Entangled Trees and Arboreal Networks of Sensitive Environments

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The German meteorologist and climatologist Heinrich Dove (1803–1879) related weather's influence to human feelings. His meteorological handbook from 1837 begins with the sentences: »When the sky is covered with a uniform grey for weeks, we also become gloomy in the end, when it's finally light again above, we also become bright. We are thus faithful mirrors of the sky above us, we adopt its moods, and in this sense, not only is everyone a meteorologist but also, so to speak, meteorology itself.«[1]

One could take this suggested direct relation of humans and weather conditions one step further and ask: Are humans also all climatologists in this sense? Could we also be faithful mirrors of the climate and climate change? Or is this something that we indeed embody but cannot consciously perceive, at least in the same way?

Interestingly, during the 19th century, the definition of climate was still grounded on emotional perceptions. In his very early definition of climate, Alexander von Humboldt, one of the first climatologists in the modern sense, addressed the sensual apparatus of humans directly. He wrote:

»The term climate, taken in its most general sense, indicates all the changes in the atmosphere which *sensibly affect our organs*, as temperature, humidity, variations in the barometric pressure, the calm state of the air or the action of opposite winds, the amount of electric tension, the purity of the atmosphere or its admixture with more or less noxious gaseous of the sky, which is not only important with respect to the increased radiation from the Earth, the organic development of plants, and the ripening of fruits, *but also with reference to the feeling and mental condition of men* [my italics].«[2]

Following Humboldt, one could infer that people of the 19th century were all still climatologists; the climate would directly enter the emotional ecology as »tem-

1 Heinrich Dove: Meteorologische Abhandlungen, Berlin 1837, p. 3.

2 Alexander von Humboldt: Kosmos. Entwurf einer physischen Weltbeschreibung, Frankfurt a. M. 2004 [1845–1862], p. 340, translation taken from: Cosmos: A Sketch of a Physical Description of the Universe, translated by E.C. Otté, vol. 1, London 1849–58, pp. 317–318.

pered atmosphere« (»gestimmte Atmosphäre«, Gernot Böhme).[3] So what happened that modern people seem to have lost this ability? Is it because ›we‹ (city inhabitants of the industrialized countries) spend most of our lifetime in shielding interior spaces which are regulated, like houses or vehicles, by air conditioners and heating? Or have we never been climatologists?

The overriding theme of this essay is an aesthetic question, one particularly regarding conditions and possibilities of sensing climate change or sensing the environmental crisis. Embedded into the history of climatology and the history of weather measurements lies a media-aesthetic paradigm that has undergone a deep transformation over the last 200 years. In his definition, Humboldt addressed climate within a broad aesthetic of the atmosphere. Climate knowledge was derived as a result of very distinct but equally valuable epistemic cultures of sensing: sentiments, impressions, feelings, observations, and technical measurements. In contrast to this diverse approach to the environmental sensorium, I would argue that in the course of the 19th century, media devices of sensing have become more and more important as organs of environmental perception. Today, sensing media might even be called the dominant interface for sensing climate change. But possibly this argument holds true in an even broader sense for nature[4] perception in general, because the sensing paradigm today is not so much a direct immediate affection of the physical organs by the phenomena of the environment, but an affection through mediated interfaces of environmental data.

In my (media-)aesthetic conception of environment, I am guided by the notion of the German term *Umwelt* (literal: around-world) of the biologist and Neo-Kantian Jakob von Uexküll (1864-1944). He introduced the term in the early 20th century to determine—broadly speaking—how physical surroundings (*Umgebungen*) of animals become inner perceptions (*Umwelt*). Later on he transferred the distinction of *Umwelt,* in contrast to *Umgebungen,* from animals to humans by considering how perceptions of the environment, and thereby world views, profoundly change when human organs are equipped with technical devices, like telescopes or microscopes. I regard media devices for sensing the environment, such as sensors, satellites, or statistical maps, as similar to the Uexküllian concept. They are devices that alter the boundaries of the perceived *Umwelt* by equipping

3 Gernot Böhme: Für eine ökologische Naturästhetik, Frankfurt a. M. 1993. Translated as: Aesthetics of Nature—A Philosophical Perspective, in: Hubert Zapf (ed.): Handbook of Ecocriticism and Cultural Ecology, Berlin 2016, pp. 123-134.

4 I use the term ›nature‹ in this article extensively, being aware that the term implies the problematic and untenable notion of nature as an object outside of ourselves and the notion of a sharp boundary between nature and culture. At the moment I still do not know how to replace the term in order to be able to speak about my subject, because terms like ›ecology‹ and ›environment‹ are also very ambiguous in their meaning.

the environment with new items, such as the planet Uranus, Martian canals, the mycobacterium tuberculosis, the ozone hole, and atmospheric CO_2-concentrations, which did not belong to the technically unmediated *Umwelt* before. In the same vein, but going even further with this argument derived from media-aesthetics, I would say that media not only change the *Umwelt* on the level of perception, but they also change the environment itself by establishing new media ecologies, such as sensor environments, by establishing an incremental densely furnished mediasphere in, on, and around planet Earth. Hence, the human biological sensorium has lost its monopoly, an observation which media philosophy needs to reflect on further.[5]

By thinking about media from an environmental and aesthetic perspective, the term »media« becomes vital in two fundamental ways which might conflict on a structural level. Nevertheless, I believe that for the subject discussed here, both notions are of equal relevance. The first way in which the term needs to be considered is from the ancient perspective of *nature as medium* word. This opens up an ontological perspective on atmospheric or elemental media, such as air, water, and earth: »Media […] are vessels and environments, containers of possibility that anchor our existence and make what we are doing possible.«[6] Secondly, we need to look at perspecitve *media of nature*. In this case, I refer to media providing interfaces for relating, connecting, and entangling nature and technology by ways of abstracting or drawing off measurements and data by techniques of grafting, which form hybrids of nature and technology. It is important to combine these two basic notions of the term »media« at this stage, because under the media and technospherical conditions of the environmental crisis, such as climate change, deforestation, or extinction, they blend into one another.

Having made this opening remark, the guiding questions of this essay are the following: How do trees become technically connected networks? What happens when trees become data? And how do trees help to make climate change understandable and visible? I will follow these questions by the use of three main examples which allow for an elucidation of the relation between trees, sensory networks, and sensory perception. By introducing different examples from the fields of

5 As has been done by Mark B. N. Hansen: Ubiquitous Sensation. Towards an Atmospheric, Collective, and Microtemporal Model of Media, in: Ulrik Ekman (ed.): Throughout. Art and Culture Emerging with Ubiquitous Computing, Cambridge 2012, pp. 63–88; Luciana Parisi: Technoecologies of Sensation, in: Bernd Herzogenrath (ed.): Deleuze | Guattari & Ecology, Basingstoke 2009, pp. 182–199; Jennifer Gabrys: Program Earth: Environmental Sensing Technology and the Making of a Computational Planet, Minneapolis/London 2016.

6 John Durham Peters: The Marvelous Clouds. Toward a Philosophy of Elemental Media, Chicago/London 2015, p. 2.

science, art, and technology, I want to describe and comprehend »forests as an ontological multiplicity,«[7] such as data, speaking subjects, proxies, biomass, or topoi.

1. Talking Trees Undergoing Stress on Twitter

The first example might seem rather trivial, or even amusing, at first sight. During the last years, individual trees became part of the ontology of the internet (Fig. 1, p. 111). Accompanied by newspaper articles with the headline »The forest goes online«, international research projects started a new way of scientific communication via the online news and social networking platform *Twitter*. The numbers of trees going online are growing steadily. What ›followers‹ of Twitter are able to witness here is what I would like to critically describe as a new form of *nature writing*—this special form of non-fiction poetry about the natural environment which evolved in the 19th century in English-speaking countries in the style of »ecomimesis«[8]—although this form of writing comes here to a poetical end. The purpose of tweeting in the name of a particular tree is to allow people to learn about its well-being under the increasing stress of a changing climate. The public interest in tweeting trees may be associated with the best-selling books of a German forester entitled »The Hidden Life of Trees: What they Feel, How they Communicate«.

Via the twitter-account »TreewatchBritz«, a pine tree is introduced by »I am a Scots pine (Ø = 26.1 cm) in Germany (Britz) in a forest of the Thünen Institute of Forest Ecosystems.« Several times a day tree data are transferred by WLAN to Ghent, where assistants of TreeWatchNet translate them into tweets. More than five hundred tweets have been published so far. On May 24: »My sap has started flowing!« May 26: »Today I have grown 0.037 mm, transported 2.7 L of water at a maximum speed of 0.3 L/h.« […] »My sap is stopping to flow for today. The maximum speed was 0.2 L/h.« May 28th: »During this warm day (max 26.7°) I lost 114 L of water and my max sapflow was 9.4 L/h—tough day.«

Even compared to nature writing, these diary entries read rather poorly. But I would like to go deeper into this example[9] because it speaks on many levels

7 Anne-Sophie Springer and Etienne Turpin: Foreword, in: Anne-Sophie Springer and Etienne Turpin (eds.): The Word for World is Still Forest (Intercalations 4), Berlin 2017, p. XIII.

8 Timothy Morton: Ecology Without Nature. Rethinking Environmental Aesthetics, Cambridge 2009, p. 33.

9 A full-length article on the subject is published in German: Birgit Schneider: Neue Formen der Klimakrisenwahrnehmung? Sprechende Bäume im Netz der Dritten Natur, in: Dritte Natur. Technik, Kapital, Umwelt 01/2 (2018).

Fig. 1: Tweeting pine tree located in the forest-lab of the Thünen-Institute of forest ecology Brandenburg, Britz.

Fig. 2: Interface for data abstraction from the tweeting pine tree.

about the relation of media and nature. Forests and trees have always played an important role in this approach to the environment. Like *nature writing,* this form of text is written in the first person. The shift from trees as objects of research to self-writing subjects is telling. It not only reveals how trees are thought about as subjects, but also how the technological possibility of Twitter, at least on the surface, transforms trees into authors, and thus into subjects. On the social networking platform, trees become social by becoming subjects. From now on, and under media conditions, it is possible to do tree hugging on a symbolic level.

The ›tweeting‹ pine tree from Brandenburg's Institute of Forest Ecosystems has many followers, some of them are other tree-accounts. The trees are embedded in a network of tweeting trees and forest observation that is connected via a research network called STReSS, TreeWatch. It is the objective behind the observation of trees to learn about the trees' resilience and their limits to adapt and cope with climate pressures, like increasingly long dry periods, but also the alteration of seasonal patterns. On this account, the wired trees under observation can be associated with observed patients in the intensive care unit of a hospital. This interest also defines what is measured: Evaporation, speed of growth, and amounts of water and sap flooding through the tree tell much about how trees already react to climate change. Taking this into consideration, the tweet of a poplar tree in Ghent reads more like a plea: »Hot, hot, hot—low air humidity is causing much water loss!« (TreeWatchEFA) Therefore, tweeting trees might be seen as the attempt to make perceivable the pain trees feel when climate patterns are changing and how they are affected by new climate extremes. The hope seems to be to set up a frame for care for the environment via trees, most directly realized by the reply of a reader: »Give him/her some water, please.«

In the outline of the conference »The Mediocene«, which lead to this article, one could read that »Life itself is short-circuited with the evolution of technical beings.« In the same line of thought, it can be asked: How exactly is the pine tree in Britz connected to the internet? And what metaphors are available to think connections of nature and technology on a more general level? The concept of short-circuiting, for instance, should be critically examined. Because, when used as a metaphor for the connection of technical and living beings, it seems that the concept does not carry on the destructive side effects of short-circuiting incidents, such as overheating, fire, and explosion. Such effects are the core consequence of this connection but the metaphor of short-circuiting only seems to maintain the concept of an electrical connection. So how is the pine tree ›short-circuited‹ with technology?

The interface (*Schnittstelle*), which establishes a connection for listening to the language of the tree in order to translate it into tweets, is reminiscent of the botanical technique of grafting (*pfropfen*) (Fig. 2, p. 111). In grafting—which has been

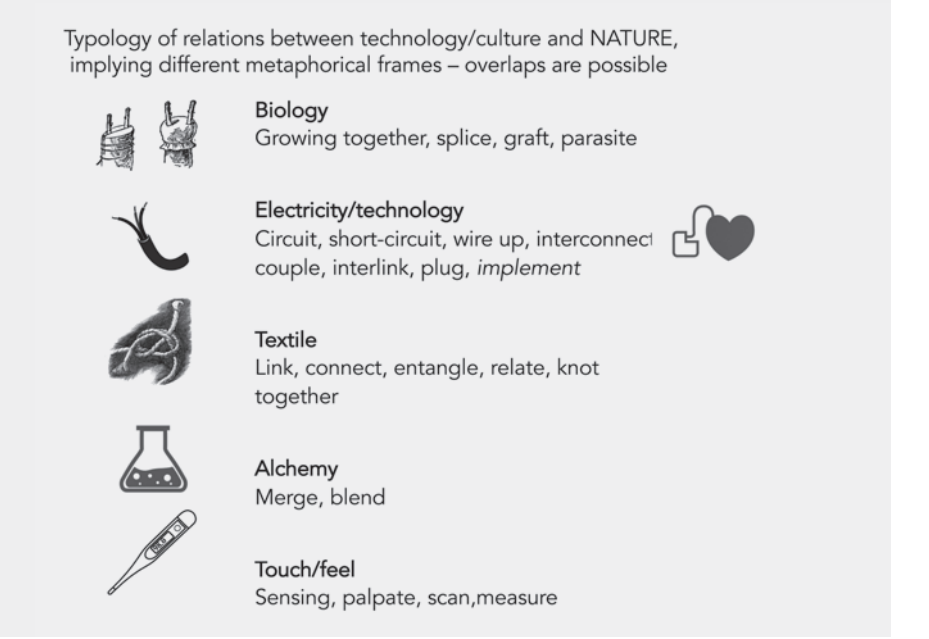

Fig. 3: Typology of metaphors for connecting nature to technology.

elaborated on media-philosophically by Uwe Wirth[10] and can only be indicated here—two different plants are connected so as to grow together. But the interface here—the connection between the trunk of the tree and the wires, tubes, and circumference measuring devices—is growing together on a visual level only (Fig. 1). We might better compare it to the cutting of the tree's bark for the abstraction or drawing of tree-milk, like *kautschuk* or *gutta percha*. The grey synthetic clay, which has been moulded so carefully around the entry where the black cables lead into the tree, is not put there to merge technology into culture like two branches of apple trees in the case of grafting; it secures the interface for a robust data abstraction. Looking carefully into the different topoi of connecting life and technology, such as short-circuiting (electricity), grafting (biology), interlinking (textile technology), blending (Alchemy), or the broad field of touch (sensing, feeling, scanning), reveals a typology of very distinct concepts about the connection of nature and technology by opening up particular metaphoric frames of how this connection is regarded, which I tried to bring into a scheme as shown in Fig. 3.

10 Uwe Wirth: Kultur als Pfropfung. Pfropfung als Kulturmodell. Prolegomena zu einer Allgemeinen Greffologie (2.0), in: Uwe Wirth (ed.): Pfropfen, Impfen, Transplantieren, Berlin 2011, pp. 9–28.

The subjectification of the Pine, on the other hand, can be associated with the long history of myths, legends, and fables that frequently set speaking and magical trees at their center. Oracle trees foretell the future and warn of dangers.[11] Such legends are deeply rooted in the concept of »tree awareness.« This is because trees and forests still play a fundamental role for the concept and imagination of the environment. Seen from that perspective, it might even be unusual not to talk about trees as subjects. If forest hydrologists today grant the right of speech to trees by means of sensory technology and the internet, trees potentially become socialized actants for a collective »politics of subjects« (Bruno Latour).[12]

2. Drawing Trees as Testimonies of a Proxy-Nature

To better understand the different underlying topoi embedded in the purpose of making trees speak, and thus to translate and listen to the language of nature, a piece of art will be examined here. In a series of artworks, British artist Tim Knowles perverted a typical arrangement of landscape painting, which was established as a new practice of art after 1800, when landscape painters went outside into the environment and put up their easels to paint nature directly (Fig. 4, p. 115). Knowles' artwork cites the basic setting of landscape painting or environmental painting (painter-subject and nature-object), albeit he blurred the static roles in this romantic schema for nature contemplation. The branch of a tree is transformed anthropomorphically; it looks like an arm holding a pencil. The branch of the tree touching the surface of the paper on the easel then causes swaying structures to appear on the paper. It is not a human being guiding the pencil but the wind in connection with the tree. Of course, this arrangement is reminiscent of the famous vortex sketches by Leonardo da Vinci trying to follow the patterns of running waters and blowing winds in order to make visible the moving actor behind the wind.

Is this a pencil of Nature? What would physiologist Jules Etienne Marey have written in his »Methode graphique« (1878) about this connection of nature and culture? Is this a graphical method, the language of the phenomena themselves, a graphical expression of the tree? Or is it just the noise of many inseparable voices—the wind moving the tree? Who is speaking in this setting?

11 Lutz Röhrich: Der Baum in der Volksliteratur, in Märchen, Mythen und Riten, in: Adrien Finck (ed.): Germanistik aus interkultureller Perspektive. Collection Recherches Germaniques 1. Strassburg 1988, pp. 9–26.

12 Bruno Latour: Das Parlament der Dinge. Für eine politische Ökologie, Frankfurt am Main 2001, p. 92. (Bruno Latour: Politics of Nature. How to Bring the Sciences into Democracy, Cambridge, MA 2004.)

Fig. 4: Photography showing the arrangement for the Tim Knowles' artwork »Tree Drawing—Hawthorn on Easel #1«, Foot of Castel Crag, Borrowdale, Cumbria, 2005, in this case an oak tree with easel.

Of course, it is not so much the outcome but the arrangement that is interesting here. The role swap of the painter and the tree points to the idea of *nature inscribing itself*. By finding a simple and evident image for this pseudo self-inscription, Knowles refers to the dream of a direct inscription of nature. This concept of understanding nature by disclosing secret inscriptions from it is part of the scientific inscription of nature in data, but is also part of a common aesthetic of nature (*Naturästhetik*). This ideal also guided many representatives of nature writing who were writing about nature under the ideal of the greatest possible closeness to nature. But, as the example of the tweeting trees might represent, the aesthetic of nature today actually is dominated by media interfaces translating measurements into numbers and data. Nature is to be found in data. Therefore, it is essential to ask what nature is inscribed here. How are the interfaces arranged in order to make nature speak in data? And how are these processes still guided by the longing for a direct, immediate connection?

The ideal of a self-inscribing nature still applies today. Here, tree data graphs can be seen as another way to make trees speak. Following Lynda Walsh, such graphs are also guided by the ideal of self-inscribing nature,[13] like the paleo-climatological »Hockey Stick Graph« representing climate history and temperature development since the year 1000 for the Northern Hemisphere. The graph, with its significant shape that lead to its nickname, was published by dendrologist and paleo-climatologist Michael Mann and his colleagues in 1998. The curve is particularly interesting in the context of trees as mediators or prosecutors of climate change perception because the temperature data were derived from chemical tree ring analysis. The curves reveal the notion of a very fundamental in-between-ness that goes together with the proxy method: The proxy is a decoy or surrogate, from Latin »procurator«, an agent representing others in a court of law. In the case of tweeting trees, proxies are the scientific nature-ghost-writers in the name of trees. They are another version of the time series graph rendered parallel to the text messages. Seen as proxies, it is possible to broaden the interpretation of speaking trees as potential agents in a politics of nature. Here, trees became testimonies of anthropogenic global warming, because only by proxies like tree-ring-analysis was it possible to find temperature data, even before instrumental weather observation through correlation.

3. Technologically Networked Natures

The history of the terms ›net‹ and ›network‹ reveals that the idea of a connection between the human nervous system and technical wires has existed since even before electricity was used to cross space.[14] This idea of the inseparable linkage between humans and nature was followed up by Karl Marx. He sketched out a profound ecological thought when stating that »Nature is man's inorganic body […]. To say man's physical and mental life is linked to nature simply means that nature is linked to itself, for man is a part of nature.«[15] One might pursue this line of thought and say that it is because of this inborn linkage to the organic and inorganic bod-

13 Lynda Walsh: »Tricks«, Hockey Sticks, and the Myth of Natural Inscription: How the Visual Rhetoric of Climategate Conflated Climate with Character, in: Birgit Schneider and Thomas Nocke (eds.): Image Politics of Climate Change, Bielefeld 2014, pp. 81–104.

14 E.g. Laura Otis: Networking: Communicating with Bodies and Machines in the Nineteenth Century, from the Series Studies in Literature and Science, Ann Arbor 2001.

15 Karl Marx: Ökonomisch-philosophische Manuskripte, 1844, Karl Marx/Friedrich Engels Werke, Bd. 40, p. 516, translation taken from Martin Mulligan: Economic & Philosophic Manuscripts of 1844, chapter »Estranged Labour.«

ies of natures that logging tree data has become so important today. Nature in this perspective seems to be a forced companion, something one is very directly linked to; like an embryo connected to the placenta with an umbilical cord. It is in fact the other way round, as Marx put it: Ecological thinking in this sense makes explicit this enforced companionship, something Joseph Beuys made the subject of his performance »How to Explain Pictures to a Dead Hare« (1967). By talking to the hare, Beuys did not listen to nature or make nature speak, but rather playfully exchanged the positions of transmitter and receiver, and by this, the direction of communication. The idea of explaining art to a dead hare is radically unsettling to paradigmatic concepts of people's role on Earth, concepts in which they see themselves as stewards of the Earth, gardeners or foresters of Nature, and eventually managers of systems.

In his book *Internet der Tiere* (*Internet of Animals*), Alexander Pschera based his perspective on nature on the metaphor of economic circuits as ecologies. He here follows, I would think, what filmmaker Adam Curtis tried to elaborate critically in his BBC documentary series All Watched Over by Machines of Loving Grace (UK, 2001, Adam Curtis) from the year 2011. The second episode of the series is entitled The Use and Abuse of Vegetational Concepts (S01E02). What Curtis tried to critically pile up in this documentary are the profound consequences of establishing an analogy between *ecology* and *system theory* in the 20th century, one which could become a leading model for economists, psychologists, social studies, and cybernetic thinkers alike. The result was a universalized idea of ecological systems subsuming technological cybernetics and natural ecologies, such as the ecology of a lake, under the same term. The consequence of this analogy is profound: Not only did technological networks become naturalized, but also a shifted perspective on nature was established, one which allowed for the inclusion of nature into processes of automatization, circuits, and feedback loops. A result of this dominant analogy, which is still valid today, is the reversion of the idea, as Pschera puts it, of »learning from nature« to »learning from digital code«,[16] to codes controlling nature. The priority of this approach towards nature is the reason why Pschera talks about a *Technocene* or *Digicene*: »Nature and digital technology merge to a system, where organic and electronic components interlock.«[17] What follows is the observation that the experience of nature is no longer a space free of data, but rather the reverse—nature in most cases is experienced only through media and data.

16 Alexander Pschera: Das Internet der Tiere: Natur 4.0 und die conditio humana, in: Zeitschrift für Medien- und Kulturforschung, 7/2 (2016), p. 113.

17 Ibid., p. 114.

Fig. 5: Amazon Tall Tower Observatory monitoring the Amazon forest relationships between the jungle and the atmosphere since 2015 (Brazil's National Institute of Amazonian Research and Germany's Max Planck Institute.)

4. Monitoring Forests as »Lungs of the Earth«

A third example making use of trees for data logging connects to this idea; it is the laboratory for »dating the atmosphere« that belongs to the new regime of techno-managed nature protection, where monitoring has become the essential feedback tool for system management on the largest scale.

For the purpose of learning more about the »Lungs of the Earth«, the tropical rain forest, researchers built a tower in the middle of the Amazon rainforest, which is said to be the world's first long-term tropical observatory. The observatory is called the *Amazon Tall Tower Observatory* or ATTO Climate Tree (Fig. 5). It is 325 m high, and by this, the highest building in South America. It is a collaborative research project between Brazil's *National Institute of Amazonian Research* and Germany's *Max Planck Institute* designed to monitor the relationship between the Earth's largest rainforest and the atmosphere. Since 2016, the observatory has permanently gathered data about the sensitive Amazonian ecosystem, which is expected to change in the upcoming decades due to climate change. Researchers want to understand the global carbon cycle, the exchange between biosphere and atmosphere, and, hence, how the forest is coupled with the atmosphere.

Built in the Sao Sebastiao do Uatumã nature reserve, 350 kilometres from the city of Manaus and reachable only after hours of travel on rough roads and a boat ride, the ATTO is »remote from human influences«, as the researchers point out. The project team uses the term »pure data« in relation to this remote situation: »Being far from town's and man's influence ensures we can collect relatively pure data«, states Meinrat Andrae, the director of the Max Planck Institute of Chemistry.[18] The notion of purity might be seen as going hand in hand with the »quintessential representation of [Amazonia] in the imaginary and epistemic constructions of Western culture and sciences«,[19] which contains the unstructured, the remote, and the untouched. Amazonia is important in an era of the world history perceived as the Anthropocene, where the human signal is expected to be anywhere. For the observation tower, this also means that since there is no internet (the station itself is »unplugged«), gathered data has to be transported physically to be processed and stored.

The tower observatory is described in terms that might remind media historians of Ernst Kapp's philosophy of technology. Kapp interpreted technical artefacts in the second half of the 19th century as »organ-projections«, as extensions of and substitutes for human sensual organs.[20] Researcher Wolfgang Lucht has highlighted the tower in its crucial role of achieving new climate change knowledge as humanity's »eyes and ears« observing the condition of Earth as a whole.[21] This makes the tall tower a giant fever thermometer sticking in the centre of the Amazonia in order to always inform humans of the health state of the climate circulation system—but the tall tower observatory might even remind one of the surreal movie *Fitzcarraldo* by Werner Herzog (1982), in which the main actor has to carry a huge steamship over a steep hill in order to gain access to a rubber-rich territory in the Amazon.

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18 See Javier Tovar: Brazil Builds Climate Tower in Pristine Amazon Jungle, under: http://www.thejakartapost.com/news/2015/08/26/brazil-builds-climate-tower-pristine-amazon-jungle.html http://www.ticotimes.net/2015/08/26/brazil-builds-climate-tower-in-pristine-amazon-jungle(26 August 2015)

19 Paolo Tavares: The Political Nature of the Forest: A Botanic Archaeology of Genocide, in: Anne-Sophie Springer and Etienne Turpin (eds.): The Word for World is Still Forest (Intercalations 4), Berlin 2017, p. 125.

20 Ernst Kapp: Grundlinien einer Philosophie der Technik. Zur Entstehungsgeschichte der Kultur aus neuen Gesichtspunkten (1877), edited by Harun Maye und Leander Scholz, Hamburg 2015; on this issue see also Leander Scholz: Der Weltgeist in Texas. Kultur und Technik bei Ernst Kapp, in: Zeitschrift für Medien- und Kulturforschung 4/1 (2013), pp. 171–190.

21 Simone Humml: Potsdamer Klimaforscher über einen Messturm in Brasilien. »Die Erde ist noch viel komplizierter«. Interview mit Wolfgang Lucht, in: Potsdamer Neueste Nachrichten (19.04.2017), p. 20, under: http://www.pnn.de/campus/1175557/ (31 January 2018).

The outcome of this form of nature sensing are masses of observation data from high above the forest in the atmosphere: data on heat, water, carbon gas, winds, cloud formation, and weather patterns. The transformation of the forest into data and diagrams might be described as chains of representation, like the process described in the photo-philosophical essay written by Bruno Latour in 1999, in which he followed the practices of an interdisciplinary team of pedologists and botanists in the Amazon rainforest—and where he detailed how the soil of the forest is transformed, via the rituals of science and through a long chain of representations, into diagrams.

The tower helps analyse the Amazon rainforest's gas emissions, like carbon dioxide, methane, and nitrous oxide, and can be seen as the counterpart of the observatory on Mauna Loa where the »Keeling Curve« of human-induced increase of CO_2 has been perpetually charted since the 1950s while simultaneously showing the annual variation of the world's forests »breathing.« The tower can also be seen as a supplement to the monitoring and collection of data on forests done by satellites such as ESA's Centre for Earth Observation »Earth Explorer Biomass«, a satellite that provides global maps of the amount of carbon stored in the world's forests.

5. Gutta Percha Tree Milk as Network Material

Suggestive here would be further examples of *media of nature* and *nature as media* in order to think about the different ways of merging/connecting nature and media systems. For this purpose, I finally would like to examine a very special piece of memorabilia, or relic, from the early age of submarine telegraphy, one which might function as a philosophical item for the whole subject discussed here (Fig. 6, p. 121). What is displayed in the ritualistic glass case is a short piece of the transatlantic cable that was installed between Europe and North America in 1873. Forty years later, in 1903, the cable was replaced and this piece was recovered for display at the Science Museum in London.

This essay already thematised the similarities of abstracting data from trees with abstracting milk from natural rubber trees. At the same time, the connection of forests and trees to electronic communication networks was highlighted. Both layers can be discussed further with the historic piece of transatlantic cable. This is because it is the inseparable interplays between organic and inorganic systems and the conditions of existence which become explicit in the relic of the transatlantic cable placed so beautifully in the glass case. What interests me in the first place is that every piece of submarine cable in this age had been isolated by a special type of raw material called ›gutta percha‹, and this is also true for the specimen we see here. This material was derived from tropical trees that only grew

Fig. 6: Museum piece of a transatlantic cable covered with gutta percha from the Science Museum London, showing the biocenosis of organic and anorganic nature. The transatlantic cable is encrusted by inhabitants of the sea like corals and sea shells. The cable was installed in 1873; in 1906 parts of it were removed.

in Southeast Asia on islands like Papua, Malaysia and the Philippines, by that time under the rule of colonial powers.

It had been a great problem to protect electric cables against saltwater, as no material had been found that would be durable enough. In the late 1840s, with gutta percha, a material was finally found that was resistant to saltwater—which thus allowed short-circuiting to be avoided—and a machine was invented that was able to cover the cable seamlessly.[22] In August 1850, a journalist wrote about this essential invention for the fortune of the ›age of communication‹ in the line with the spirit of technological euphoria: »We live in an age of wonders. […] There

22 Media study scholars have worked on the history of telegraphy extensively as this is a key example for the evolution of technical networks. In media history the focus is naturally placed on technology and not so much on ecology. In contrast, environmental historians such as Verena Winiwater and John Tully have elaborated on the ecological implication of telegraphy and the use of gutta percha. For some years a focus on the insustainability of resources to produce media also has been taken by media scholars, such as Nicole Starosielski in her book The Undersea Network, Durham 2015, in which she combines both perspectives.

seems to have been a ›special providence‹ in the case, for had gutta percha not turned up in the nick of time in all probability the submarine telegraph would still have been numbered among the visionary projects of the day.«[23]

What is interesting here, when reflecting about the entanglement of human, technological, and earthly forces, is that in the very centre of media history lies a history of excessive unsustainability and colonialism.[24] Between 1845 and 1847, on the island of Singapore, 70.000 trees were felled. Until 1880, more than 160.000 kilometres of cable was installed in the oceans, in 1907, 370.000 km were counted. Every part of these cables was covered with gutta percha. The indigenous people of the islands undertook the extraction of gutta percha. They walked into the tropical forests and searched for wild-growing gutta percha trees, cut it, and harvested its milk. With this method, by 1890, more than 80 million trees were cut down. Since three quarters of gutta percha were consumed by the telegraph industries, we can say that the tropical stock of gutta percha trees fell victim to telecommunication. At the end of the 19th century, there were barely any trees left; as a consequence the companies were unable to establish more telegraph lines according to schedule. This meant they could not work on establishing the communication sphere needed for the distribution of colonial power.

Solutions to this shortcoming were sought by cultivating *gutta percha* trees, but the material limitations remained. Finally, in 1933, the problem was solved by the invention of another material derived from organics: plastic. Gutta percha was replaced by polyethylene, the geological remains of microorganisms.

What we can learn from this story is the very close entanglement of the organic and the inorganic for the very early establishment of networks. To think about the material in such a way stands in contrast to the notion of ›the internet‹ that is guided by an *immaterial* imagination. This early example of the network shows how the net is strongly dependent on ecology; raw and organic materials nourish it. The conditions of the existence of the early communication networks have been tropical trees felled in colonies, unsustainable conditions of overexploitation, and exploitative working conditions.

Current examples that bring to mind these interdependencies of the technosphere with the bio- or the geosphere would be the inhuman conditions of how rare-earth elements are gathered in the Congo, but also how electronic waste is shipped to Ghana where it forms large toxic graveyards. This is in addition to the seldom-discussed geopolitical fact that 97 % of rare-earth elements produced today are sourced from China—therefore the future of technical media and networks,

23 Carlisle Journal: The Submarine Telegraph, 7 September 1850, p. 2.

24 See John Tully: A Victorian Ecological Disaster. Imperialism, The Telegraph and Gutta Percha, in: Journal of World History 20/4 (2009), S. 559-579: 572f.

but also essential raw materials to realize an exit from fossil-fuel energy can be realized only under the conditions of this geopolitical condition.

What would it change if the encrusted cable in the glass case were to be moved into the collection of a Natural Museum? How would nature as media and media as nature be reconfigured if the glass case were to be placed next to the diorama of an oyster bank, which biologist, oyster-specialist, and director of the museum, Karl Möbius, installed in the late 19th century—a habitat made of natural material he displayed at the Berlin Natural Museum to demonstrate how different specimen coexist in a biocenosis, or ecological community (Fig. 7)? Would this be an opportunity for contemplation about the politics of subjects and nature that we—people of the former colonies and industrialized countries—need to rethink

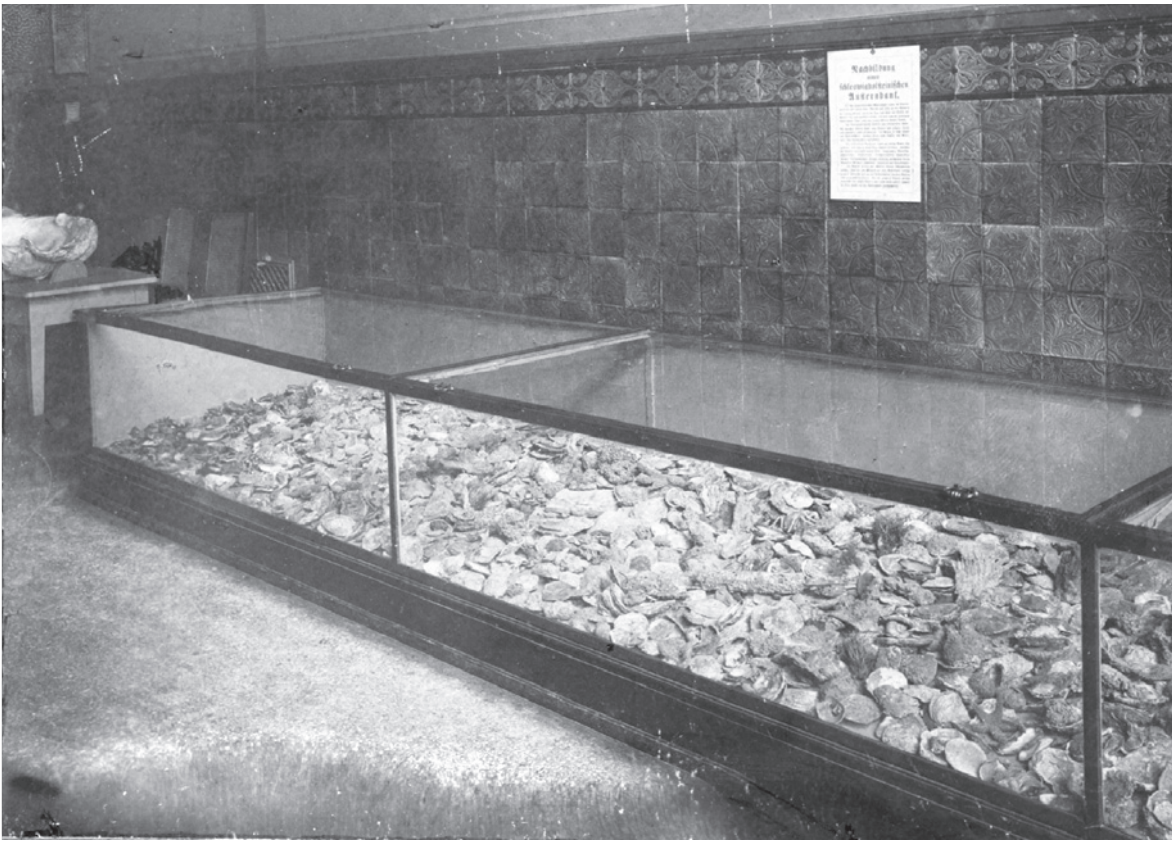

Fig. 7: Replica of an oyster bank from Schleswig-Holstein. Glass showcase from the collection of the Museum of Natural History Berlin showing the cohabitation of oysters and other maritime creatures in a biocenosis, Karl A. Möbius, late 19th century.

so urgently today? The enshrined object in the glass box is encrusted by marine growth, inhabitants of the sea, like corals and sea shells. The glass box contains the cable, like an aquarium located in a museum of natural history, but in reality it is stored in another institution, the museum of science and technology. The display case with the encrusted gutta percha cable may therefore be an early example of the interplay and entanglement of organic and inorganic natures and technologies; an ecosystem of communication; or a model and shrine enabling one to consider the inseparable entanglement of technological, social, organic, and earthly spheres—a media ecology.

6. Trees as Smart City Environments—Outlook

Perhaps the dream and desire to merge nature an technology take shape in the more than 40-year-old phantasies of futurist city structures. In many cases such visions present the city or the building as a forest.The imagined architectures of Sou Fujimoto and Vincent Callebaut, or the realized architectures of Stefano Boeri's *Bosco Verticale*, or the so-called *Trees by the Bay* in Singapore (Fig. 8) would be the renewed versions of this dream of the healthy merging of trees and technology—today, of course, planned in the ecological paradigm of the so-called smart city. They reveal the persistent romantic dream of a symbolic healing of nature and civilization, of city and forest. Thus the dream of a possible symmetric relationship between the spheres appears. Today, such concepts come together with the ecology of the smart house, as Jennifer Gabrys has pointed out. Sensing environments that »know« how the inhabitants of the habitat feel, where to shed light, or when to change the room atmosphere. The old fear of a hostile nature is suspended symbolically into an image of two different spheres healing. Ecomimesis in the city becomes the new symbol of domination over nature, quite similar to the European idea of the baroque garden.

Then again, following the ideas of Marx, nature always has been the anorganic part of the human body, connected to it in different metabolistic ways. However, the question why most people do not feel the »pain« they cause to the anorganic parts of their extended nature body still remains.

The discussion of different examples might make the following explicit: currently, the mediasphere primarily or even uniquely seems to offer the conditions to perceive the nature of climate change. We have become climatologists through media—by transpositions and mediations of nature in cascades of different discourse networks and on the basis of media materialities, as can be concluded according to Friedrich Kittler. His method to study media is still valid for this domain, because in order to find nature, one has to examine the tools, monitoring

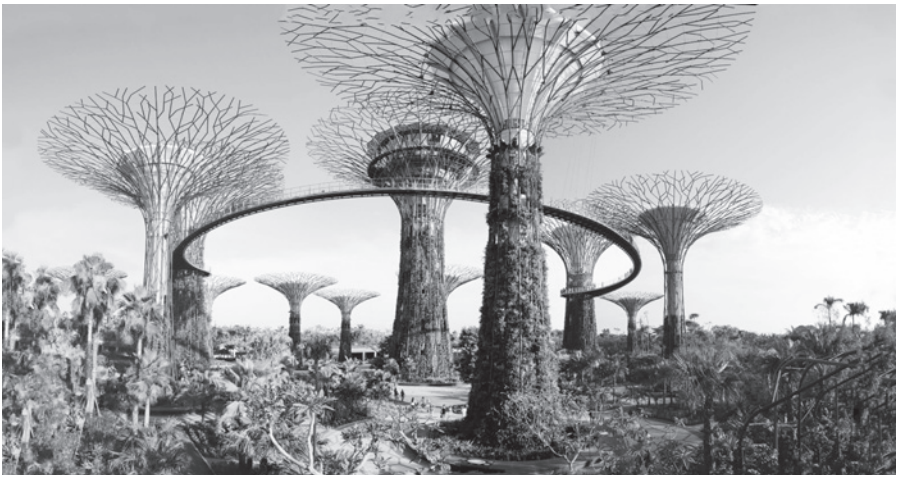

Fig. 8: *Supertree Grove* in the *Garden by the Bay*, Singapore, spanning 101 hectares, built on an artificially raised coastal area, completed in 2012. The grove follows the idea of a city in a garden.

devices, and technological networks that shape the environmental sensorium. This is also what media theory scholars drawing on environmental criticism and history can base their studies on, because »with technical media, Nature becomes registered, inscribed as the Real through the possibilities of technical media.«[25] The climate crisis becomes sensible only through and within mediated data of concern.

25 Jussi Parikka: So-called Nature: Friedrich Kittler and Ecological Media Materialism, in: Nicole Starosielski and Janet Walker (eds.): Sustainable Media. Critical Approaches to Media and Environment, New York/London 2016, pp. 196–212: 206.

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Fig. 1: Tweeting pine tree located in the forest-lab of the Thünen-Institute of forest ecology Brandenburg, Britz. © Photographer: Birgit Schneider, 2017.

Fig. 2: Interface for data abstraction from the tweeting pine tree. © Photographer: Birgit Schneider, 2017.

Fig. 3: Typology of metaphors for connecting nature to technology, Birgit Schneider.

Fig. 4: Photography showing the arrangement for the Tim Knowles' artwork »Tree Drawing—Hawthorn on Easel #1«, Foot of Castel Crag, Borrowdale, Cumbria, 2005, in this case an oak tree with easel. © Tim Knowles.

Fig. 5: Amazon Tall Tower Observatory monitoring the Amazon forest relationships between the jungle and the atmosphere since 2015 (Brazil's National Institute of Amazonian Research and Germany's Max Planck Institute.) © Bruno Kelly.

Fig. 6: Museum piece of a transatlantic cable covered with gutta percha from the Science Museum London, showing the biocenosis of organic and anorganic nature. The transatlantic cable is encrusted by inhabitants of the sea like corals and sea shells. The cable was installed in 1873; in 1906 parts of it were removed. © Science Museum/SSPL.

Fig. 7: Replica of an oyster bank from Schleswig-Holstein. Glass showcase from the collection of the Museum of Natural History Berlin showing the cohabitation of oysters and other maritime creatures in a biocenosis, Karl A. Möbius, late 19th century. © Museum für Naturkunde, Berlin.

Fig. 8: *Supertree Grove* in the *Garden by the Bay*, Singapore, spanning 101 hectares, built on an artificially raised coastal area, completed in 2012. The grove follows the idea of a city in a garden. © Harrytan Photography.