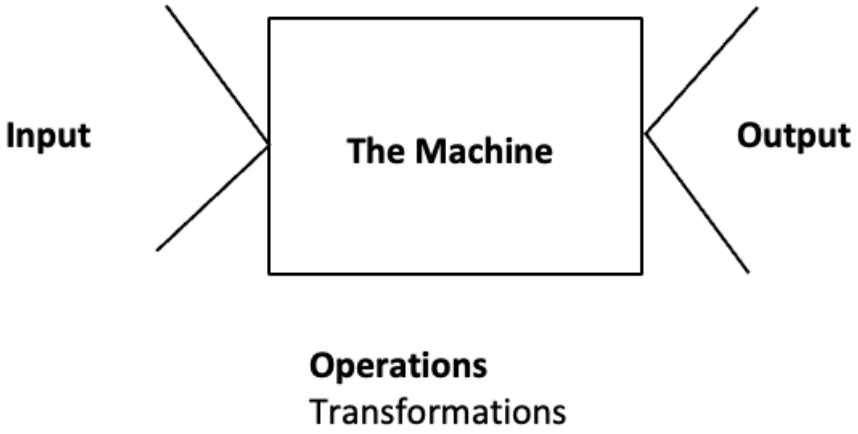


Figure 1 shows the abstract and principle machine. Using the tree as an example, the input is light, water, services from microbes, etc. The machine is the tree itself, which transforms input into output. The output is bark, trunk, leaves, oxygen, fruit, but also, for example, the possibility for birds to build nests. The machine is dependent on and structurally coupled to its environment but also, through its transformations, contributes to shaping its own environmental conditions. For example, an animal may eat the fruit but also excrete or die and give nutrients to the soil in which the tree grows. The tree can be seen from various perspectives in the sense that it can be seen as a symbiosis of many different smaller machines, such as microbes.

Bryant's conception of the machine fits well in a synthesis with Luhmann's communication sociological conception of autopoietic machines. According to Luhmann (2007: 123), autopoiesis only explains evolution in connection with conditions for the structure's compatibility with the environment; either there is autopoiesis or there is not. There is no design, no finished plan where the germ contains what it will become. Instead, evolution tests which structures are compatible with autopoiesis. Self-maintenance depends on the fact that the formations that are formed in the medium of life (a species, a given structure) can be reproduced under the prevailing selection pressure. The sociotechnical autopoiesis machine that I am presenting here can describe how a way of life, human beings, in a

[5] The illustration of the machine as seen in Figure 1 was originally developed in collaboration with Michael Paulsen in Paulsen and Tække (2022).

distant past differentiated themselves from other life forms, and subsequently linked their structural development to a wide range of environmental structures (such as meat, fire, and stone tools), and through these transformative linkages, with increasing strength, transformed their environment, and thereby changed the selection pressures under which they themselves must live.

The origin of the machine and its components

Human development from primates to hominization and to homo sapiens did not occur in one leap, after which humans, with their intelligence, developed technology, language, society, and culture. On the contrary, one must view nature, society, language, intelligence, technology, and culture in collaboration, through myriad transformations and structural linkages, to produce homo sapiens through a process of several million years (Morin 1974: 63). Pre-linguistic hominin societies must have evolved with biological genes as the storage medium for behavior. This development has been slow but led to a critical mass in the population for the emergence of speech, and thus for the differentiation out of the social, so that, as it is popularly said, it was no longer genes but memes that became the focus of evolution, making the concept of sociomedia-evolution relevant. However, this leap from traits inherited in nucleic acids to oral transmission could only have occurred in a population with a critical mass that made it adapt to this leap. The understanding of human development must be led through a long series of interacting factors, such as bipedalism, with the liberation of hands and the subsequent development of the thumb's opposition to the other fingers, making the hand a polyvalent instrument. On two legs, the hominin can gain an overview and carry objects in its hands, which frees the jaw from its vertical position, which in turn frees the cranium from its mechanical constraint and makes room for the brain to become more substantial, as well as for the development of the vocal cords (Morin 1974: 64; Jensen 1996; Fitch 2010). These changes require both genetic mutations, leading to anatomical changes, and changes in the environment from forest to savanna, which provide selection for bipedalism. These changes have formed the basis for making the hunted hominin the hunter by allowing the hominin, unlike the omnivorous chimpanzee, to systematically exploit the collaboration between foot, hand, and brain. About 2 million years ago, our ancestor, a bipedal hominin in Africa, began to switch to a meat-based diet, which correlates with this branch of hominins (ours) beginning to develop larger and larger brains (Cordaina et al 2001; Fitch 2010: 421). Darwin already pointed out that it is not the ability to produce sounds that makes the leap to language, but neural development (Fitch 2010: 362).[6] These hominins develop and use weapons, build shelters, and thus begin the technical development (Morin 1974: 65). With the use of fire (from about 1,6 mil. To 800 thousand years ago), hominins gain a range of advantages, such as easier digestion of cooked meat, and fire can also provide warmth and security. Hunting improves the hominin, who becomes an interpreter of a very large number of ambiguous and weak sensory stimuli. Hunting requires communication and stimulates strategic abilities: attention, endurance, fighting spirit, courage, cunning, deception, traps, and ambushes (ibid.: 72). Donna Haraway (1991) points out that there is a co-evolution between humans and nonhumans, i.e., a mutually influencing development between humans and animals, plants, and tools. Most clearly in terms of understanding domestication, Haraway (2003) writes a manifesto about

[6] The ability to produce and imitate sounds must have preceded and developed for other purposes, such as imitating animal sounds, singing, and, of course, as a means of signaling.

the dog-human relationship, about humans and dogs as "companion species," where the relationship with the dog in the last 150,000 years (the dog is a much earlier companion to humans than any other animal) has significantly influenced our development. Perhaps the dog helped to facilitate linguistic development by taking on olfactory and guard duties, thereby relieving humans both physiognomically and neurally.

With language (which we will return to), animals, plants, and tools, humans had already developed a division of labor to a point where we were captured by an overarching organization - society. With the more stable climate of the Holocene, the table was set, and our ancestors left the natural paradise to live short, unhealthy, monotonous, and hard lives as a result of the agricultural revolution, in relation to which Israeli historian Yuval Noah Harari points out that it more likely was humans being domesticated by grain than the other way around (Harari 2015). Humans were now fundamentally altered beings. We had become cyborgs, a fusion of nature, organization, and technology with plants, animals, language, tools, and socially-controlled organization. From a media perspective, it can be argued that spoken language as a medium technology was the decisive factor in this development. Even the ancestors of homo sapiens began a journey into an alliance with language and tools. It is believed that homo erectus had proto-language as they were the first to migrate out of Africa, had larger brains, better technology: they were a new kind of animal that the world had never seen before (Fitch 2010: 403).

The great mystery has been why individual human beings begin to share propositional information with each other. However, the answer appears to be simple: it is an evolutionary advantage to freely share good information with one's offspring (ibid: 425).[7] Erectus was not nearly as innovative as later sapiens, but there is (at least) a 100,000-year gap between anatomical homo sapiens and any evidence of a technological explosion (ibid: 407). Here, new research points again to Darwin's initial theory that the brain is crucial, as it seems plausible to select for new/more neural connections, neurotransmitters, without changes in the neural cell types, or brain volume (ibid: 409). In Luhmann's terminology, there is co-evolution with language as the structural coupling between the biological, the psychic, and the social levels of systems formation. The interplay between the brain, self-control, and tools on the one hand and more and more advanced division of labor and social complexity, on the other hand, drove humans forward in a development with language as a condition of possibility. Language itself was part of the mutual transformation: the development of more and more advanced syntax, more and more advanced tools, smarter and smarter brains, more and more different work tasks, roles, dances, hunting, trade, and faith slowly drove humans into a development where the individual elements of the development constituted each other's necessary foundation.

Human beings cultivated themselves while simultaneously cultivating the surrounding nature, and one day the stone age farming human stood there, as a hybrid of language, fire, clothing, tools, livestock, and crops, as a member of and subordinate to an organized society. Perhaps humans were pressured into farming life by self-made circumstances – we had burned half the world and wiped out most of the wild megafauna, which is an impact

[7] Phatic communication may be an adaptation to prepare the ground for honest proportional information exchange (Fitch 2010: 428).

on the planet long before the burning of coal, but through which we, if not completely created the environment we lived in, certainly influenced it significantly – also climatically.

Spoken language

The starting point for language, literally speaking, was the ability to produce and imitate sounds, which gradually entered into a form of proto-language. Here, the crucial leap is believed to consist of the emergence of a lexical language (Fitch 2010), since humans already had a cognitive semantic property as a starting point (the ability to conceptualize – which other larger primates also have, for example, an understanding of water).[8] However, language allows us to communicate about the world in a lexical language, where proportional information can go from more experienced to less experienced (where and when are there fish, how are they caught, and with what technology and how is this technology produced). The lexical language operates through a kind of double pattern (duality of patterning, Fitch 2010: 94), which within language and system theory is referred to as *double articulation* (Martinet 1960: 26; Esposito 1999). A double articulation system consists of a hierarchy where a subsystem constitutes a supply of distinctive features without independent specification, by means of which an unlimited number of statements can be composed. All known modern (current) spoken languages are double-articulated, which gives them a unique economy, because double articulation provides an inexhaustible supply to draw upon in connection with linguistic innovations (Martinet 26-28; Esposito 1999). By single articulation (a call system), it is meant that each sound has a meaning, by double articulation, the individual sounds are functional units (phonemes) that are semantically empty but with a meaning-distinguishing function so that they can be combined to form infinitely many meaningful expressions (ibid). Double articulation as a phonological system provides a great advantage over a call system (where each sound has a meaning) as it provides an unlimited supply of words that, for humans, worked and still works as a "mental syllabary" (Fitch 2010: 411). As with the ability to produce and imitate sounds, double articulation is seen as a prerequisite for the later development of modern language, characterized by advanced syntactic structures, including different word classes. It is difficult to say when modern language was developed, as the languages we know today, but sapiens developed, selected, or arose from anything but pure nature, but on the contrary in culture, technology, society, and in connection with a form of proto-language. If we look at the extinction of megafauna and cultural creations (technology and cave paintings), 40 to 60,000 years ago could be a guess as to when modern language was developed.

Society and language-based communication: The first sociotechnical autopoiesis machine

Although we cannot determine a specific date for the emergence of modern spoken language, we can reason that cooperation in the population of hominins has previously been governed by inherited instincts mediated through genes, where acquired knowledge perished with the death of the individual. As long as the sum of experiences lost upon death is bigger than or equal to the amount passed on to the next generation, there is no

[8] The cognitive-semantic property, combined with world knowledge (ontology), seems to be the obstacle to the development of true strong AI. In this case, the approach has been reversed, starting with syntax, as computers lack both semantics and world knowledge.

accumulation of experience (Weisskopf 1964). At some point in evolutionary history, humans surpassed this barrier, making a leap from traits inherited in nucleic acids to oral transmission (ibid: 213). Therefore, it is through the medium of language that society can accumulate knowledge.

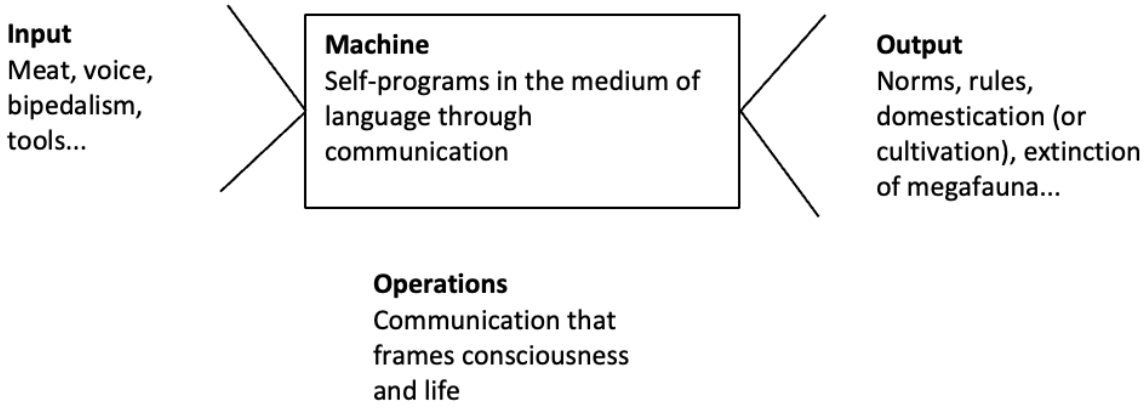
Chimpanzees can imitate and transmit traditions across multiple generations, a phenomenon referred to as "chimpanzee culture" (Fitch 2010: 163). Tool use is a good example, as there are significant variations between groups (ibid: 238).[9] However, chimpanzees cannot surpass the barrier. While different tool usage may be passed on to the next generation within different groups, there is no accumulation of knowledge from generation to generation. Chimpanzee development occurs on the genetic level and not on a level where language acts as a structural coupling. Humans, however, are not the inventors of society, as we can find the formation of societies in the animal world (Morin 1974: 35). In the beginning, proto languages increased the accumulation of knowledge through structural coupling with the genetic transmission of traits. This knowledge may have acted as a supplement to inherited traits without truly uncoupling the social from biological determination. Even hominins with a proto-language consisting only of gestures and a call system, and later with a lexical proto-language (a double-articulated language), would have had an advantage in evolution and gradually built complexity through co-evolution between new/more neural connections and increasingly advanced linguistic syntax. This eventually led to the critical mass for the emergence of both proper language and the modern human as we know it today, perhaps around 40,000 years ago.

According to Luhmann (1995: 153), language can be seen as a threshold that triggers the emergence of the social as an autopoietic system. Over time, this system came to regulate larger and larger parts of human social life. At this threshold, the psychic system is also differentiated out as a self or mind in its own right. From this moment, humans had to determine themselves to follow socially constructed norms and, as described by Freud, develop the ability to postpone the satisfaction of needs. The reason is that the level of social system formation became self-reflective with modern language, as language enabled communication about communication (ibid). Thus, what this text conceptualizes as the first sociotechnical autopoietic machine was constructed.[10] This machine consists, in regulatory terms, of linguistic communication in structural coupling with conscious psychic systems (conscious about oneself and one's environment), as well as the material environment consisting of food, technology such as fire and weapons, climate, etc. Through language, the social could differentiate itself from what did not communicate and present itself as a machine that subordinated humans to its organization, with rules and knowledge of, for example, tool use.[11] According to Luhmann (2012), the social then begins to differentiate internally, and in a simple world where communication was solely carried by language (not

[9] The chimpanzees cannot learn spoken language, but with human training they can learn a few hundred symbols and an elementary syntax, but will be left behind by a 5-year-old child (Fitch 2010: 14).
[10] Where Luhmann's theory strongly focuses internally, the synthesis with Bryant's concept of machines allows for the inclusion of the external environment as well (not that this contradicts Luhmann's theory; it is a matter of theoretical focus).
[11] Perhaps cave paintings, tattoos, jewelry, etc., as well as possibly some incised or painted symbols, have also played a role.

writing or printing), society differentiates into segments.[12] Differentiation is the way society divides itself to handle complexity (see Tække 2022a). In a segmentally differentiated society, society is divided into families, villages, and tribes. When a unit becomes too large (complex) to be handled through spoken language, a group of individuals departed and established a unit similar to the one they originated from. There will also be a center-periphery differentiation between the initial tribe and the others, where they meet periodically for trade and further (Luhmann 2012).

Figure 2. The machine based on spoken language.



In Figure 2, we can see the first sociotechnical autopoietic machine. It captured humans by using communication based on spoken language to establish rules and provide a framework for understanding life, or in other words, to subjectivize humans. Biological needs were now processed through consciousnesses guided by social norms and knowledge, whereby "humanity" began its transformation of itself and its surroundings.

It is this machine that stone age humans were captured in, and it should be considered the actual actor for the further cultivation (transformation) of plants, animals, and the environment. The chimpanzee is also captured in a society where cultural differences can be observed from group to group but remains stagnant in its cultural and normative development since it is determined primarily by genes and not language-based communication, which significantly influences the transformation of lifestyle and interaction with the environment. In contrast, humans were captured by a machine that, with its components, technology, fire, tools, and language for coordinating between the psychic and social, abstraction, and negation, was dynamic and hyper-adaptive (working in different climatic conditions, for example). This highly complex machine continuously transformed itself and its surroundings and, in turn, transformed itself again, albeit at an infinitely slower pace compared to the present, but immeasurably faster compared to the animal and plant world. As Canadian media theorist Harold Innis (1991) developed a theory, saying that

[12] Of course, spoken language's words also enter conscious thinking at this point and of course also nonverbal communication was part of communication, but the medium of language was the structural coupling.

media can have either a time bias or a space bias. Spoken language, when used alone, has a strong time bias, which means that society is extremely stagnant and conservative.[13]

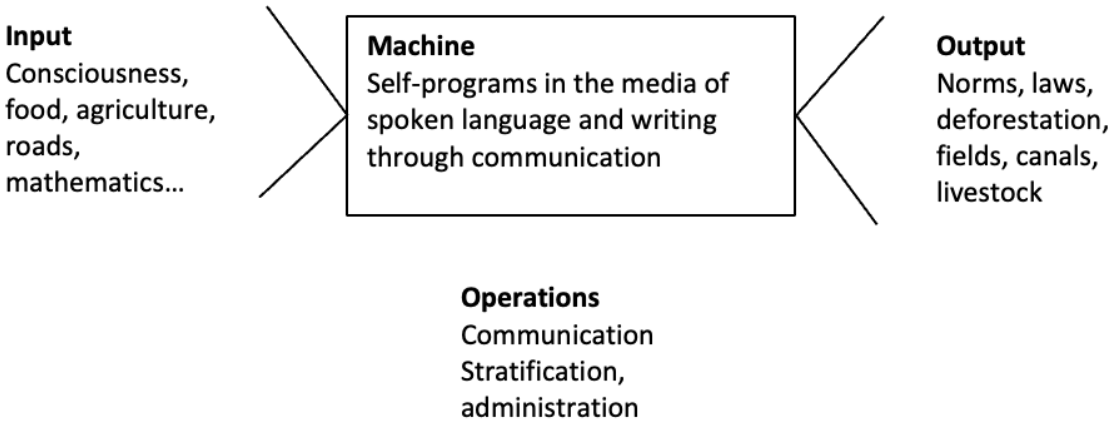
At the same time, it can be argued that, due to its operational closure, the society quickly developed logics and norms that are harmful to its living environment (and thus to its own conditions of existence). Only in recent times has humanity begun to observe this problem. Fitch (2010: 428) points out that as soon as a linguistic system is in place, gossip, social control, and punishment can play a crucial role in information transmission. This can occur without further biological evolution, through culture and a set of social norms. We have inherited the Machiavellian intelligence of primates (ibid.), but with the sociotechnical machine, this "intelligence" is multiplied many times over.

The Machine Plus the Written Medium

There are many stages in the development of writing, and its origins likely date back to Ice Age cultures.[14] Approximately 7,000 to 8,000 years ago, the development of writing gained momentum in Mesopotamia through the use of clay figures representing animals, wine, and crops to aid memory in relation to possession, ownership, accounting, trade, and travel activities (Hallager 1997: 15). About 5,000 years ago, the first writing systems were developed for all forms of communication. Writing societies differentiated into strata, thus developing hierarchical societies with god-kings at the top and slaves and/or farm workers at the bottom. In Mesopotamia, solar and water clocks and calendars were developed, and humans were enumerated in large river dynasties where they had to pay taxes or serve as slaves. The god-king and a stratum of priests and aristocrats sat at the top of this highly religious hierarchical system. Humans were once again transformed into a new form of cyborg and, based on writing, developed a spoken language with many more words and much greater knowledge than what was seen in earlier media societies. Science and philosophy were developed, navigation across open seas was learned, and with the relatively greater spatial bias of the written medium, empires spread across vast areas. The extensive reach and administration of dynasties were thus dependent on writing (Clark 1992: 11). The Romans colonized enormous territories and built up to 80,000 km of roads for administration, troop transport, and trade (Madsen 1991: 73). The typical person in a society based on speech and writing typically couldn't read but lived in a society that existed in structural coupling with writing. They lived in an animated world with the intervention of gods and demons. Their economy was based on slaves, whom the Romans referred to as "talking tools," equating them with livestock and other tools. Perhaps due to the slave society, the steam engine, which was invented in antiquity, was not used for production but only for circuses and religious purposes. However, the period saw not only the development of technology but also the utilization of technology. Mathematics, physics, tool, and material knowledge made significant advances, and aqueducts, canals, ports, and agricultural tools like generations of increasingly better plows were built (Nielsen et al. 1990; Madsen 1991).

[13] Luhmann (1995) points out that before writing, there was no distinction between interaction and society.
[14] See Finnemann (2005: 35) for an overview, and Logan (2004: 17) for a connection between phases in the development of writing and their implications for cognitive competences.

Figure 3. The machine based on spoken language and writing.



In Figure 3, we can see that the machine increasingly begins to transform its own output into its own input. Whereas the previous machine (Figure 2) predominantly used natural resources in their original form, there is now less wild nature and more domesticated crops and livestock. The machine itself gains entirely new possibilities for managing resources, and locations, subjectivizing individuals, and processing decisions through writing.

It is a machine that effectively distinguishes between inclusion and exclusion in the sense that humans must meet a set of conditions typically based on theological reasoning. If one falls on the wrong side, they are killed or forced to live outside society as an outlaw. It is now even clearer that the machine is the subject of governance, although the emperor may at times rise above the rules. However, it is still evident that the machine sets the goals one wants to achieve, the honour one can attain is socially constructed, and the food and wine, the jewellery one may desire are now almost entirely societal outputs. Nature has been transformed into domesticated animals and plants, into ploughs and swords, into your land and my land, into money, and the human being itself has transformed into an individual who is born, lives, and dies within the same stratum, such as a feudal peasant.

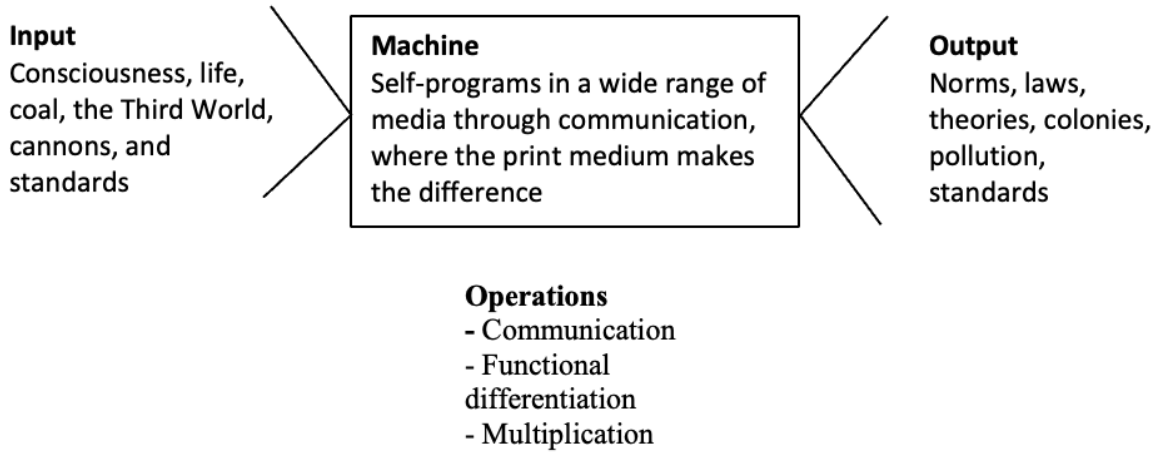
The Machine plus the Printing Medium

With the printing press, the machine acquired a new component that further enhanced its capabilities. Maps provide a good example: there are more than 600 maps from the period between 300 AD and 1300 AD that have withstood the test of time, and in them, it is not possible to find signs of the development of cartography, no progression in either thought or precision. What eventually led to precise maps is the feedback process between those who create the maps and those who use them, which was not possible before the printing press (Eisenstein 1983). It was only with the printing press that it became possible to compare one's own observations with the knowledge that was already "stored" in society - before this, no one knew what others had discovered. Through reading books, humans learned about themselves and others, for example, how a prince was and how they should behave. At the same time, one could read about the past and compare texts, and within a century, one had a grasp of what both Plato and Aristotle had written. Once the inheritance from antiquity was understood, Renaissance humans could delve into the development of

new knowledge, especially technical knowledge. They could compare results, receive feedback, make corrections, and share knowledge. The European printing man found a powerful ally in capitalism and, through investments in corporate form, could colonize the world with gunpowder and bullets. With letters, maps, compasses, ships, and cannons financed by capitalism, the machine became more powerful than ever before, and the exploitation of the third world and the world's natural resources truly began. With coal-powered steam engines, the machine expanded its capabilities once again, and industrialization reshaped the world to such an extent that we now discuss the Anthropocene.

The form of societal differentiation also began to change in the wake of the printing medium. The stratified society was divided into autonomous functional systems, so that politics, religion, economy, law, science, and eventually a range of other systems became operationally closed systems in their own right (Luhmann 2012). The functionally differentiated society is a society without a unifying centre, so that in principle, one cannot buy political decisions or scientific results (truth). It is up to science itself to clarify what is truth, and the emperor or prime minister must not interfere. This also means that individuals must include themselves in society through communicative contributions but otherwise stand outside as the environment to the social, to the machine. With printing, literacy belonged not just to a layer of scribes, priests, and a few privileged free citizens. Every human in the Western World gained a much more widespread opportunity to learn to read and write, and thus the possibility to ally themselves with knowledge and technology from all over the world.

Figure 4. The machine based on spoken language, writing, and the printing medium.



It was an epoch where the Bible was translated into native languages, and as a result, wars broke out over its proper interpretation in Europe (Eisenstein 1983). At the same time, the configuration of the machine began to change as it started to incorporate what Latour (1990) calls inscriptions, such as diagrams and columns that are combinable and easy to incorporate and integrate into texts. They are unchangeable because they are merely representations on paper; they are mobile as they can be copied (printed) and moved, and their postulates can be tested based on clearly defined shared rules. They possess optical

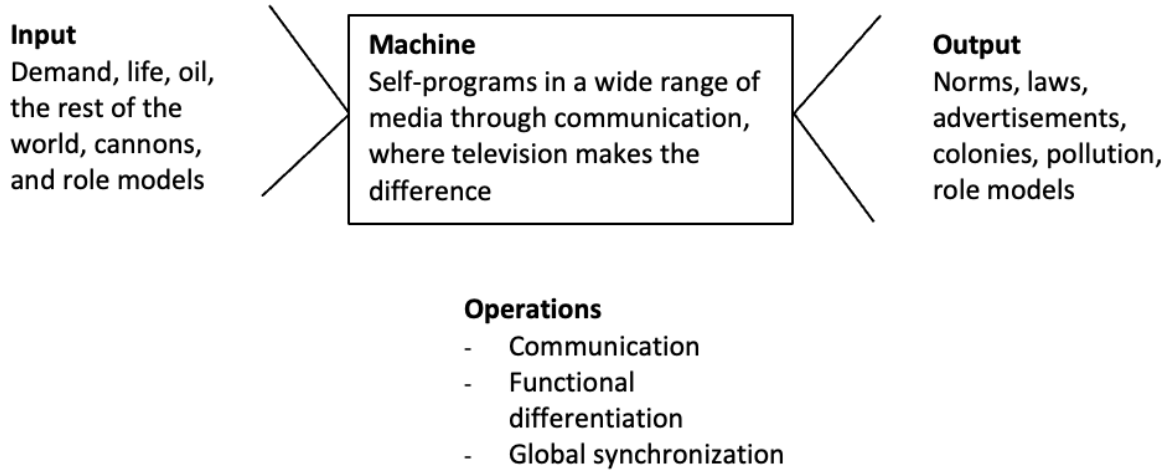
consistency as one can use perspective to move things from their context and interpret them under different conditions, given that their logic is universally known, and the method by which they are presented is accepted. This process of scientificizing the environment through media/technology has significant political and economic consequences. An example is how Europeans, using cartographic technology, could map and rediscover islands in the Pacific, create diagrams of population, minerals, soil, plant, and animal life, and compile it all into economic and military calculations of investments and profits. One can sharpen Latour's (1990) point that we have never been modern to the extent that science has not figured out an objective explanation, but rather, the machine, through printing technology, has gained access to inscriptions in the regulation of society. Another example could be European health policy, where the various conflicting states in the 18th century began to be concerned about the health of their populations, as population size was an important parameter in the competition between states. This involves scientification and regulation, which can be captured by Foucault's (2008; 1997) concept of biopolitics. With the new media technology, the machine constructs the social discourse of what is right and wrong. Measuring instruments and tables stabilize objects that would otherwise be observed as multistable (Ihde 2001). At the same time, texts and illustrations in printed materials begin to establish standards for health, what one should believe, the techniques for it, and what one should work with, etc. Strong norms that have increasingly global impact, which, along with the growing functional differentiation, create common semantics on a global level within the various functional systems such as economy, power, knowledge, etc., gradually forming a global society. The machine, which previously functioned as many small and more local machines, almost solely relying on spoken language-based communication and comparable rules of differentiation, now operates on a more global scale. Since the dawn of the machine, norms of behaviour had been regulated through what Foucault (2015) conceptualized as pastoral power, the religious micromanagement of individuals' adherence to power. Now, with the printing medium and scientification, we see more of a model with biopower and disciplinary power, and what Giddens (1994) conceptualizes as a disembedding of institutions and regulation to increasingly global systems. Granted, one could argue that with what Habermas (1976) conceives as the public sphere, a counterforce to the machine emerged. However, even public spheres seem to operate within the framework of the machine's strategic and instrumental power, and communicative action in the lifeworld is an idealistic and normative dream of deliberative democracy that is difficult to empirically observe. With Luhmann (2000), one can observe the problem as such that no communication exists outside society, which can only observe the environment based on its own semantics and with the functional differentiation, even only centerlessly based on the code of the various subsystems. In other words, the machine had now internally started to differentiate itself into smaller machines, each constituting the social environment for the others in an interdependent but mutually exclusive system, where subsystems are closed around their own codes (Luhmann (2012). However, economics seems to have taken precedence, so both knowledge and power were placed behind the profitable exploitation of the world's resources. Even the inherent god of the machine looked with Stone Age peasant logic auspiciously to the transformation of the outside world.

The Machine Plus Analog Electronic Media

It may be clearer why the medium is the message (McLuhan 1967) when one understands the media environment as a component of the machine. Despite the fact that everyone had

previously lived in a society made possible only by the structural coupling with printing, and many in the West could actually read, it turns out that only a few can read complicated texts and almost no one can understand texts outside their own field, in addition to that, censorship takes on a different character with the analogue electronic media, for example, you cannot speak outside of quotation on live TV (Meyrowitz 1985). With analogue electronic media, all citizens, regardless of gender, age, profession, and social class, gained insight into society, into others' backstage, into other genders, ages, professions, and nationalities. In addition, society gained an unprecedented ability for self-synchronization as news and information could now be telegraphed in and gradually transmitted from around the world. However, mass media create reality based on their own code and organizational decisions (Luhmann 2000b), to which they have a primary linkage either to profit or to a state. Content ranges from political propaganda to democratic debates - albeit in fierce competition with art and culture, news, and especially entertainment. According to Meyrowitz (1985), these media created a new information situation, among other things, resulting in everyone (worldwide) wanting to achieve the same privileges and rights as the white, American, heterosexual, Christian, middle-class man - especially women. People all over the world wanted houses, cars, TVs, meat, rights, and vacations, and advertisements showcased consumer goods. And once again, the planet had to provide resources for the now billions of people, with a total biomass exceeding that of both domesticated and wild animals combined.

Figure 5. The machine based on spoken language, writing, the printing medium, and analogue electronic media.



The machine in Figure 5 illustrates the course of a media society that heavily relies on fossil fuels in its pursuit of consumer goods. However, it should be remembered that large parts of the world's population still lived without contributing to the significant pollution—not because they didn't want to, but because they didn't have the opportunity. The machine propelled everyone towards success criteria, showcased by role models who drank cola, ate meat, drove large cars, and went on vacations by airplane. In developing countries, people also dreamt of such aspirations while struggling through a life where clean water, sanitation, fuel, and food were lacking, in a world gradually marked by overpopulation and pollution.

The media era, with its functional differentiation, also brought about protest movements, including the environmental movement. These movements acted as part of a growing periphery that started to challenge the power centre with alternatives and emerging ideas of green energy and social justice. They sought to connect functional systems such as economy, politics, science, and law. However, strong values and logics entrenched within the machine are difficult to separate from capitalist logic, with profit maximization and the commodification of nature as mere resources. Since the era of the printing society, humans have been able to see themselves in the third person (Locke and Hume) and have, to varying degrees, sought to govern themselves morally. Yet, the social programming and power dynamics of the machine still dictate the potential life of the individual, and political power that could bring about structural changes increasingly appears paradoxical, resembling a parasite that ultimately seems poised to kill its host. Drawing on Bourdieu, one can say that we only have the forms of capital that are dispensed by the machine; as individuals, we can only navigate within the machine's game board (Bourdieu and Wacquant 1996). The picture becomes one of strong individualization in a functionally differentiated society, where the machine determines inclusion and exclusion based on forms of capital. Sympathy is humanistic, but the distribution is unequal, and the natural foundation is transformed into lifestyle products and markers of social identity. Despite the scientific community's warning since 1972 through the report "Limits to Growth" (which highlighted the ecological catastrophe associated with fossil fuel combustion), the environmental movement, and democracy in the Western World, the machine continued its course.[15] In the centreless communication of functional differentiation, there was no response to the alarm calls from science and the environmental movement. The systems only operate through their own code, which is why politics, economy, and law did not adjust their observations from what was economically beneficial, what would secure electoral success, or what was right. Despite the transparency provided by a medium like television, and the fact that the subject was not illegal, other agendas pushed themselves forward based on news value and estimated viewer ratings - even the mass media operate according to their own code (Luhmann 2000b). At the same time, the alliance between economic interests, science, and politics exerted a strong influence in the opposite direction, with oil production, for example, accelerating, especially in countries like Norway and Denmark. The machine's functional, instrumentalist, and profit-oriented algorithm led to asphalting of natural areas (e.g., Aarhus River), and fossil-fueled production of artificial fertilizers and pesticides, resulting in increased CO2 emissions, pollution, and a biodiversity crisis. The inscriptions and subjectivization primarily served the destruction of nature,[16] although in the free world, we also had a counterculture with a diametrically opposite discourse - but, as we now know, it had no power to change the trajectory towards the destruction of the biosphere.

The Machine Plus Digital Media - The Battle for the Machine

With digital media, we still don't know how the development will continue. Will we see a new form of differentiation? Will the machine be reprogrammed? Will the computer save us, or will it give us a final push over the edge regarding the natural foundation? Or will digital media, or those belonging to the absolute power elite, who currently own almost all

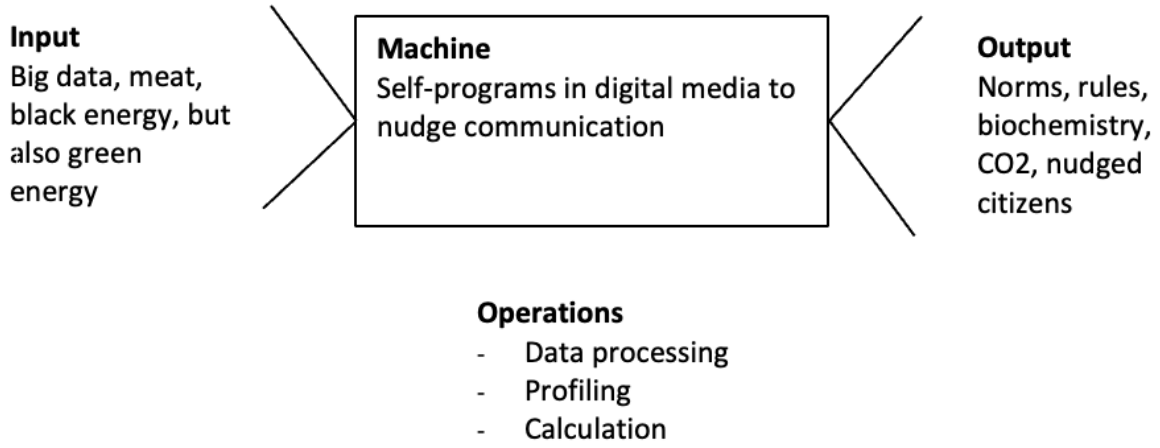
[15] As early as 1895, the Swedish scientist Svante Arrhenius knew that increased emission of CO2 into the atmosphere would lead to a rise in global temperature.

[16] When I was growing up on Læsø, there was a man who erected a windmill in the early 80s. He was subjectivized as a fool: "Søren Windmill haha" where "mill" also mean ash in Danish.

the wealth in the world, in some configuration, mutate into a decisive new being, a *homo digitalis*, in a transformation that leaves sapiens as livestock, as a mere resource? The questions are numerous, and the answers are blurry, which is why I will only attempt to outline how the machine, which now has digital media as its underlying technology, appears to function. First, I will outline the functionality of digital media to describe how the sociotechnical autopoeisis machine can be observed now that it also operates digitally. Then, I will provide a brief and selective analysis of various scenarios that may be speculative but are based on theory and empirical observations.

The computer, as the key technology for digital media, fundamentally relies on an alphabet with only two letters and operates as an underlying triple articulation system. Based on Finnemann (1999: 143), the three articulation levels can be described as a notation level where the alphabet is found, an algorithmic level, and finally an interface level where the semantic content becomes observable. Thus, there is always a notational representation, an algorithmic syntax, and an interface that defines the semantic content of the syntax (ibid: 146). While there is only one alphabet, there are no limits to the variation of algorithms used to control processes or to define the semantic content of the syntactic process (ibid.). Over the past decades, the management of society and communication, in general, has been digitized at a rapid pace. We have barely understood the new social potential and the risks that the new medium presents before new companies have become the largest and wealthiest in the world through the exploitation of digital media. The experience from previous media revolutions is that the initiation period is marked by turmoil and many problems, but it is also the experience that many new structures, driven by the new media, replace the old ones (Tække 2019; 2022a). Virtually the entire society is now governed and regulated by machine learning algorithms, ranging from the economy to the healthcare system, transportation system, welfare system, and education system, albeit to varying degrees within different sectors and different states. Overall, our communicative and regulatory infrastructure has already been digitized in a country like Denmark. Digitally regulated systems, whether it is the healthcare system or social media, are now controlled by machine learning algorithms using big data. This requires comprehensive surveillance of citizens' behaviour, past choices, records, tax returns, purchases, preferences, likes, etc. With the digitized form of inscriptions, large amounts of data about users are collected, enabling individual user behaviour to be subjected to psychometric analysis for user profiling. Subsequently, users can be punished or rewarded, or as is most common now, nudged economically and attitudinally, including being included or excluded, depending on the specific coding (see Tække 2022a). However, it is also potentially possible to receive the correct diagnosis and treatment in the healthcare system, the right benefits in the social system, the right price for a bus ticket, or relevant articles, movies, or chatbot responses. Additionally, questions arise regarding transparency about how algorithms work, as well as democratic influence - surveillance and sousveillance: Foucault (2002); Tække (2011) and the panopticon (being watched from above for self-discipline); Jensen (2020) omoptikon (we monitor each other for self-discipline) and Han (2016) banopticon (the surveillance that comes with profiling, controlling social inclusion and exclusion).

Figure 6. The machine based also on digital media.



In figure 6, the sociotechnical autopoiesis machine is seen in its current form. As a starting point, media are neutral and can be used for both good and evil in a normative sense. However, what is considered good or evil is contingent in the sense that there is no consensus on what specifically falls on either side of the distinction (Luhmann 1993). The specific coding of a system is currently opaque, as digital media, due to their functional architecture (alphabet, syntax, semantics), are always already programmed with particular preferences, values, and logics on a deeper, invisible level for the user (Tække 2022a; 2022b). One can argue that they have a specific materiality where communication unfolds through an already programmed infrastructure that governs and co-constructs communication (Tække 2022b). One can say that norms are programmed into the very medium itself, so the machine's regulation of humans now takes place on a new level where it is not up to the individual to assess the fate of another human based on printed guidelines. Now, the machine can practically step in and make the assessment. For example, regarding biopolitics, if the algorithm reveals you as a smoker, you go to the back of the line for surgery. Previously, the doctor might not have known that you smoked or might have overlooked it, or deliberately chosen to overlook it. Or in education, if eye tracking shows that a student has been inattentive or has looked at "wrong" things, a message is sent to the parents who can then nudge or punish the child accordingly. Currently, those who have the power to program the machine are the ones who determine which values determine citizens' possibilities, and this can potentially be done democratically and with minority protection and/or environmental protection in mind.

Currently, we are witnessing what can be observed as a battle for control over the new communicative infrastructure. This naturally has huge implications for climate and the environment, for example, in the form of consumerism, investments in fossil energy, the goods offered to individuals, nudging of habits, etc.

Paulsen and Tække (2022) propose three scenarios, three types of machines for the future society. One is the state-controlled big data machine, which, inspired by China, can be seen as the totalitarian surveillance state where citizens are nudged and coerced through registration and calculation using a form of social points that determine the privileges,

opportunities, and punishments citizens receive. Here, it is the state (in China, the party) that programs the machine with the values and logics that govern inclusion and exclusion in society.

The second model is a market-driven corporate model, which, inspired by the USA, can be seen as both neoliberal (Han 2016) and surveillance capitalism (Zuboff 2019). The "big five" (Meta, Amazon, Apple, Microsoft, Alphabet) decide the apps, social media, shopping options, transportation options, and information options available to citizens (Dijck 2018). Similarly, the societal institutions are overwhelmingly commercial businesses, so the healthcare system, banking system, transportation system, and, for example, the education system operate through Silicon Valley and based on profit motives. Citizens live in apparent freedom but are profiled and nudged to an extent that rivals the state model. None of the models are intended as malevolent, but rather for the good of the people/individuals (Paulsen and Tække 2022).

The third model is conceived as the democratic model, where big data is used in a transparent and democratically determined manner. Ideally, this would be done deliberatively so that those who are profiled, along with their allies, such as guardians of schoolchildren, can determine who has access, what should be measured, and with what consequences. Bildung in education requires students to learn to take a critical stance and have the necessary knowledge (understanding of big data), to adopt a perspective of the common good (and now we can add the perspective of the biosphere), and to existentially choose whom they become through their actions (ibid). This last model is, of course, a utopia, but even this utopia provides no guarantee that the biosphere will be more than a topic on the digital school schedule.

A climate-related example can demonstrate the current situation where we live with all three models in the proto-phase and indicate who has dominated the programmed values in the initial period.

In the 1990s, the first advanced computer models emerged that could simulate global warming and climate change under different scenarios of economic growth and greenhouse gas emissions. While these models are useful and indispensable in many ways, they also removed the need for deep critical thinking (Watson et al. 2021). Such models portray society as a network of idealized, rational buyers and sellers, ignoring the complex social and political realities and even the effects of climate change itself. The implicit promise of these models is that market-based solutions will always work. This meant that discussions about political strategies were limited to what was convenient for politicians: gradual adjustments to legislation and taxes (ibid).

In relation to climate change, it means that the idea of net-zero is a deception that has arisen because our ability to model has led us to believe that we can rationally calculate climate efforts using computers without being able to reflect rationally on their programming. Through modelling, the climate becomes an algorithm that can be manipulated. According to Watson et al. (2021), today's net-zero strategies will not keep global warming below 1.5 degrees because that has never been their purpose. They were and continue to be driven by the need to protect business as usual, not the climate.

The example shows that computer models have already been providing us with the rationale we act upon for a long time. Watson et al. (2021) specifically criticize the models because the values the algorithms are modelled after have supported the capitalist business as usual—a "burn now and pay later" logic. Watson et al. (2021) demonstrate that the models have been used to argue for delaying efforts, acknowledging probable technological developments, etc. At the same time, it is hard to imagine how we will solve the problems without utilizing digital technology. Currently, the observation of the environment depends on the logics programmed into the algorithms. The future is unclear at this point, but it is likely that the autopoietic sociotechnical machine will address this issue in the new media environment. It is up to the machine itself to condense its forms, and we are likely heading towards a new fundamental form of differentiation dependent on computers, where the machine, perhaps soon, will self-program for a tight coupling to algorithms that distribute humans in space and time as frictionless resources. Here, it is important to remember that artificial intelligence has no knowledge of the world, no ontology—that semantics and meaning are purely syntactically produced representations. Only the human animal has semantics but has been subject to the machine since the advent of modern spoken language.

Returning to the question of societal differentiation, Luhmann (2012 vol 2) points out that functional differentiation makes a collective effort to avert the impending ecological catastrophe impossible, highlighting the need for planning and coordination (ibid: 108). However, there is no coupling system (ibid: 115), no coordination of irritation, no central monitoring (ibid; see also Jönhill 1997). Earlier in the book, Luhmann (2012 vol 1: 182; 249) speculates that digital media (the computer) can affect the social structure (see Tække 2022a for further elaboration).[17] As I have mentioned, one can imagine that digital media becomes the focal point in the machine, so that individuals are included or excluded based on profiling determined by the machine's values. Furthermore, one can imagine that human contributions are still sorted based on the different codes of functional systems, but the machine serves as the centre for all transactions and transformations. There are experts who believe that the problem of the programmed goals and values in the algorithms is just a digital childhood illness that can be cured by including more and more goals and values, along with programmed uncertainty in collaborative algorithms (Arora and Doshi 2020). This could mean that AI will ultimately save us from human irrationality and from the lack of a centre in functional differentiation.

Conclusion

The conclusion is that humans have had a significant impact on their environment, on the world with its flora and fauna, and increasingly on its climate. It seems undeniable that the influence began back in the Pleistocene, intensified in the Holocene, and culminated in the Anthropocene. In the work of this paper, it has proven useful to use geological terms that everyone knows and can relate to. From a geological perspective, it is likely that it is only from humans began to burn coal and onwards that there are geological deposits in the Earth's sediments that can be traced back to humans. However, the work with this paper has not changed my opinion that Malm and others are correct in stating that the term does

[17] Tække (2022a) suggests algorithmic differentiation as a new fundamental form of differentiation that aligns with the previous forms of differentiation.

not act as a causal explanation since the causes of the geological deposits cannot be attributed solely to humans per se, but to capitalism, to a system. In fact, this text shows that Malm is only partially correct, as capitalism itself was only possible as a development within an already established system. This system is what this text has described as a machine, as a sociotechnical autopoietic machine that traces back to the Pleistocene. Of course, it was only with industrialization in the 19th century that the machine began to leave traces in the Earth's sediments, but the mechanism itself, the argument concludes, must be much older. The machine's self-destructive functionality was already established with language, after which the destruction of the biosphere has been exponentially increasing with each media revolution, from the initial extinctions and burnings, to the extinction of megafauna, the cultivation of landscapes, animals, and plants, to the biodiversity and climate crisis that characterizes the present. The transformation so far seems to have converted other parts of the biosphere into more and more humans, into a monoculture that will not be able to sustain itself once it has displaced enough of other life forms.

The theoretically decisive aspect is whether the text has succeeded in presenting a satisfactory and comprehensive model with the machine. The argument is that in the distant past, after the selection of bipedalism, humans began to develop a more and more advanced language in a dialectical context with the development of larger and larger brains, the transition to consuming more meat, increasing use of tools, utilization of fire, domestication of dogs, etc., in a spiral where more advanced social patterns led to the selection of more advanced proto-language, larger brains, more advanced tools, and so on. It seems plausible that at some point, a critical mass existed that allowed for the emergence of modern language and thus the machine. The theory is that with the medium of language, the machine enabled the transmission and accumulation of knowledge and culture from generation to generation. According to Luhmann, the social level of system formation emerges precisely with language, as it turns the social into a self-referential system. This leap means that individuals become subjectivized, that in the medium of language, they begin to perceive themselves based on the linguistic "instructions" of the machine. This leap decisively wrenches man out of biological determination, only to subject them to a high degree of social determination, as there are no self-descriptions, knowledge, culture, etc., outside the social realm. Unbeknownst to them, humans, as an immediate animal among others, have been captured as part of a machine through language, transforming them into a part of this larger entity. Subsequently, this entity produces and reproduces the structures under which humans then live. The theory argues that the self-destructive effects of the machine (destruction of its own natural foundation) are rooted in the animalistic nature of humans (desire, fear, survival instinct, securing one's offspring, compassion, love, and aggression) and form the basis of the machine's initial programming and thus its most fundamental functional structure. The machine's initial algorithms have evolved on a foundation that can be understood as symbiotic mechanisms and what Fitch (2010: 428) refers to as the Machiavellian intelligence of primates.[18] Initially, the machine has sustained its autopoiesis in a harsh environment where distinguishing between in-group and out-group, ensuring food supply, and securing offspring have been crucial for its structural experiments. From a systems perspective, there is either autopoiesis or there isn't. If the

[18] Luhmann (1995: 250) uses the concept of symbiotic mechanisms to describe how the body is a source of disturbance and differentiation, such as how politics relies on physical power.

structural experiments do not enable the system to sustain itself in its environment, it ceases to exist. Systems are always already adapted to their environment, and my argument is that when the machine emerges, so to speak, it is born with a set of structures that it has not been able to get rid of since (and from a species egotistical perspective, it has been successful since Homo sapiens now constitutes the largest biomass on Earth - although it also is on the verge of self-destruction, which is the other side of the coin). There have been attempts within religions (love your neighbour) and humanism (e.g., human rights and Bildung), but these attempts have been species egotistical (anthropocentric) from the perspective of current scientific observations, which indicate that our natural foundation is threatened by our social structures, by the machine. On the other hand, one can say that nature does not care; if humans destroy their natural foundation, they will perhaps become extinct, while nature with its biodiversity will have created itself anew after a few million years. Only psychic systems become wistful at the prospect of the current diversity disappearing forever, while nature, through autopoietic experiments, will build new structures in an unknown future - without worries.

This analysis does not subscribe to any eco-Marxism; it does not endorse any critical theory. It is simply a descriptive analysis. Despite the bleakness of the analysis, it is also part of the conclusion that we are currently in an open situation because we cannot predict how digital media will influence the machine or, rather, how the machine will utilize the new media.

References

Arora, S. and Doshi, P. (2020). A Survey of Inverse Reinforcement Learning: Challenges, Methods, and Progress. Preprint submitted to Elsevier: arXiv:1806.06877v3 [cs.LG] 18 Nov 2020.

Barnosky, A. D. (2008). Megafauna biomass tradeoff as a driver of Quaternary and future extinctions. *PNAS, August 12, 2008, vol. 105, suppl. 1, 11543–11548.*

Bourdieu, P. og Wacquant L. J. D. (1996). *Refleksiv sociologi - mål og midler.* København: Hans Reitzels Forlag.

Bryant, L. (2014). *Onto-Cartography – An ontology of machines and media*. Edinburgh: Edinburgh Uni. Press Ltd.

Clark, G. (1992). *Space, Time and Man*: *A prehistorian's View*. Cambridge University Press.

Cordaina, L., Watkinsb, B. A. and Mannc, N. J. (2001). Fatty Acid Composition and Energy Density of Foods Available to African Hominids Evolutionary Implications for Human Brain Development. In Simopoulos AP, Pavlou KN (eds): *Nutrition and Fitness: Metabolic Studies in Health and Disease*. World Rev Nutr Diet. Basel, Karger, 2001, vol 90, pp 144-161

Dijck, J. v., Poell, T. and Waal, M. D. (2018). *The Platform Society*. New York: Oxford Uni. Press.

Eisenstein, E. (1983). *The Printing Revolution in early Modern Europe*. Cambridge: Cambridge Uni. Press.

Esposito, E. (2017). Artificial Communication? The Production of Contingency by Algorithms. In Zeitschrift für Soziologie 2017; 46(4): 249–265.

Esposito, E. (1999). Two-sided forms in language. In Baecker, D. (Ed.), Problems of form (pp. 78-98). Stanford, California: Stanford University Press.

Finnemann, N. O. (2005). *Internettet i Mediehistorisk Perspektiv*. Frederiksberg: Forlaget Samfundslitteratur.

Finnemann, N. O. (1999). Modernity Modernised - The Cultural Impact of Computeriation. in *Mayer. Paul A. 1999. Computer Media and Communication.*

Fitch, W. T. (2010). *The Evolution of Language*. Cambridge: Cambridge Uni. Press.

Foerster, H. v. (2003). *Understanding Understanding: Essays on Cybernetics and Cognition*. New York: Springer.

Foucault, M. (2015). *Viljen til viden – Seksualitetens historie 1*. Viborg: Det lille forlag.

Foucault, M. (2008). The Birth of Biopolitics: Lectures at the College de France, 1978-79. Palgrave Macmillan.

Foucault, M. (2002). *Overvågning og straf*. Frederiksberg: Det lille forlag.

Foucault, M. (1997). Society Must Be Defended: Lectures at the College de France, 1975-1976. Picador.

Giddens, A. (1994). *Modernitetens Konsekvenser*. København: Hans Reitzels Forlag.

Habermas, J. (1976). *Borgerlig offentlighet – dens framvekst og forfall*. København: Fremad.

Hallager, E. (1997). Skriftkulturens tilstand år 2000 før vor tidsregning. In *Hallager, Erik og Finnemann, Niels Ole 1997: Skriftkulturens tilstand år 2000 før og efter vor tidsregning. Center for kulturforskning ved Aarhus Universitet*.

Han, Byung-Chul (2016). *Psykopolitik. Neoliberalisme og de nye magtteknikker*. Forlaget THP.

Harari, Y. N. (2015). Sapiens A Brief History of Humankind. London: Vintage.

Haraway, D. (1991). A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century. in *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge, pp.149-181.

Haraway, D. (2003). *The Companion Species Manifesto: Dogs, People, and Significant Otherness*. Chicago: Prickly Paradigm Press.

Haraway, D. (2016). *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, N.C.: Duke University Press.

Hunt, C. O., Gilbertson, D. D. and Rushworth, G. (2012). A 50,000-year record of late Pleistocene tropical vegetation and human impact in lowland Borneo. *Quaternary Science Reviews Volume 37, 22 March 2012, Pages 61-80.*

Ihde, D. (2001). *Imaging Technologies: Plato Upside Down*. Ikke publiceret bog.

Innis, H. (1991). *Bias of communication*. Toronto: University of Toronto Press.

Jensen, J. L (2020). *The Medieval Internet*. Bingley: Emerald Pub.

Jensen, P. K. A (1996). *Menneskets oprindelse og udvikling*. København: Gad.

Jönhill, J. I. (1997). *Samhället som system och dess ekologiska omväld*. Lund Dissertations in sociology 17.

Latour, B. (1999). A Collective of Humans and Nonhumans I Pandora's Hope: essays on the reality of science studies. Latour. London: Harvard Uni. Press. pp. 174 – 193.

Latour, B. (1990). Drawing Things together. Lynch & Woolgar (eds.) Representation in Scientific Practice. Cambrige, Mass: IT Press pp. 19 – 68.

López-Corona O and Magallanes-Guijón G (2020) It Is Not an Anthropocene; It Is Really the Technocene: Names Matter in Decision Making Under Planetary Crisis. Front. Ecol. Evol. 8:214.

Logan, R. (2004): *The Alphabet Effect*. Hampton Press, Inc. Cresskill, New Jersey

Luhmann, N. (2012). *Theory of Society. (vol 1 & 2).* Stanford, California: Stanford Uni. Press.

Luhmann, N. (2007). *Indføring i systemteorien*. København: Unge Pædagoger.

Luhmann, N. (2000b). *The Reality of the Mass Media*. Cambridge: Polity Press.

Luhmann, N. (1995). *Social Systems*. Stanford: Stanford University Press.

Luhmann, N. (1993). The code of the moral, In *Cardozo Law Review, Vol. 14 Nos 3/4, pp. 995-1010.*

Madsen, A. (1991). *Arbejdet og teknikkens socialhistorie*. Viborg: Systime.

Malm, A. (2016). *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming*. New York: Verso Books.

Malm, A, og Hornborg, A. (2014). The Geology of Mankind? A Critique of the Anthropocene Narrative. *The Anthropocene Review 11 (2014): 62–69.*

Martinet, A. (1960). *Elements of general linguistics*. London: Faber and Faber LTD.

Maturana, H. R. and Varela F. (1980). *Autopoiesis and cognition: The reallization of the living*. London: D. Reidel Publishing Company.

McLuhan, M. (1967). *Mennesket og Medierne*. København: Gyldendal.

Meyrowitz, J. (1985). *No Sense of Place: The Impact of Electronic Media on Social Behavior*. New York: Oxford Uni. Press.

Morin, E. (1974). *Det glemte mønster: Den Menneskelige natur*, København: Gyldendal.

Neumann, J. v. (1958). *The Computer and the Brain*. New Haven: Yale University Press, 1958.

Nielsen et al. (1990). *Skruen uden ende*. *Den vestlige teknologis historie*. København: Teknisk Forlag A/S.

Paulsen, M. and Tække, J. (2022). *A New Perspective on Education in the Digital Age - Teaching, Media and Bildung*. London: Bloomsbury.

Postman, N. (1986) *Amusing ourselves to death*. New York: Penguin Books.

Thomsen, E. (1985). *Menneskets oprindelse*. Århua: Forlaget Niche.

Turvey, S. T. and Crees J. J. (2019). Extinction in the Anthropocene. *Current Biology 29, R942–R995, October 7, 2019*

Tække, J. (2022a). Algorithmic Differentiation of Society – a Luhmann Perspective on the Societal Impact of Digital Media. *Vol. 18 No. 1 (2022): Journal of Sociocybernetics. https://papiro.unizar.es/ojs/index.php/rc51-jos/article/view/6225*

Tække, Jesper (2022b). Materiality and Autonomy - Big Data in the Education System. In *Cybernetics & Human Knowing 29(1-2) 2022.*

Tække, J. (2019). Acquisition of new communication media and social (dis)connectivity. in Current Sociology, Mongraph. SAGE.

Tække, J. (2011). Digital panopticism and organizational power. in *Surveillance and Society, Vol. 8, Nr. 4, 2011*, s. 441-454. https://ojs.library.queensu.ca/index.php/surveillance-and-society/article/view/4181

Watson, R., Knorr, W. and Dyke, J. (2021). Climate scientists: concept of net zero is a dangerous trap. In The Conversation: https://theconversation.com/climate-scientists-concept-of-net-zero-is-a-dangerous-trap-157368

Williamson, B. (2017). *Big Data in Education*. London: SAGE.

Weisskopf, V. (1964). *Viden og Undren*. København: Gyldendal.

Wood, B. A. (1977). Human Evolution (Outline Studies in Biology). Chapman & Hall.

Zuboff, S. (2019) Overvågningskapitalismens tidsalder. København: Informations Forlag.