YVONNE VOLKART

TECHNOLOGIES OF CARE

FROM SENSING TECHNOLOGIES TO AN AESTHETICS OF ATTENTION IN A MORE-THAN-HUMAN WORLD

DIAPHANES

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BEING TROUBLED: AN INTRODUCTION

> The problem is not that you do not know that our forests are burning and our peoples are dying. The problem is that you have become accustomed to this knowledge.[1]

The point of departure for this monograph is the research project *Ecodata-Ecomedia-Ecoaesthetics. The Role and Significance of New Media, Technologies and Technoscientific Methods in the Arts for the Perception and Awareness of the Ecological,* which our team conducted from 2017–2021. Using the example of a 10,000-year-old pine forest in southern Switzerland that has been severely damaged by climate heating, we explored the interplay between art and natural science, asking how art can use digital technologies and data to raise sensibility to ecological relationships in a more-than-human world, and what distinguishes them from other techniques of observing and accessing "nature." The relevant questions were: How and by what means can art bear witness to anthropogenically produced ecocide? What role do technologies and scientific data, reports and methods play? And how can art and its technologies affect us toward a planetary co-living and promote moments of attention and care for the cross-species multiplicity of the Earth's inhabitants? Central to the overall project was the collaboration with the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and their experi-

ments with the "Pfynwald," an alpine outdoor laboratory where research on the effect of climate heating on the forest is conducted.[2]

The research project was initially conceived as an updating and deepening of the exhibition and book project *Ecomedia. Ecological Strategies in Today's Art,* which Sabine Himmelsbach, Karin Ohlenschläger and I curated in 2007–2009.[3] At that time, we were also interested in how artists use media and technologies to explore and articulate ecological contexts. We called these ecomedia: hybrid couplings between "nature" and technology, and practices of translation that make sensor-based environmental data perceptible to humans (e.g., sonifying weather data).[4] Ecomedia and the ecodata they collect are not only explicitly involved in the production of knowledge about "nature," but also—stylized as apparatuses for raising awareness, as mediators between worlds—have become outright beacons of hope for sociopolitical change. This broad euphoria towards advanced technical means for ecologization also made me skeptical, despite my enthusiasm for media-ecological experimentation. What good are the technical means if they do not correlate with a practice of mindfulness and care? And how to get into such a practice? That the machinic logic and capitalist infrastructure of ecomedia can quickly over-code "good" intention, dispel immersion in and relation with the forces of "nature" and subsume

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1   Kay Sara, Milo Rau, "'Against Integration': Dieser Wahnsinn muss aufhören," *Der Standard*, May 16, 2020, https://www.der-standard.de/story/2000117523875/against-integration-dieser-wahnsinn-muss-aufhoeren (accessed March 11, 2022).

2   The research project *Ecodata-Ecomedia-Ecoaesthetics* (2017–2021) was realized by Yvonne Volkart (Principal Investigator), Marcus Maeder, Rasa Smite and Aline Veillat, in collaboration with Arthur Gessler, Christian Ginzler, Andreas Rigling, the Swiss Federal Institute for Forest, Snow and Landscape Research WSL, and Kaisa Rissanen, WSL and University of Helsinki. It was funded by the Swiss National Science Foundation and hosted by the Academy of Art and Design Basel FHNW, https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-des-instituts-kunst-gender-natur-iagn/ecodata-ecomedia-ecoaesthetics (accessed March 5, 2023).

3   Sabine Himmelsbach and Yvonne Volkart, eds., *Ecomedia. Ecological Practices in Today's Art* (Ostfildern: Hatje Cantz, 2007). In 2018–2019, Sabine Himmelsbach, Karin Ohlenschläger and I again curated a joint exhibition in Basel and Gijon on the topic, where we wanted to investigate what had changed in the intervening decade, just as with the ongoing SNSF research project. *Eco-Visionaries. Art, New Media and Ecology After the Anthropocene* was the title of the exhibition series, now in semi-autonomous association with other institutions in Lisbon (MAAT), Umea (Bildmuseet) and London (Royal Academy of Arts). https://www.hek.ch/en/program/exhibitions/eco-visionaries (accessed March 21, 2022). See Pedro Gadanho, ed., *Eco-Visionaries. Art, Architecture and New Media After the Anthropocene,* exhib. cat. (Berlin: Hatje Cantz, 2018).

4   We adopted this term from Sean Cubitt, *EcoMedia* (Amsterdam and New York: rodopi, 2005), and Andrea Polli, https://www.andreapolli.com (accessed March 21, 2022).

these into its own machinic logic is undeniable, but readily suppressed in light of the manifold hopes invested in its possibilities. At the same time, media-induced disruptions, lapses, and dispersions are interesting from an aesthetic perspective—after all, they show that "nature" can only ever be perceived and mediated by means of certain technologies—eyes, ears, sensors, algorithms, drawing, photography, etc.—that "nature" is *natureculture,* and that media-aesthetic perceptions create alienations and surpluses that are affective.

The fact is, with digitalization and the associated mobility of the last 30 years, the centuries-old process of exploitation of the Earth has experienced an unimagined increase. The entire planet and its human and nonhuman inhabitants have become resources that can be consumed, depleted and turned into waste. This also includes the data processing of matter. At the same time, these processes of consumption appear tied to the promise of prosperity, making it so difficult to detach from them. A critical question is then how to deal with this, with these contradictions of our life in the Wasteocene, our age of wasting the world.[5] How and by what means to continue, to seek to change the conditions—despite everything? That is the question behind this project. Our great task today is to develop strategies that first make the dimensions of this deadly circle perceptible, second oppose it, and third make possibilities of life based on other values, values of relationality and care, sensorially and aesthetically graspable. All practices—artistic, media-cultural, spiritual, activist, communal, reproductive, pedagogical—that try to break out of this economy of devaluation with playful aesthetic means, that pay attention to all of the Earth's inhabitants and open us to transformations beyond simple promises of wholeness, I understand as caring practices: they produce and reproduce life. Caring is enacting practice, desiring sensing, and responding across species. This is why I prefer the verb form *caring* to the noun *care*. It has a *transitive* direction, going toward the other, perhaps toward the other of the self. The relational *to care* is open to alterity, to the strangeness of the world.

In this publication, I would like to discuss how technologies become technologies of caring in a more-than-human world, using selected artistic projects as examples: they thwart the dominant culture of exploitation, work through hierarchized dependencies, and seek other connections and patterns. What does it mean to come into an ecological co-being, a caring with beings that are radically different? What role can technologies and scientific data play in this? As I attempt to show, moments of caring are not so much enabled by the use of innovative (sensing) technologies[6] as by techniques of sensing, by aesthetic-media practices of alienation and *transmaking.* I coin this term with regard to practices of *translating,* whose etymology goes back to the Latin *trans* (over, across). By transmaking I mean a fundamental disposition toward transitions and the allowing of alterity that is opposed to *othering.* As in the time of the first *Ecomedia* project, today connections to the manifold of the world, to its data as well as to its translations still play a role. But more than then, the intensities, surpluses, and shared ecologies that occur through media-aesthetic transpositions come into view, as do queerfeminist, decolonial concerns. I have called these strategies techno-eco-feminist.[7] By this I mean that in the wake of the intensification of the technological, and the losses and threats posed by climate heating, the concerns of previously separate techno- and eco-feminist currents are combining in novel ways; and that as struggles over climate justice and questions about planetary coexistence enter dominant discourses of theory and art, feminist approaches have begun to leave their ghettos and become central references.

[5]   Following the many -cenes, we coined this term in our SNSF research project *Times of Waste* (2015–2018). (Flavia Caviezel, Mirjam Bürgin, Anselm Caminada, Adrian Demleitner, Marion Mertens, Yvonne Volkart, Sonia Malpeso), https://www.objektbiografie.times-of-waste.ch/en/. At the same time, environmental historian Marco Armiero introduced the term into the discourse. See Marco Armiero, "Fumogeni #2," *Chanarte,* February 28, 2018, https://www.chanarte.com/2020/07/29/fumogeni-2-%e2%80%a8-marco-armiero/ (both accessed April 3, 2023).

[6]   Birgit Schneider and Evi Zemanek translate *sensing technologies* into German as *Spürtechniken.* It has a combined sense meaning *techniques of sensing/feeling.* Birgit Schneider and Evi Zemanek, eds., "Introduction," *Spürtechniken: Von der Wahrnehmung der Natur zur Natur als Medium,* Media Observations Special Issue (April 30, 2020), https://www.medienobservationen.de/ (accessed March 5, 2023).

[7]   Yvonne Volkart, "Techno-Ecofeminism: Nonhuman Sensations in Technoplanetary Layers," in *The Beautiful Warriors: Technofeminist Practices in the 21st Century,* ed. Cornelia Sollfrank (Colchester, New York and Port Watson: Minor Compositions, 2020), pp. 111–135; Cornelia Sollfrank, "Preface," in ibid., pp. 1–17: https://www.minorcompositions.info/wp-content/uploads/2019/10/BeautifulWarriors-web.pdf (accessed March 5, 2023). First published in German as Cornelia Sollfrank, ed., *Die schönen Kriegerinnen. Technofeministische Praxis im 21. Jahrhundert* (Vienna: transversal texts, 2018).

BECOMING ENVIRONMENT, BECOMING-ANTENNA

In the art of the last 15 years, then, a relational, cross-species turn has taken place—a techno-eco-feminist turn toward the environmental, toward ontologies of becoming-together and caring for the Earth. It is a new sensibility toward planet Earth's grounding on physical forces like atmospheric and oceanic flows, in the middle of the total technologization of the world. Technologies are everywhere, but "nature" is everywhere, too. "Gaia intrudes," Isabelle Stengers says, to name the generative, physical and cosmic[8] forces mobilized by the capitalist exploitation of the Earth and leading to the Wasteocene: Gaia is a "ticklish being" that not only backfires when she is offended, but is also "blind to the damages she causes, in the manner of everything that intrudes."[9] Countering the dominant perception of climate change as something "distant and abstracted," Astrida Neimanis and her colleagues propose "our relationship to climate change as one of 'weathering'."[10] These new perceptions of the onto-power of the material world and humans' entanglement in that world specify and amend the dominant discourse of the Anthropocene: of man as the driving factor of planet Earth. They open up to what I called "environmental becoming."[11]

This relational turn is carried by an emotional refrain that sees itself as deeply political: "My tear is political! It is a sign that the current structure no longer works, that we as individuals cannot solve anything."[12] This statement from a young climate activist exemplifies the micropolitical mood today, which mobilizes groups of like-minded people by affixing a planetary sense of community.[13] By means of aesthetic actions, such as sticking themselves to the ground, they create unrest and concern. In connection with this, problematized concepts such as empathy or kindness experience a revaluation and politicization. In particular, there is an attempt to develop strategies of solidarity and cooperation with beings that are ignored or fought against in the dominant culture, such as pigeons, weeds, insects, mosses, mycelia or bacteria. The better world that is sought to be created is neither a world full of technically upgraded superhumans nor one without humans. Rather, alliances of "conspiring"[14] and "togethering"[15] are conceived, which include humans in their creatureliness and their participation in the planetary, in their "non-human ontology." These are forms and practices of collective subjectivizations to bring about, if we follow Félix Guattari, social, mental and ecological changes in capitalism.[16] Guattari calls such practices "ethico-aesthetic." By this he means that forces to change what exists are mobilized through affects that can be triggered by micropolitical, sensory aesthetic practices.[17] Ethical-aesthetic practices are not necessarily artistic ones, even though I focus on such in the present framework.

As mentioned, alliances with machines are also being sought at the same time. Sensor technologies in particular are supposed to help make the non-human modes of existence perceptible—in the hope that they will be used to uncover ignored environmental phenomena and crimes as well as generate concern for the "environ-

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[8] By "cosmic" I refer to the physical forces associated with the universe. But I also use the term to blur the split between physics and myth.

[9] In Isabelle Stengers' adaptation, "Gaia" is neither Earth "in the concrete" nor the connective cybernetic organism of Deep Ecology; rather it is an ontic force, beyond humanity, beyond all the various species inhabiting Earth. Isabelle Stengers, *In Catastrophic Times. Resisting the Coming Barbarism* (Lüneburg: Open Humanities Press in collaboration with Meson, 2015), p. 43.

[10] WEATHERING. a collaborative research project: http://weatheringstation.net/about/ (accessed October 26, 2021).

[11] Yvonne Volkart, "Flowing, Flooding, Fibbing: From Fluid Subjects to Environmental Becoming," in *Liquidity, Flows, Circulation: The Cultural Logic of Environmentalization*, ed. Matthias Denecke, Holger Kuhn and Milan Stürmer (Berlin and Zurich: diaphanes, 2022), pp. 221–240.

[12] Quoted in Tobi Müller, "Das Sekret des Theaters sucht den Weg ans Licht," *WoZ Die Wochenzeitung*, October 7, 2021, p. 21.

[13] In a similar way, and despite the danger of homogenization, I also use the "we" in this text. I want to indicate with it my own (changing) involvements and to name effects which have planetary dimensions because of global hierarchies. They affect, even if differently, all Earth-dwellers.

[14] Natasha Myers, "How to grow livable worlds: Ten not-so-easy steps," extended lecture version, 2021 [2018], https://www.abc.net.au/religion/natasha-myers-how-to-grow-liveable-worlds:-ten-not-so-easy-step/11906548 (accessed February 24, 2023).

[15] Tim Ingold, *Anthropology and/as Education* (London: Routledge, 2017), p. 26.

[16] Félix Guattari, *The Three Ecologies* (London and New Brunswick, NJ: The Athlone Press, 2000).

[17] Félix Guattari, "Remaking Social Practices," in Pierre-Félix Guattari, *The Guattari Reader,* ed. Gary Genosko (Oxford and Cambridge, Mass.: Blackwell Publishers, 1996), pp. 262–271. https://monoskop.org/images/4/4b/Genosko_Gary_ed_The_Guattari_Reader.pdf (accessed March 5, 2023); Félix Guattari, *Chaosmosis: an ethico-aesthetic paradigm* (Bloomington and Indianapolis: Indiana University Press, 1995). For a nuanced development of the term, see Matthew Fuller and Olga Goriunova, *Bleak Joys: Aesthetics of Ecology and Impossibility* (Minneapolis and London: University of Minnesota Press, 2019).

ment"—as an effect of technologically enabled contact with others. This new acceptance of and hope invested in technology as a means of ecological sensitization is due on the one hand to general technologization, and on the other hand to a techno-political, media activist tendency to appropriate and recode the normalized means. It springs from the insight of "our" complicit dependence on infrastructures of exploitation that are ideologically abhorred yet have a pragmatic necessity. At the same time, one does not want to be paralyzed by these contradictions: in a world where technologies machinate us and chain us to the consequences of climate heating, there is neither a life beyond technology nor a return to a pristine untouched nature. Thus, all kinds of technological devices, such as cell phones, thermal imaging cameras, lidar scanners, drones, GoPros, as well as technologies based on Big Data, such as Neural Networks, AI or Blockchain, tend to be positively received even in activist communities. The priorities in media and eco-activism still diverge—while blockchain technology is celebrated quite euphorically as a means for virtual participation and democratic communication in communities with an affinity for the arts (despite criticism from within their own ranks, who see no added value in it), eco-activists criticize its disproportionate waste of resources.

As I would like to show in contrast, the technical means play an essential role for technologies of care, but not only in their instrumental function of enabling perception; rather in their affective, sensory, aesthetic, and phantasmatic possibilities: it is the artistic setting with its specific way of *making-become*, hence aesthetics, that creates attention and concern for the more-than-human world.[18] It is the functioning of the aesthetic that connects sensuality with passion and knowledge, and not technology that creates affective forms of knowledge and cognition. Strengthening the power of imagination (with or without new technologies) is central to this, be-

cause imagination is needed to be able to perceive even that which eludes the sensual. And much in the world eludes even the most innovative technological senses.[19]

Therefore, I claim that the transversal,[20] consequently the critique of power and the political potential of techno-eco-artistic projects, is to be sought less in the use of innovative technologies and well-intentioned themes than in a radical affectation/affirmation of our relationality and the enabling of aesthetic experiences of co-existence with our co-beings. It lies in the celebration of a surplus that, without denying the catastrophic, activates the aliveness of co-being. Such movement from technique to the aesthetics of care and attention is formulated in the subtitle of this monograph.

Sensors are feelers that scan and measure the environment; originating from both the natural and the technical world, they are receptive and active. They translate physical or chemical processes into electrical signals and make them rationally tangible in the form of numerical information.[21,22] The ecological data obtained with sensors are based on measurability and verifiability, they suggest accuracy and truthfulness; that is why their collection is also very popular in *citizen-sciences*. The associated accumulation of data and its interpretation does not necessarily lead to certainty, however. Jean-Luc Nancy has pointed out that technical results become means to trigger new purposes, new search processes[23]—a complexity factor of techno-scientific activity that plays into the hands of climate change deniers and their desire for complexity reduction. As Nicole Seymour mentions, too much information and knowledge can even have a paralyzing effect.[24] That the hope for facticity associated with sensing technologies as a basis for sociopolitical change engenders a dilemma is also made clear by the opening quote from indigenous actress Kay Sara: The real problem is not that we know too little. Rather, the problem is that we "have gotten used to this

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[18] By aesthetics (*aisthesis*) I understand not only its fundamental meaning as the gaining of knowledge and cognition through sensory perception, but also the way something is (artistically) made, has a sensory effect and thus subjectivizes.

[19] See Kathryn Yusoff, "Insensible Worlds: postrelational ethics, indeterminacy and the (k)nots of relating," *Environmental and Planning D: Society and Space*, vol. 31 (2013), pp. 208–226.

[20] Roberto Nigro and Gerald Raunig on Guattari's "transversality," in *Inventionen 1*, ed. by Isabell Lorey, Roberto Nigro, and Gerald Raunig, Zurich: diaphanes 2011, pp. 194–196.

[21] "Sensing technology, simply put, is a technology that uses sensors to acquire information by detecting the physical, chemical, or biological property quantities and convert them into readable signal." https://www.yokogawa.com/special/sensing-technology/definition/ (accessed March 5, 2023).

[22] On the ubiquity of sensor technologies, see Chris Salter, *Sensing Machines: How Sensors Shape Our Everyday Life* (Cambridge, Mass.: MIT Press, 2022); Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (Minneapolis and London: The University of Minnesota Press, 2016).

[23] Jean-Luc Nancy, "Of Struction," *Parrhesia*, no. 17 (2013), pp. 1–10, here p. 3.

[24] Nicole Seymour, *Bad Environmentalism* (Minneapolis: University of Minnesota Press, 2018), p. 2.

knowledge."[25] My colleague Johannes Bruder sums up this attitude thus: "I know, but I don't care."[26]

It no longer needs information and knowledge, but touch: aesthetic practices that turn the technical-sensorial observing/measuring/data processing of *sensing technologies* into a *technology of sensing*, a participation (willingness) without distance. *Sensing* goes back to the Old French *sens, sen, san* ("sense, reason, direction"), Latin *sensus* ("sense", "direction") and the Proto-Indo-Germanic word *sent* ("feel").[27] The German *spüren* ("to sense"/"to feel") means etymologically first of all to *follow a track*.[28] A *Technology of Sensing* would thus be a sensing, a sense and direction pursuing action: it is sense-ability, a technical as well as non-technical method of measuring. "Measurement is a form of touching," writes Karen Barad.[29] And touching means, as she argues on the basis of subatomic particles touching themselves: to embrace something/self in its otherness. From such an unfamiliar particle perspective, *sensing technologies* are always potentially *sensories* for *feeling alterity*—but to fulfill them, strategies are needed that, like Barad's, invert, reinterpret and alienate the familiar and purely instrumental.

The strength of sensor-based art, activism, or citizen-science projects thus lies, often contrary to their own claims, not in the facticity or scientific relevance of the collected data (which they do not provide), but in the participation and witnessing[30] of what is going on, thus in their affective and affecting relevance: they create restlessness and desire for wanting to know more precisely, to demand answers—Why do we have very different numbers than those we are given about the toxicity of the earth around Fukushima or the extent of deforestation in the rainforest? In addition, sharing and reusing the data, as well as the associated realization of one's own (image and audio) realities, engages people and provides a sense of participation in a common cause:

[Satellites] are to ecological activism what cellphone cameras are to #BlackLivesMatter... When the cool, abstract data of the environmental sciences are adopted and expressed by impassioned individuals and groups, you get the Climate Justice Movement. Spanning the globe with its powerful proxies, the climate movement turns data into knowledge, then it turns knowledge into aesthetic forms, and finally it turns aesthetic forms into action.[31]

However, the processes of translation between technologies, art, and activism do not run as seamlessly as Brian Holmes' argument suggests. Already Félix Guattari, who was open to electronic communication media such as radio as means for a "post-medial era," points out that "future forms of subjectivation"[32] have to be elaborated just as much. In one of his last texts, he adds: "Obviously, we cannot expect a miracle from these technologies: it will all depend, ultimately, on the capacity of groups of people to take hold of them, and apply them to appropriate ends."[33] The crux of the matter is not only to get into an eco-political action at all, but also into one that has a sustainable and broad impact. Obviously, this requires a variety of means, such as "future forms of subjectivity," data, technologies, "aesthetic forms," etc. Yes, technology can, must be included in ecological action. But only if it puts us in constant disquiet and is not seen as the ultimate cure.

Technologies of caring, then, as the title suggests, are not so much sensor technologies as aesthetics that invite us to pay attention to the more-than-human world because attention, according to Tim Ingold, is one of the most fundamental acts of engaging with the world: "'Attention' comes from 'ad-tendere,' literally meaning to stretch (*tendere*) toward (*ad*)."[34] Being attentive, in this definition, is an action that moves the act of perceiving from the head to the body and from the body to the en-

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25 Sara and Rau, "Against Integration."

26 Johannes Bruder, on the occasion of the conference *Situated in the Global: Conflicts, Costs, Atmospheres*, Kunstuniversität Linz, IFK, October 12–19, 2022.

27 https://en.wiktionary.org/wiki/sense (accessed February 25, 2022).

28 In German, the word *spüren* means "to trace." Grimm's dictionary, quoted in Schneider and Zemanek, *Spürtechniken*, n.p.

29 Karen Barad, "On Touching—The Inhuman That Therefore I Am (v1.1)," in *Power of Material / Politics of Materiality*, ed. Susanne Witzgall and Kerstin Stakemeier (Zurich and Berlin: Diaphanes, 2014/2017).

30 Jonathan Gray calls this function "data witnessing." Jonathan Gray, "The Datafication of Forests? From the Wood Wide Web to the Internet of Trees," in *Critical Zones: The Science and Politics of Landing on Earth*, exhib. cat., ed. Bruno Latour and Peter Weibel (Cambridge, Mass.: MIT Press, 2020), pp. 362–369, here p. 368.

31 Brian Holmes, "Empathy Machines: Emergent Organs for an Eco-Body?," in *Springerin* 4 (2017), https://www.springerin.at/en/2017/4/empathiemaschinen/ (accessed March 5, 2023).

32 Guattari quoted in Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (Cambridge, Mass.: MIT Press, 2005), p. 5.

33 Guattari, "Remaking Social Practices," p. 263.

34 Ingold, *Anthropology*, p. 21.

vironment. It turns the body into a machine, a sensor, and gives it a direction (toward the other). As a responsive act, it is, according to Ingold, less intentional and "cognitive" than "ecological,"[35] that is, relationally interconnected with many.[36]

Similarly, Anna Krzywoszynska and Sam Outhwaite speak of the need to develop "apparatuses for cultivating the art of paying attention to Gaia" in relation to agriculture: "Gaian apparatuses"—farming techniques of immersive observation—have to be learned and practiced, because attention (in their case to the soil) is not automatic, even with the latest equipment:

> The Gaian response demands more than a democratization of science through public participation or citizen science efforts. ... In Gaian apparatuses, local knowledge actors need not only to be included, but to be furnished with a capacity to pay attention to the material world in ways which would lead to a composing with it.[37]

As with the artistic-media activist practices, the peasant Gaian apparatuses are also practices of listening and doing. They are ethical-aesthetic practices that go beyond mere technical and sensory perception and have implications for how one leads a life. And as with Gaian apparatuses, technologies of care is about technologies of sensing, an aesthetic of becoming attentive to and participating in alterity. Becoming environment. Becoming sensing. Natasha Myers speaks of "Becoming Sensor,"[38] Anna Lowenhaupt Tsing of "Arts of Noticing,"[39] Donna Haraway invents beings with feelers,[40] Chus Martínez thinks "receivership."[41] It's becoming-antenna: with a large parabolic antenna and her future organs, the protagonist in Ursula Biemann's video tableau *Acoustic Ocean* receives the sound of the world (fig. 1). Being an artist would then mean being a medium[42] for sensing the materiality of the Earth. And making a techno-eco-logical-aesthetic event out of it.

I use the term "technology" in a broad sense. First, I mean "technology" in an instrumental and cultural-technical sense, then "technology" as the "becoming technological of technology" that goes beyond the purely technical.[43,44] However, I also then borrow substantially from Michel Foucault's technologies of the self and from Teresa de Lauretis's technologies of gender, thought further for the constitution of gender.[45] Here, Foucault means bodily technologies, such as self-care, "by which the individual constitutes and recognizes himself *qua* subject."[46] De Lauretis connects such a body- and gender-technological approach to the subject-constituting power of the imagination, which can be aesthetically articulated in the arts. Technologies, and the fantasies associated with them, interpellate, invoke us as subjects, and are therefore political.[47]

[35] Ibid, p. 26.

[36] A contemporary definition of ecology is given by Erich Hörl: "Ecology has started to designate the collaboration of a multiplicity of human and nonhuman agents: it is something like the cipher of a new thinking of togetherness and of great cooperation of entities and forces, which has begun to be significant for contemporary thought; hence it forces and drives a radically relational onto-epistemological renewal." Erich Hörl, "Introduction to general ecology: the ecologization of thinking," in *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl and James Burton (London and Oxford: Bloomsbury, 2017), p. 3.

[37] Anna Krzywoszynska and Sam Outhwaite, "Unsettling Soils: Soil Microbiome, Farmer Knowledge Anxieties, and the Search for a Gaian Agriculture," unpublished paper given at the workshop *Techniques Matter* as part of the research project *Ecodata–Ecomedia–Ecoaesthetics* (2017–2020), Academy of Art and Design Basel FHNW, May 7, 2020.

[38] Natasha Myers, *Becoming Sensor in Sentient Worlds*, https://becomingsensor.com (accessed March 10, 2023).

[39] Anna Lowenhaupt Tsing, *The Mushroom at the End of the World* (Princeton and Oxford: Princeton University Press, 2015), pp. 17–25.

[40] Donna Haraway, "The Camille Stories: Children of Compost," in *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016), pp. 134–168.

[41] Chus Martínez and Quinn Latimer, Mastersymposium "Ages of Receivership. On Generous Listening," Institute Art Gender Nature, Academy of Art and Design Basel FHNW, spring 2022, https://dertank.ch/we-explore/podcast-promise-no-promises/ (accessed March 10, 2023).

[42] Artist Leena Valkeapää defines herself as a helper to her partner, an indigenous reindeer herder facing tremendous problems in times of climate heating. Valkeapää in a Zoom meeting with Yvonne Volkart, 2020.

[43] Erich Hörl means by this the "assemblage of human and non-human entities that can no longer be described at all with the terms that come from the sphere of the instrument, the tool, the simple, trivial, classical machines." Erich Hörl and Jörg Huber, "Technoecology and Aesthetics. An Exchange of Ideas," *The Magazine of the Institute of Theory,* 31, no. 18/19 (2012), pp. 9–20, here p. 9.

[44] In German, it is easier to distinguish between *Technik* and *Technologie* than in English.

[45] Teresa de Lauretis, *Technologies of Gender: Essays on Theory, Film, and Fiction* (Bloomington: Indiana University Press, 1987).

[46] Michel Foucault, *The Use of Pleasure*, Vol. 2 of *The History of Sexuality* (New York: Vintage Books, 1990), p. 6. He emphasizes that self-care is a choice that the individual makes within the dispositifs of power.

[47] Teresa de Lauretis, "Popular Culture, Public and Private Fantasies: Femininity and Fetishism in David Cronenberg's 'M. Butterfly'," *Journal of Women in Culture and Society*, Vol. 24, No. 2 (Winter 1999), pp. 303–334.

Fig. 1: Video still from Ursula Biemann, *Acoustic Ocean*, 2018.

Technologies of caring are thus technologies, techniques, practices, and aesthetics in art that enable, poeticize, celebrate, and deploy caring for the Earth as a political practice of desire and recuperation: as a reappropriation of what has been rendered impossible in the history of capitalism and its values of compartmentalization, individualization, and competition, and their altruistic flip side, paternalism and control:[48] an ethics and aesthetics of care as becoming and acting together with the others with whom I share life on Earth, co-creating—knowing that everything I do has effects on others and returns in some way: not because I am human, rather because I am a material being, immersed in the energies, the physical laws of the Earth. The concern for others is also a concern for (the strangeness in) me, for the dependence of my existence on the multiplicity of further existences.

Programmatically speaking: technologies of caring—in the midst of the flood of images and information permanently calling to us and the consequent paralysis—spark porosity and desire *to see, to hear others*. This desire makes us receptive to the chaotic forces of the world and strengthens our imagination in response to the question of how to float the raft together. It ignites the passion to engage with others, with earthbound ones, and to focus on nurturing these relationships.

THE MANY WAYS OF CARING

The term *care* or *caring* was contested even before the Corona pandemic (recall the feminist Care Strike 2019): On the one hand, it was problematized for its instrumentalization for economic, colonial, and personal purposes (including paternalism). On the other hand, as a practice of interest-led action and response, it became an overarching concept of hope for systemic change. Art also intervenes in this change: If we want to think, to live other worlds, then we need caring relationships.[49] For

48 On the techno-eco-feminist reappropriation or "counterappropriation" (Thomas Edlinger) of metaphors of flowing, see Volkart, "Flowing, Flooding, Fibbing."

49 Of the many references for this, a few are selected here: Joan C. Tronto, *Moral Boundaries: A Political Argument for an Ethic of Care* (London: Routledge, 1993); Aryn Martin, Natasha Myers and Ana Viseu, eds., "The politics of care in technoscience," special issue of *Social Studies in Science,* Vol. 45, issue 5 (2015), https://doi.org/10.1177/0306312715602073; Jessica Ullrich, "Who cares for animals? Interspezies-Fürsorge in der zeitgenössischen Kunst", in Manuela Rossini, ed., *Animal Traces / Tierspuren / Traces Animales,* special issue of *figurationen,* Vol. 15, 1 (2014); Tobias Bärtsch et al., eds., *Ökologien der Sorge* (Vienna: transversal texts, 2017), http://transversal.at/books/oekologiendersorge; Katharina Brandl and Friederike Zenker, eds., *TechnoCare* (Vienna: Verlag für

this context of techno-eco-feminist thinking, María Puig de la Bellacasa and Natasha Myers are central. Puig de la Bellacasa has, for example, expanded the notion of care to include permaculture in terms of more-than-human forms of subjectivation. She highlights that the different human and other-than-human actors of soil-making live in different temporalities and worlds. If one wants to improve soil management, she says, it is important to take this fact into account. Taking permaculture, for instance, she discusses caring, even healing relationships with the soil—in contrast to conventional agriculture, which, situated in the homogenously constructed time of progress, only drains it through artificial fertilizers and monocultures. "Maintenance and repair" had been *the* paradigm of agriculture until the twentieth century. Only with modernization and the green revolution did "maximization of soil beyond the renewal pace of soil ecosystems" become the new ideology.[50] Similar to Puig de la Bellacasa's approach to care with soil, Myers pleads for "other ways to feel, to think, and know" with plants. Specifically, "art, experiment, and radical disruption" as well as hybrid technologies would help us to learn to sense and act otherwise.[51] Thus, more than Puig de la Bellacasa, she thinks together cross-species attention, contested techno-organic boundaries and care with art and re-appropriated (laboratory) technological approaches.

"Care ethics is often thought to be just about caring *for* someone, but it is essentially a relational ethics," writes animal ethicist Lori Gruen.[52] So no matter how one defines or critiques care, it always has a direction toward the other and presupposes a disposition to open up to alterities. This is a promise today, at the height of our planetary ecological, social, and political crisis.[53] Ironi-

cally, the politics of total exploitation, including the exploitation of care workers, the privatization of the care sector, and the failure to address the suffering of colonialism, also has devastating economic consequences for the Global North. Not least because, as Maria Mies and Silvia Federici noted back in the 1970s, capitalism is based on the reproductive sector.[54] The devaluation of time-consuming reproductive work and its use for the functioning of the capitalist economy goes hand in hand with technological upgrading in agriculture, the kitchen and the care sector. The current demands for recognition and fair payment of care and reproductive labor connect to demands of second- and third-wave feminism, but they also transcend them: too quickly, during the discourse-based feminist expressions of the 1990s, activities and physicalities related to reproductive and care work were suspected of essentialism or backlash; interestingly, this was countered by the tech-savvy cyberfeminists with their revelatory reference to mothering and metaphors of fluidity.[55] The radicalization of the dispossession and wasting of bodies and land, to which even privileged people of the Global North increasingly fall prey today, highlights the need for re-productive practices of care. The extent to which the situation has changed, also with regard to the recognition of self-care, is indicated in the citation of Angela Davis by the editors of "Radical Care":

In a recent interview, Angela Davis explicitly tied social change to care: "I think our notions of what counts as radical have changed over time. Self-care and healing and attention to the body and the spiritual dimension—all of this is now a part of radical social justice struggles. That wasn't the case before."[56]

Moderne Kunst, 2019); The Care Collective, eds., *The Care Manifesto: The Politics of Interdependence* (New York: Verso, 2020); Jasmin Degeling and Maren Haffke, eds., *ZfM. Medien der Sorge*, 1/2021, https://zfmedienwissenschaft.de/heft/archiv/24-12021-medien-der-sorge; Manuela Zechner, "To Care as We Would Like to: Socio-ecological crisis and our impasse of care," in Journal Berliner Festspiele, Gropius Bau, 2021, https://www.berlinerfestspiele.de/en/gropiusbau/programm/journal/2021/manuela-zechner-to-care-as-we-would-like-to.html; Bonaventure Soh Bejeng Ndikung, *Delusions of Care* (Berlin: Archive Books, 2021); Elke Krasny et al., eds., *Radicalizing Care: Feminist and Queer Activism in Curating* (London: Sternberg Press, 2022); Valeria Graziano et al., eds., *The Pirate Care Project*, https://pirate.care (all URLs accessed January 28, 2023).

50 María Puig de la Bellacasa, "Making time for soil: technoscientific futurity and the pace of care," *Social Studies of Science*, Vol. 45 (2015), pp. 692–716, here p. 699; María Puig de la Bellacasa, *Matters of Care: Speculative Ethics in More than Human Worlds* (Minneapolis and London: University of Minnesota Press, 2017).

51 Myers, "How to grow livable worlds"; Martin, Myers, Viseu, "The politics of care in technoscience."

52 Katharina Brandl and Friederike Zenker, "Caring Technologies. An interview with Lori Gruen," in Katharina Brandl and Friederike Zenker, *TechnoCare* (Vienna: Verlag für Moderne Kunst, 2019), p. 28.

53 Martin, Myers, Viseu, "The politics of care in technoscience," pp. 10–11.

54 Maria Mies, "The Subsistence Perspective," transcription of a video by Oliver Ressler, recorded in Cologne, Germany, 26 min., 2005, https://transversal.at/transversal/0805/mies/en (accessed March 11, 2023).

55 For example, Alla Mitrofanova, "Pregnancy as a Philosophical Problem," in *n. paradoxa*, vol. 2 (1998), pp. 49–51.

56 Hi'ilei Julia Kawehipuaakahaopulani Hobart and Tamara Kneese, eds., "Radical Care," special issue of *Social Text*, vol. 38, no. 142 (2020), p. 1.

Concern thus becomes the micropolitical basis "for creating 'alternative livable relationalities' within otherwise dominant configurations."[57]

Even etymologically the German *sorgen* and the English *to care* have many meanings. Derived from Germanic, they range in English and German from *to grieve* and *to lament* to *to be troubled*, *to be concerned*, *to pay attention*, *to attend*, and *to love*. Despite the similar sound and meaning, *care* is not related to the Latin *cura* and the *curate* derived from it.[58] The German *Sorge* (Middle High German *sorge*) is related to the New English *sorrow*.[59] Also the Middle High German *Kar* ("sorrow", "grief"), *as* in the word *Karwoche* ("Holy Week"), roots in the Old English *cearu*.[60] What is unmistakable in both languages is the etymological change from a negative to a positive occupation, as if working through "being troubled," "staying with the trouble," to use Donna Haraway's phrase, opened up other horizons. In this sense, then, *caring* here always means "a critical survival strategy for enduring precarious worlds."[61]

ART AS TRANSLATING, AS TRANSMAKING AND TRANSBECOMING OF THINGS

Art, insofar as it translates reality into something different, appears by definition to be suitable for making diverse forms of alterity experienceable. It becomes a field of action in which seemingly immovable realities can be experienced differently through transformations. It is a structure that can shift the normalized view of things, introduce differences, and make things happen differently—even if only temporarily or as a game. "Why are you, as a lawyer, presiding over a tribunal of opinion, a theater tribunal?," quotes theater director Milo Rau from the exchange between Jean-Louis Gilissen, who works at the International Criminal Court in The Hague, and a colleague there.

> And Mr. Gilissen replied, "Because a court like the 'Congo Tribunal' can only happen on stage right now." He is right:

the "Congo Tribunal" is a symbol, a sketch of justice. It exists precisely because it legitimizes itself from within itself, constitutes itself ever anew through its practice, and not because it was established by any legal body. The Tribunal will therefore exist precisely until the official legal and political institutions want to begin their work.[62]

By enabling perceptions that are not based on identification, art can tear apart fixed contexts and create ruptures. Of course, art does not do this because it is art and occupies a privileged social place. As I will show on the basis of the selected examples, these are ethical-aesthetic processes of shifting meaning that must be staged again and again—medially, materially, socially—towards movements that, despite precise settings or "well-intentioned" intentions, cannot be precisely defined. These shifts, these translations generate moments of being different, of being foreign, of non/sense, of poetry. In this calculated strangeness of things and their incalculable strangeness, still and again lies the potential of the aesthetic. It can break open naturalized ideologems and so permit us to participate in and through the fundamental indeterminacy of existence. It pulls us into the unavailability of things, lets us become outside ourselves, produces (sense) surpluses, opacity. The machinic, non-human, close to the phenomena and forces of the other-than-human operating techno-eco-aesthetics challenges the conventional concept of art, especially in the interdisciplinary links of art and science. Furthermore, it centers the quest and leads us with and without (measuring) technology to the imprecise, appreciated and touching (back).

With Félix Guattari, I read the artistic projects discussed here as actants of an "eco-logic": a psychic, corporeal, non-rational "logic of intensities" that affectively and generatively produces things.[63] Eco-logic means (pre-subjective) forms of existence in which beings and things *become* (or do not become) *with each other*. So my question about how something is aesthetically *realized* is interesting because it has *real effect* as an "ethical-aesthetic" practice. Because it interacts, produces alterities,

[57] Puig de la Bellacasa, quoted in Martin, Myers, Viseu, "The politics of care in technoscience," p. 10.

[58] Oxford English Dictionary: https://www.oed.com/view/Entry/27899?rskey=4U96cx&result=1 - eid (accessed March 11, 2023).

[59] Friedrich Kluge, *Etymologisches Wörterbuch der deutschen Sprache*, 22nd ed. (Berlin and New York: de Gruyter, 1989), p. 680.

[60] Ibid., p. 356.

[61] Hobart and Kneese, "Radical Care," p. 2.

[62] Milo Rau speaks of "institutionalized irresponsibility": "The question is what we do with the knowledge," *WoZ Die Wochenzeitung*, January 6, 2022, pp. 20–21, here p. 20.

[63] Guattari, *Three Ecologies*, p. 44.

and *subjugates* subjects. *Technologies of Care* is thus also a plea: for practices of M-othering, for generating re/productive forces that do not reject the other as rejected or incorporate it into one's own self, but rather recognize the otherness of the other (also of oneself) and develop care out of this recognition of radical strangeness and alterity. M-othering is the other practice of othering; the connecting or separating line does not denote the either-or of the slash (M/othering), but the search for connections where there are differences. Caring as M-othering thus means a mode of existence of coming into/over/being together, beyond the well-known idealization of the (woman as altruistic) mother. It is an event that, being reproductive, *is* again and again: again and again the same and yet *different*. (Again and again: wiping away shit, drying up, feeding).

In this context, the question arises whether a word like "eco," which emphasizes the unholy alliance of ecology and economy, makes any sense at all? *Oikos* means the "house," "the household," "the habitat" in Greek. Emanuele Coccia criticizes that we thereby equate the terrestrial, of all things, which goes far out and reaches into the atmospheric, with the narrow human sphere: the home, the property of the patriarch.[64] If we consider that our global *habitat* is not only occupied and proprietarized, but also reduced to a resource and capitalized, this critique can be agreed with: *ecological economizing* is also often not much more than *greenwashing*—extending the business sector to the next, higher level. But there are ecology approaches based on cooperation[65] and disruption that are closer to what is of interest here: "New developments in ecology make it possible to think quite differently by introducing cross-species interactions and disturbance histories."[66] Or Nicole Seymour's queer interactions: "Queer values—caring not (just) about the individual, the family, or one's own descendants, but about the Other species and persons to whom one has no immediate relations—may be the most effective ecological values."[67] *Oikos* is neither the coercedly harmonized "home," where everything has its economic use, nor the nostalgic "house of being": it is the jointly inhabited space—a place of relations, not only of affiliations. It is made of micro-economies, intensities and forces, full of porosity and opacity. As feminists, we know that

power and violence permeate the interior, that the separation of interior and exterior is a phantasm. It is precisely because the household has been degraded to the place of women and children, of others, to the place of inferior services, and precisely because its centerpiece—the kitchen—has been technologically upgraded but not valorized in modernity, that it has potential to be queered: the *oikos* of techno-eco-feminism is im/possible living together, and does not distinguish between the self and the other, the human and the non-human. "I look for disturbance-based ecologies" writes Lowenhaupt Tsing, focusing on forms of living together that need not be harmonious or competitive.[68] With her and the projects discussed here, we focus on circuits of pulsating forces, tangles of more-than-human beings that dabble in touch and concern.

PREVIEW

The chapters of *Technologies of Care* fan out along the basic etymological meanings of *caring*. By means of variations, deviations, and repetitions, they attempt to narrow down the polyphony, counter-directionality, repetitiveness, and insistence of caring. The introduction, "Being Troubled" names the starting point: We are troubled! And we ask: How to survive? How to intervene in the permanent wasting of the world? "Being Concerned: Sensing a Damaged Forest" uses the example of forest research to show how scientists and artists are addressing the catastrophic situation. They seek to understand, communicate, and inspire passions about forest concerns. The focus is on our research project and the different technologies of forest sensing. Caring as a passionate preoccupation—concern—with cross-species alterities finds itself preferably situated in the field of art and science: thus, Marcus Maeder, Rasa Smite/Raitis Smits, Karine Bonneval and Agnes Meyer-Brandis work closely with forest scientists whose technologies and methods they conspiratorially appropriate and misuse. They translate them into scenarios that don't work out without gaps; they create surpluses and "distortions" whose strength lies in the strangeness of things. Thus, instead of detachedly following numbers,

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64 Emanuele Coccia, "Nature is Not Your Household," in Latour and Weibel, *Critical Zones*, pp. 300–304.

65 See Hörl, footnote 36.

66 Lowenhaupt Tsing, *The Mushroom at the End of the World,* p. 5.

67 Nicole Seymour, quoted in Heather Davies, "Toxic Progeny: The Plastisphere and Other Queer Futures," *philoSOPHIA. A Journal of Continental Feminism*, Vol. 5.2 (Summer 2015), pp. 231–250, here p. 232.

68 Lowenhaupt Tsing, *The Mushroom at the End of the World,* p. 5.

curves and diagrams, the audience can become part of vibrating eco-events whose opacity is touching. *Caring* requires attentiveness, especially in one's own work. To the extent that it is not head-centered—if we follow Tim Ingold—but instead responsive, immersive, and ecological, it provides the conditions for a cross-species aesthetic. "Paying Attention: From the Laboratory to Labbing" discusses how the artistic fascination with the laboratory and its instrumental techno-aesthetics transforms into experiments in cross-species responding. Projects by Pinar Yoldas, Alexandra Toland, Mindaugas Gapševičius', Humus Sapiens and Ursula Damm will be discussed. *Caring* is "*going along* with others, as in joining and accompanying."[69] That's why the chapter "Going Along: WasteMachines" enunciates: I am there, part of the wasting of world, part of the grief and anger about it. Witnessing. The example of lithium-ion batteries and our research project *Times of Waste* is used to negotiate our approach to the wasting of raw materials. In the project of Unknown Fields, the original meaning of *caring*—as *grieving* and *lamenting*—appears in a non-human concatenation, and the mythical dimension of impotent mourning transforms into witnessing and resisting. "M-othering: Tending and Healing" considers the proposition that to survive (the catastrophic), to thrive and become, we need atmospheres in which to heal and be healed. Wanuri Kahiu, Leena and Oula Valkapää and Špela Petrič demonstrate caring as becoming m-other: forms of transformation, of growing and repairing, of inclusion and expansion of alterity that transcend gender and species boundaries. The formal proximity produces the meanings *mothering*, *othering*, *not othering*; in short, a mothering that embraces rather than excludes the other and becomes other together. *M-othering* is the condition for environmental becoming to be a planetary mode of existence and not another possibility in the set of privileged subject positions. *Caring*, then, is always: touching oneself/others; it is going (out of oneself), connecting, becoming collective, exceeding the mark, and at the same time coming (back) to oneself: "Exceeding: Toward an Aesthetics of Attention." Leaving one's own house and arriving at the *oikos of* the Earth, its unpredictable, chaotic, cosmic forces. This is care as surplus and excess. Surplus generates where something fits and does not fit, where there are disturbances, where opposites and incompatibles coincide polyphonically and not homogeneously, where meaning is generative and machinic, through addition and adjacency, where poetry is opacity. Even more than the respective meanings of *to care,* it is therefore the word's both difference-creating and unifying facility that is promising—especially for aesthetic concerns that aim at poetizing dual opposites. *Technologies of Care* are polyphonic, mutable, open, context-specific, yet always directed toward an other: They are out of themselves and with themselves, excessive and close to matter—allowing us to experience the radical unpredictability of terrestrial being. The most promising works do this in cool, funny, contradictory or incomprehensible ways. They give us and themselves the space to be different. After all, projects that are about feeling, empathy, love, etc. always run the risk of becoming pathetic or talking things to death. Aesthetic methods that create restlessness, contradiction, closeness—in short, care—are therefore able to affect more than those that want to say everything in a comprehensible way.

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[69]   Ingold, *Anthropology*, p. 21.

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BEING CONCERNED: SENSING A DAMAGED FOREST

When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of *science*, whatever the matter may be.[70]

How do the arts use data, technology, and scientific methods to bear witness to destruction and create a new eco-sensitivity? How can art and science come into a conversation, sharing concern and passion for forest concerns? These questions were the point of departure for the research project *Ecodata-Ecomedia-Ecoaesthetics. The Role and Significance of New Media, Technologies and Technoscientific Methods in the Arts for the Perception and Awareness of the Ecological*. It was based on the desire to bring technological (sensing) techniques more strongly into the eco-art debate and to test their feasibility as media for "nature mediation." As discussed in Chapter 1, the hopeful discourse in the field of ecodata and ecomedia has intensified. At the same time, our perspective was underpinned by a certain skepticism toward the technodeterministic viewpoint that technologies can solve the problems we face. Investigating these processes, as well as engaging in them, was the goal of our applied theory-practice research. As institutionally approved artistic research, it was now possible to take a longer-term and interdisciplinary stance as well as to cooperate with an institution advanced in forest and climate research, the Swiss Federal Institute for Forest, Snow and Landscape Research WSL. This national institution, part of the ETH Domain, operates one of the world's oldest long-term drought manipulation experiments, the Pfynwald Research Station. For more than

20 years, monitoring and experiments have been carried out there on the forest's ability to acclimate to climate change, specifically to increasing drought.[71]

This unique mountain forest in the south of Switzerland was therefore chosen as the starting point for the artistic research. Pioneer vegetation that emerged in a moraine landscape at the end of the last Ice Age, it is one of the largest contiguous Scots pine forests in the Alps. Originally formed 10,000 years ago and used over centuries by locals for firewood and forest pastures, the individual trees are on average 100 years old and 10.8 m high. On the flank of the highest mountains in the Alps, the forest is located in one of the driest regions of Europe—the high mountains prevent precipitation from reaching the valley. Steppe climate meets glacial water. Once polluted by fluorine emissions from the local aluminum industry, nowadays the forest is suffering from increasing drought due to climate heating[72] and the associated infestation by parasites (such as mistletoe), which have affected it to such an extent that repeated drought-induced tree mortality occurs and, in some places, up to 50% of the pine in the canopy have died (fig. 2). Considering ongoing climate change and the resulting further increase of drought, it is still unclear whether the pine forest will become barren or be replaced by drought-resistant trees such as downy oak that have migrated from the south. What is clear, however, is that the days of this type of forest, growing today at the dry edge of its possibilities, are numbered and that it will develop into another and drier ecosystem with other trees and probably less dense tree cover—a fact that has not yet entered the general consciousness. It has also become clear that artificial irrigation with sprinklers could activate microorganisms, increase the growth and vitality of the pines and that the forest could recover. But beyond a

70   Lord Kelvin, "Electrical Units of Measurement" (1889), quoted in Susan Ratcliffe, ed., *Oxford Essential Quotations*, 4th ed. (Oxford: Oxford University Press, 2016), https://www.oxfordreference.com/display/10.1093/acref/9780191826719.001.0001/q-oro-ed4-00006236;jsessionid=C1EE6D672B2C5EC344DD87FEC3F7080D (accessed May 18, 2023)

71   The long-term irrigation experiment Pfynwald is part of the Swiss long-term forest ecosystem research program LWF: www.lwf.ch (accessed March 15, 2022). For more details about this experiment, see my interview with the scientists responsible in this chapter, pp. 40 sq.

72   The warming at this location is more than twice the global average, and at the poles it is four times as high.

Fig. 2: Scots pine trees dieback of large areas in Central Valais, September 2017.

certain level of repeated drought and heat, the trees lose their acclimative capacity and die. To study and understand these drought-related processes the trees, the forest floor, and even the deeper soil layers were equipped with manifold sensor technologies and plastic covers—they have become cyborgs that seem like "patients in intensive care"[73] (fig. 3).

In short, the alpine situation is a point of convergence in the current Anthropocene discourse, yet at the same time it is hardly considered in the international eco-art discourse—the problem seems too marginal compared to the situation at the poles or at the equator, in the oceans, or in the rainforest with the economic and political violence taking place there. In response to this lacuna, three artistic researchers, Marcus Maeder, Rasa Smite and Aline Veillat, took up the exemplariness

and experimental nature of the Pfynwald and sought to work through "Being Troubled" and "Being Concerned" in collaboration with WSL; each team member focused on the question of data and technologies and developed a personal approach to it.

LISTEN TO THE FOREST

We enter a room and are immersed in a manifold synthetic-natural sound: a sustaining drone and roar, birdsong, water splashing, frogs croaking, the whoosh of wind, branches cracking, bugs crawling, and there is also a low, infinitely slow, strangely spreading elegiac sound, as if coming from the depths of the Earth, rhythmically repeating, varying, getting lower and lower,

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[73] This metaphor has been applied or critically analyzed for various non-human "patients." See Martin Siegler, "Volcano Observations. Sensory Media and Geological Vital Signs," in Schneider and Zemanek, *Spürtechniken*; Birgit Schneider, "Entangled Trees and Arboreal Networks of Sensitive Environments," in the *Mediocene* issue of *ZMK Zeitschrift für Medien- und Kulturforschung*, ed. Lorenz Engell and Bernhard Siegert (September 1, 2018), pp. 107–126; Latour and Weibel, *Critical Zones*.

Fig. 3: Pfynwald Research Station, September 2017.

another high and getting higher and higher, all seeming dreamily slow, until both fade away.

What we are listening to is Marcus Maeder's sound installation *Perimeter Pfynwald. A Soundscape Observatory* (2019) (fig. 4). It aesthetically maps the ecosystem of the Pfynwald and makes it audible in a way that cannot be heard in real life on site. In the installation, there is, in addition to the acoustic experience, a visual one: several black boards are distributed on stands in the room; they are the loudspeakers that act like signals: locations are indicated on them with white chalk. Six different sono-grams with the same location information are projected onto the wall. The movements on them run synchro-nously to the respective sound snippet: Forest/Channel, Mountain Stream, Riverbank, Pondside, Pond Underwa-ter, Forest/Channel Soil. In the projection on another wall, the camera's view floats through the forest, slowly, steadily, immersed in the middle of it. Photographs laid

out on a table show different conditions: dead trees on the ground, an eroded streambed, a view of the moun-tains, a patch of forest full of ground markings that make the site recognizable as a research station.

For this work, Marcus Maeder distributed autono-mous audio recording devices at designated locations in the forest, which automatically recorded the sounds:

In the installation, a soundscape consisting of a temporal and spatial compression can be heard: the recording devices were placed several kilometers apart in the Pfynwald forest and recorded environmental sound at intervals of 10 min-utes… different biotopes that lie far apart in a landscape can be heard simultaneously. On the other hand, the interval recordings create a timelapse sound track that reproduces events in the environment in a shorter time than would normally be heard.[74]

[74] Marcus Maeder, "Project description *Perimeter Pfynwald. A Soundscape Observatory*," research project *Ecodata-Ecomedia*-Ecoaesthet-ics, https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-des-instituts-

Fig. 4: Marcus Maeder, *Perimeter Pfynwald. A Soundscape Observatory*, 2019, Installation view, LABoral Gijon/Spain.

The immediate impression that the sound reproduces an extremely complex and differentiated ecoacoustic, which is both momentarily condensed and progressively varied, results first from the strategy of spatiotemporal compression, and second, from Marcus Maeder's generative dramaturgy. He calculated it to some extent from the collected weather data of that heatwave summer of 2018, and implemented it along a progressive temporality. A third element consists of the sonification of environmental measurement data collected by the WSL in the Pfynwald:

> *Perimeter Pfynwald* integrates two microclimatic parameters as artificial sound sources: measurement data of the air temperature and humidity in the forest control the sound synthesis on the computer of the installation. The result is a sound that is supposed to sound like a voice of the forest. This voice consists of a deep and a high tone—the depth represents the humidity, the height the temperature.[75]

The fundamental sound, which transports the mood at the same time with interval-like flickering rumbling noise, is "voice," neither something human nor "saying" anything. The listener only has the "feeling" that it comes from deep down and far away and is ancient, a kind of earth tone or spirit. This indeterminacy leads to a permanent tension that is not resolved. The listener, or perhaps better experiencer, "feels" that the forest represented here, which they hear and see and feel resonantly, is a body, a living being. That it *is*. They move in its terrain; they are affected by its mystery. Although *Perimeter Pfynwald* accomplishes these sound evocations entirely without narration and suggests, at least aesthetically, the information design of science or pedagogy, the atmosphere has something mythical about it, recalling in us non-modern knowledge in which the forest does not represent an outside, but is part of the body. At the same time, the artificiality of the sound, of the voice, conjures up a cyborg, something hybrid. The forest being, the forest body, the forest here is *natureculture*.

kunst-gender-natur-iagn/ecodata-ecomedia-ecoaesthetics/research-project/perimeter-pfynwald (accessed March 15, 2022).

75 Ibid.

In the installation *Perimeter Pfynwald* it becomes possible to experience how drought and heat have an acoustic effect on the forest in the course of climate change: it becomes quiet. The more intensively the heat and drought period develops in summer 2018, the less can be heard in the individual biotopes: the noise of the nearby river becomes quieter because it carries less water; mountain streams dry up. The fauna retreat, are less active and therefore quieter. The air humidity decreases, the temperature increases, which results in the sound synthesis of the forest voice, that the deeper sound becomes deeper and deeper, the higher one higher and higher, until they lie outside the audible range and the voice silences.[76]

Marcus Maeder's research, which initially aimed to make the forest audible and thus conscious as a complex, acoustic ecosystem, changed during the research process. His compression and sonic spatiotemporal translation of what happens in the forest became an autonomous aesthetic ecology, a living happening that, as an "observatory," simultaneously says something about the situation there and the hot summer of 2018. This becoming ecological succeeds precisely because the sound to be heard in each instance is created generatively, again and again, through an algorithmic program. Thus, we do not hear pre-recorded, fixed sound loops, but instead witness a techno-aesthetic, techno-ecological event: an openly programmed interplay of many participating data sources. Although processed within certain parameters, the acute sound is unpredictable and singular. If you listen to the work for a very long time, or several times in a row on different days, you will notice that the sound is somehow the same and yet not the same. It is neither variation nor does it have any resemblance to anything given, because there is no given original soundscape. There is only a succession of singular events, a mix of (sound) snippets, rules, time sequences. This is meaning through accumulation, contiguity, touch. And this brings with it *concern* about the event going forward. Where is it going? Where is the soundscape taking me? The soundscape is related to itself in a radical, alterity-creating way, without being identitarian or creating identity. Rather, confronted with *Perimeter Pfynwald*, the experience of the otherness of the soundscape exposes one to the strangeness of things, of oneself.

Already in an earlier SNSF research project entitled *trees: Rendering ecophysiological processes audible,* Marcus Maeder had worked with sonification and generative sound strategies, and was closely involved with WSL and ecophysiologist Roman Zweifel. The two were able to demonstrate that ecoacoustics, as well as the sonification of measured data, also produces useful categories of analysis for science. They recorded acoustic emissions from a tree in the Swiss Alps, near the Pfynwald, using special sensor technology, and Marcus Maeder translated (sonified) them into frequencies perceptible to humans. In addition, he sonified ecophysiological measurement data from WSL—for example, the changing stem and branch radii, which depend on the water content, the sap flow rate in the branches, the water present in the soil, relative humidity, solar radiation, and so on. In different installation variants titled *trees: Pinus sylvestris* (2015) (fig. 5), he experimented with sound and the aesthetic mode of representation. What remains essential is that even in this older work the sound, because it is generatively produced from the data, always sounds slightly different, albeit infinitely more elegiac than that of *Perimeter Pfynwald*, and is accompanied by snapping noises. These "cavitation sounds" are emitted by the tree as a result of drought stress in the course of the day when the sun is at its highest and the flow of water in the tree is at its scarcest, as the running times on the screen below show, regularly around midday and afternoon. Already in this work, a "more fundamental phenomenon could be experienced: namely, how trees react to increasingly prolonged heat and dry periods in the wake of climate change."[77]

This "fundamental phenomenon could be experienced" due to the audibility of data coming from sensor technologies directly attached to the tree trunks. On the one hand, these record acoustic phenomena that cannot be perceived by humans, such as the cavitation noises inside the tree caused by drought stress; on the other hand, they measure other parameters concerning the health of the tree. But it is the composition of the various data that makes the music, which is more than just a "statement" about the tree's behavior under climate stress: the solemn music is infinitely sad, reminiscent of a requiem, giving a sound to the dying of the pines, shaped as a farewell.

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[76] Ibid.
[77] Marcus Maeder, ed., *Kunst, Wissenschaft, Natur. Zur Ästhetik und Epistemologie der künstlerisch-wissenschaftlichen Naturbeobachtung* (Bielefeld: transcript, 2017), p. 51.

Fig. 5: Marcus Maeder, *Trees: Pinus sylvestris*, Immersive Lab, ICST Zurich.

In *Perimeter Pfynwald* the sound, even if it slowly fades away as an effect of the heat, is more diverse; we hear the voices of many beings. For this project Marcus Maeder worked less with sensors and more with his own field recordings from ecoacoustics, which are still in the humanly audible range. He uses acoustic recorders with built-in microphones. The sensor data from the WSL field recordings are only used for the generation of the synthetic fundamental sound. The acoustic event is also paired with different visual representations: photographs, sonograms and a drone video. This scenography, like the title, is reminiscent of a display arrangement that allows both the object of investigation and the means used to create it to be seen. This may be due to the artist's epistemological claim, saying: "hey, my sound installation is not only a place of emotions and affects, but also an observatory that, like technoscience, says something fundamental about climate change and makes it a matter of public interest. We have common concerns." Maeder himself sees this modular structure as more akin to an artistic-pedagogic presentation than a scientific one. Thus, the use of the slates is a reference to Joseph Beuys' spatial installation *Das Kapital* (1970–1977), which he understood as a "monument of the future," a "thinking space," an "artificial cosmology."

> The creativity of the visitors as capital of a transformation of society is also a central element for me. Creativity through participating observers in the artistic observatory—in the perception, in categorizing, verbalizing the sounds and their contexts. That which arises in associations and appreciations, in criticism, is the capital for the future.[78]

In contrast to many artists from Bio Art, who often adopt technoscientific idioms formulaically and uncritically,[79] Marcus Maeder also provides infrastructural determinants. This becomes clear when we compare the spatial installation of *Perimeter Pfynwald* with the net version of the same name.[80] The net version, which, because it is stereo, sounds flatter than the room installation and is

[78]   Marcus Maeder in an e-mail to Yvonne Volkart, March 30, 2022.

[79]   I discuss this point in more detail in Chapter 3.

[80]   This was created for the Corona conditional online version of *Critical Zones*: https://critical-zones.zkm.de/#!/detail:perimeter-pfynwald-a-soundscape-observatory (accessed March 15, 2022).

Fig. 6: Video still from Rasa Smite/Raitis Smits, *Atmospheric Forest*, VR-Installation, 2020.

viewed at home, in the "home office," therefore relies on the amplification of intelligent information: the respective times as well as parameters such as temperature, humidity, etc. are displayed, so that the sound changes can be compared with the course of the day and the selectable seasons. This interactive display brings with it a loss of immersion for a gain in rational knowledge. Of course, this scenography of techno-medial boundaries is no coincidence: it plays with the fact that there is no forest sensing beyond the respective sensing techniques.

WHEN THE FOREST SMELLS OF RESIN

I enter a pictorial space that seems light and dark, abstract and realistic, dissolved and organically compact at the same time. Tree trunks lie on the ground, branches, leaves. Bushes are coming towards us. We drive up a long trunk to the crown, which sprays and flames. Then we are down again. Are we inside the tree? There is no inside, just particles combining, dancing, dissolving. It crackles. The trees are like smokestacks, throwing thousands of brightly shining particles into the blackness of the surroundings: the trees are machines, organisms, constellations gone mad, breathing beings that are

frighteningly alive and eerily beautiful. We experience them as alien things we do not understand.

In Rasa Smite's VR installation *Atmospheric Forest* (in cooperation with Raitis Smits) (fig. 6, 7) we also enter a forest in times of climate heating. In the course of her collaboration with WSL, she learned that trees not only convert CO_2 into oxygen, as is commonly known, but that they also secrete resin, produce volatile gases and even emit CO_2. These VOCs (volatile organic compounds) have a strong odor and consist of various chemical molecules, for example, monoterpenes, the basis of the most well-known plant fragrances and balsams, such as pine oil and turpentine, much loved by humans. Trees, however, use these scents to deal with heat or increased light, to ward off parasites, or to send warning signals to symbiotic creatures. These substances affect the atmosphere and climate, combining with other chemicals to create complex feedback loops that can potentiate changes. For example, they increase ozone concentrations in polluted atmospheres while reducing them in clean air, or they extend the longevity of methane. In the wake of the current drought and heat stress, certain trees are beginning to emit more VOCs. The details of the interaction and the extent to which soil, water, trunk, and other plants are involved cannot

Fig. 7: Video still from Rasa Smite/Raitis Smits, *Atmospheric Forest*, VR-Installation, 2020.

yet be fully explained; this composite is the subject of extensive research using various measurement techniques and visualization technologies.[81]

WSL provided Rasa Smite with technologies such as the lidar scanner as well as their own collected data. One of the results is the VR video described above, in which there is a sequence where the representation of the quantity of emissions is conveyed by means of graphic curves, and this is reminiscent of conventional scientific representations: they are abstract waves in flow with the names of the gases given, which if illegible, don't convey much, and are not especially evocative. Art proceeds differently from the abstract scientific mode of representation: Smite/Smits, for example, animated the images of the forest taken with the scanner according to the parameters (quantity of emissions, time, temperature, etc.) in the affective way described above. Where it is warm and particularly many emissions happen, the color changes from yellow through orange to red. Where there is little heat and therefore lower levels of emissions, the particles are white. Although WSL also works with this color spectrum, the data used to deter-

mine the animation rhythm is real, and the process itself is scientifically measured, yet the way it is implemented is speculative: though they may appear in this rendering to be like smokestacks, trees probably do not emit the VOCs in such an erect manner.

Smite/Smit's aesthetic strategy is an appropriation of the techno-scientific and a mixture of abstraction and physicality. Rasa Smite went into the forest with the lidar scanner to scan individual trees. Scientists also do this, but this technology tends to be used more and more at a distance to take large-scale images, for example with drones. This means that scientists no longer need to be on site. In *Atmospheric Forest,* on the other hand, the audience enters the forest using VR technology and is immediately surrounded by it, as if in a thicket. Different ways of moving around have to be tried out. The atmosphere is artificial, yet ambiguously distanced and touching. Not only do we hear and see the invisible VOCs, but we also experience ourselves as part of this happening. Rasa Smite also tries to overcome techno-scientific distancing by means of performative actions: in *Resin Experiment*[82] (fig. 8) she works directly with the

[81]   For further explanation of this, see my interview with Arthur Gessler and Kaisa Rissanen later in this chapter.
[82]   The performance can also be done as collective workshops.

Fig. 8: Video stills from Rasa Smite, *Resin Experiment*, Performance, 2020.

"emissions" of trees, collecting the resin, boiling it in a forest clearing in a firepit until it becomes liquid, and the volatile fractions evaporate into the atmosphere. What remains is turpentine oil, which is used in oil painting, among other things, and rosin, which is used to lubricate violin bows.

Rasa Smite's performance reiterates not only the extractivist gathering and transformation of this raw material into commodities useful to humans, but also the heating and polluting of the atmosphere. Moreover, she stages what the stressed trees have come to do as well (albeit, of course, on a vastly smaller scale than the fossil fuel industry): pollute the air we breathe, the basis of life for trillions of living beings. But Rasa Smite's artisanal, processual activity also recalls the caring actions of a housewife, the healing of a shaman, or the intoxicating work of a drug cook—activities whose contribution to transformative forms of knowledge is usually repressed, devalued, and persecuted. Yes, one could conclude that the artist stages and celebrates artistic activity as an act of transforming, of making different, of becoming different. Located at the firepit in the clearing of the forest, in the terrestrial outside, this activity seems at the same time scientific and speculative, ancient and of the future.

LIFE AS FOREST

Aline Veillat approached the Pfynwald through a set of quasi-ritual, quasi-archetypal relationships. She defines forest as "a multilayered network of complex multispecies agencies."[83] Soil, water, the air, its human and non-human beings exchange with each other in a constant material-semiotic process. The forest is a cultural-ecological becoming *and* a being in the making. It connects different times, practices and actors. "For a long time, I wanted to open doors to help us grasp and experience the contingent relations between human and non-human beings, living or non-living," Veillat records.[84] For her planned installation and video *attentiveness—being present in the entanglement of signs* (fig. 9), she began to recreate the tree using hemp ropes and mouth-blown objects—symbolizing the tree's vessels and dewdrops.

Archetypal artifacts made of clay were added. The materiality of the glass objects—water and sand—and that of the ceramic figures—clay—correspond to the tree's nourishment. But technical artifacts, such as microphones with sound snippets, and videos also come into play, following Jean-Luc Nancy's dictum that all technology comes from nature and therefore their separation becomes invalid.[85] The transparent glass, in its brittleness and fragility, points to the vulnerability of trees in times of drought. Although the work is only in its first unfolding, it is clear that Aline Veillat is attempting to use art to create a parallel universe, an ontology of the forest that brings together climate heating and the Stone Age, signs and relations, human rituals and cross-species actions. Whether this leads to its goal, to situations in which the audience learns to not relate everything that happens in the more-than-human space to itself, cannot yet be said.

Marcus Maeder's, Rasa Smite's and Aline Veillat's Technologies of Care, for all the diversity of their approaches, are Technologies of Concern. Disturbed by the damage and transformation of the ancient forest, they try to understand and mediate what is happening. They (re)discover techniques of affectation, touching us through and as the forest—opening up new approaches to life in the forest. Their techniques are both old and new, digital and analog. All of these techniques and modes of representation are used in the sciences as well as in the arts and in the consumer realm. This mix points to their claims to both witness climate change almost scientifically and participate in a political sense in "something larger than art."[86] It creates unease and disturbs us with beauty whose fullness and power is incongruous in the face of the catastrophic facts. But it also reveals the reality-building effect that technoscience with its sensing technologies and data has on our previous (colonial, romantic, and fairy-tale) constructions of "forest," "nature," and their mediation: as they meticulously record changes on planet Earth, they transform it into a cyborg, a tightly woven testing ground from which there is little escape. Marcus Maeder's and Rasa Smite's installations model this ontological status of the Earth as machine, program, laboratory and experiment

83 Aline Veillat, "Concept," 2019, https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-des-instituts-kunst-gender-natur-iagn/ecodata-ecomedia-ecoaesthetics/research-project/attentiveness (accessed March 15, 2022).

84 Ibid.

85 Nancy, "Of Struction," p. 1.

86 Tom Holert has named this a central claim in the context of artistic research. Tom Holert, *Knowledge Beside Itself. Contemporary Art's Epistemic Politics* (Berlin: Sternburg Press, 2020) pp. 198–200.
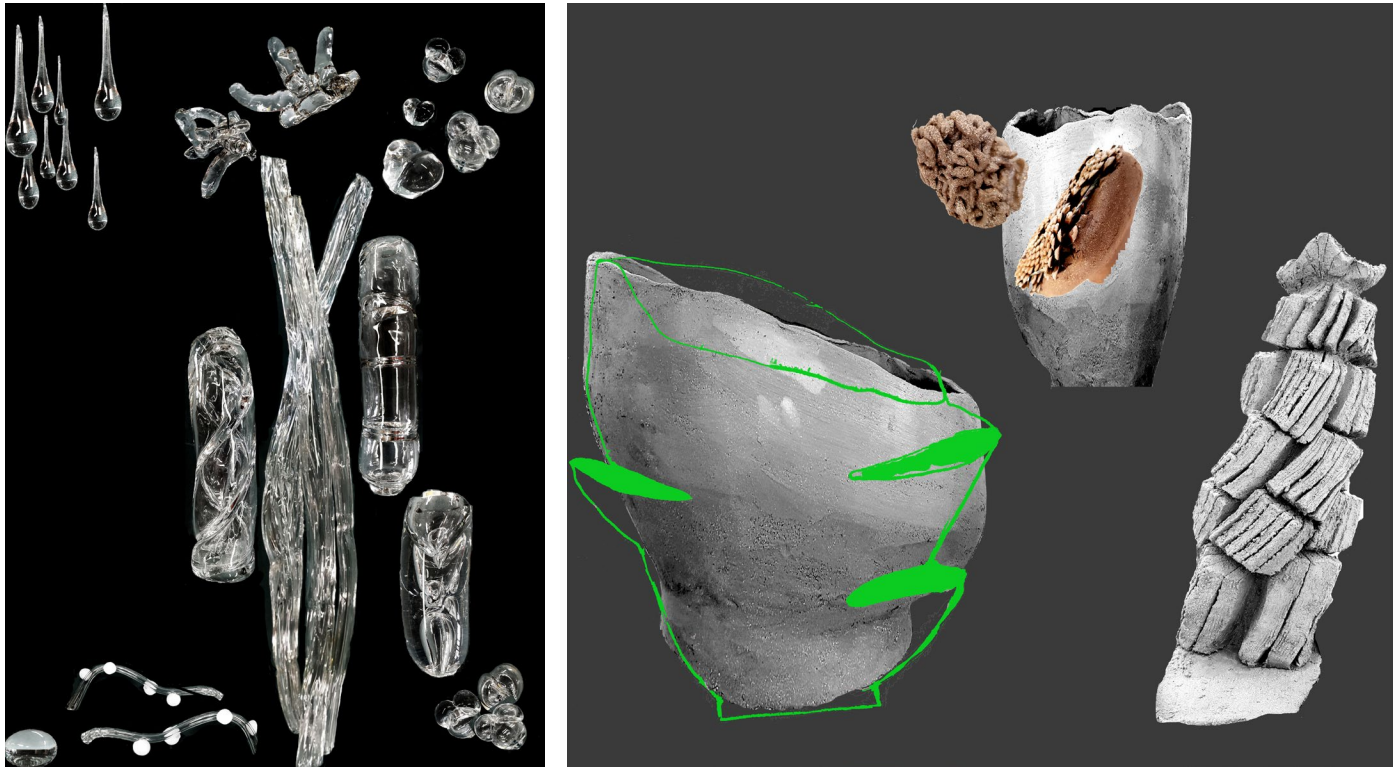
Fig. 9: Aline Veillat, *attentiveness—being present in the entanglement of signs*, objects from glass, clay and wood, 2020.

with an unpredictable outcome. They make it comprehensible. Or attackable. And thus open up a slice of the future.

OUTSIDE WITH THE TREES

The subprojects from *Ecodata-Ecomedia-Ecoaesthetics* stand in a series of further artistic and activist practices of "sensing and making sense of trees" with data and technologies, whose methodology Jonathan Gray began to systematize.[87] Ecodata can be collected by any means imaginable, not just using technology. And they can also be anything imaginable, as long as accounts about trees, manners, encounters and rituals can be derived from them. Accordingly, studying the forest scientifi-

cally does not have to mean cutting it up and extracting it as Big Data—even though I learned such methods in biology class at school. Rather, art and science today share a concern for the forest. The curators of *Critical Zones*, for example, point out that the scientific observatory which they make the starting point and center of their exhibition has its linguistic root in the Latin *observare* (*to watch carefully, to guard, to esteem*).[88] Constructing experimental arrangements thus means firstly wanting to understand the ecological contexts in which we live. That this scientific desire, this concern to know might trigger solidarity with alterity can be seen in our interviews with the WSL.[89]

During the research period I conducted workshops on forest sensing. Starting with sensory, bodily exercises, we systematically incorporated different media,

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[87] Gray, "The Datafication of Forests?", in Latour and Weibel, *Critical Zones*, pp. 361–369. See also the workshop and archive *Ways of Listening to Forests* that Gray initiated and conducted with Birgit Schneider on the occasion of *Critical Zones*: https://forestlistening.publicdatalab.org (accessed March 11, 2022); Jennifer Gabrys' chapter "Sensing an Experimental Forest" in *Program Earth*, pp. 29–54 as well as Myers, *Becoming Sensor in Sentient Worlds*.

[88] "At the Heart of Climate Change. Exhibition at the ZKM Karlsruhe," *TAZ*, May 27, 2020, online: https://taz.de/Ausstellung-im-ZKM-Karlsruhe/!5684912/ (accessed March 11, 2022).

[89] See the texts and interviews with WSL below as well as on the *Ecodata-Ecomedia-Ecoaesthetics* project website, https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-iagn/ecodata-ecomedia-eco-aesthetics/forest-science (accessed August 31, 2023).

such as smartphones, drawings, texts. It turned out that the rift was not through the particular media, or, as I had assumed, whether they were technology or body-centered. Rather, the problem was whether or not people could expose themselves to forest sensing at all. I had the same experience when urban forester Naomi Zurcher and I conducted workshops with the i-Tree app. Naomi Zurcher helped implant the i-Tree app in several Swiss cities as part of an SNSF research project at the ZHAW School of Life Sciences and Facility Management.[90] This is a *citizen science* app, originally developed by the USDA Forest Service and now used globally, that can be used to assess the condition of a tree and, from that, evaluate its ecosystem services (ESS).[91] A tree, according to the ESS approach, is a capital asset as it provides various vital processes such as the production of oxygen, cooling of superheated temperature, cleaning of dust particles, generating well-being, etc. The storage and sinking of CO_2, which trees now seem to be reduced to, is just one of many ecosystem services. The i-Tree app provides various parameters that can be used to measure and "data" the tree. A program evaluates this data and creates a tree inventory of particularly valuable or endangered urban tree stands. Although the parameters are clear and include differentiated measurement categories—such as diameter of the tree crown—sensory, subjective and experiential moments play a central role in the recording, such that tree measuring becomes an event of touching, which, carried out in a group, creates connections and is fun. The subsequent evaluation provides facts and figures that one actually already knows or notices when collecting the data, for example that old trees with a thick trunk and many branches provide significantly more ESS than young thin ones. Or one is amazed to notice that many young trees are not only planted in completely the wrong locations, but are also planted completely incorrectly, such that they can never grow old. In short, although i-Tree is a technology-based app, it is mainly hands-on techniques outdoors with the trees that are required to make the app function.

Marcus Maeder goes one step further with regard to the use of devices in his sound walks. With special bioacoustic microphones and sensors, which he sticks into the ground near trees or on branches or trunks, he can make sounds and noises audible to people, for example, beetles crawling on the roots. However, even though such sounds, and his walks demonstrate this wonderfully, they are not so easy for untrained participants to decode. The brain cannot match what is heard here for the first time with familiar sounds from the everyday world. And thus they can have many interpretations. Likewise, many confuse the technical noise made by the devices themselves with environmental sounds—inaccuracies that have already turned many eco-media art installations into unintentional fakes. But intentional fakes by artists are also not uncommon in sensor-based installations, as the arrangement requires complex technical set-up scenarios and support that go beyond the resources of the white cube or the technical understanding of those involved.[92] Marcus Maeder is different: for him, conscientiousness, precision and authenticity are absolute priorities in ecomedia data art. This comes at a price: be it the costly specialist equipment which is needed for recording and playback, or that the installations have to be completely rewired for each new exhibition. This is not, as one might think, a matter of course, because many exhibition institutions want to save money at precisely this point, and many artists have a penchant for technical tinkering. They prioritize the touches, coincidences, and discourses into which an eco-media installation leads over the question of whether the whole thing is also technically what it promises to be.

Marcus Maeder's sound walks also turn out to be—as mentioned above—collective, fun events. For in these, too, the focus is on trying things out together, puzzling about, and comparing notes with the artist's own experiences. Data collection by means of technical devices becomes a shared process of learning that sensitizes those involved to the perception of different situations and spheres. Undoubtedly, this confirms the assumption that sensor technologies become technologies of

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[90] www.zhaw.ch/i-tree (accessed March 21, 2022). Naomi Zurcher, *Connecting Trees with People—Synergistic Strategies for Growing the Urban Forest* (Cham, Switzerland: Springer Nature, 2022).

[91] Out of political considerations, ESS are appraised and monetarily quantified as capital for the purpose of being able to demonstrate the use of biodiversity, functioning ecosystems, and so on, in the context of a green economy and climate change.

[92] For Iñigo Manglano-Ovalle's computer installation *You Don't Need a Weatherman* for the exhibition *Ecomedia* (2007–2009), for example, we were sent a dummy with a DVD instead of a functioning measuring station. Sensors should have measured the changing room climate and thus controlled the video's image rhythm. Or the sensors in Aline Veillat's robotic installation *Pas de deux en vert et contre,* which are supposed to measure the constantly changing sensory plant activity regarding light, water, people in the room, etc., being replaced by an AI for the sake of simplicity.

Fig. 10: Video still from Karine Bonneval, *Dendromacy*, 2017.

sensing, technologies of care, if they are applied in this way. Thus, it turns out that data collection using sensing technologies to sense a forest, much praised in the *citizen science* milieu, is neither better nor worse than other technologies. It is simply one, albeit contemporary and witnessing, method among others. My fear that digital media will obfuscate and make abstract rather than advance approaches is not substantiated. The crucial point is rather whether one is able to leave behind the (infra) structures of encapsulation and self-mechanization (Google, the cozy room, etc.), and set out into the outdoors of the forest and "become a sensor."

BREATHING WITH A TREE

"How to regain empathy towards the non-human" is one of the questions that has been driving French artist Karine Bonneval for years.[93] All her works and exhibitions, with such telling titles as *Sometimes, I Hear the Plants Whisper*, can be read as attempts to become sensitive and to develop future organs and technologies of sensing. In *Listen to the Soil* (2018), she builds sculptural shells (amplifiers) out of clay that can be used to hear soil life. *Embrace* (2019) consists of ephemeral pieces of wood built around various urban trees that people can slip into and so embrace the tree. And in *Dendromacy* (2017), the becoming-together of trees, people, sciences, and technologies is demonstrated (fig. 10, 11).[94] Even

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[93]   Karine Bonneval, https://www.karinebonneval.com/eng/projets/dendromite-1 (accessed March 14, 2022).
[94]   Dendromacy or dendromité is a neologism and means "in intimacy with a tree." Ibid.
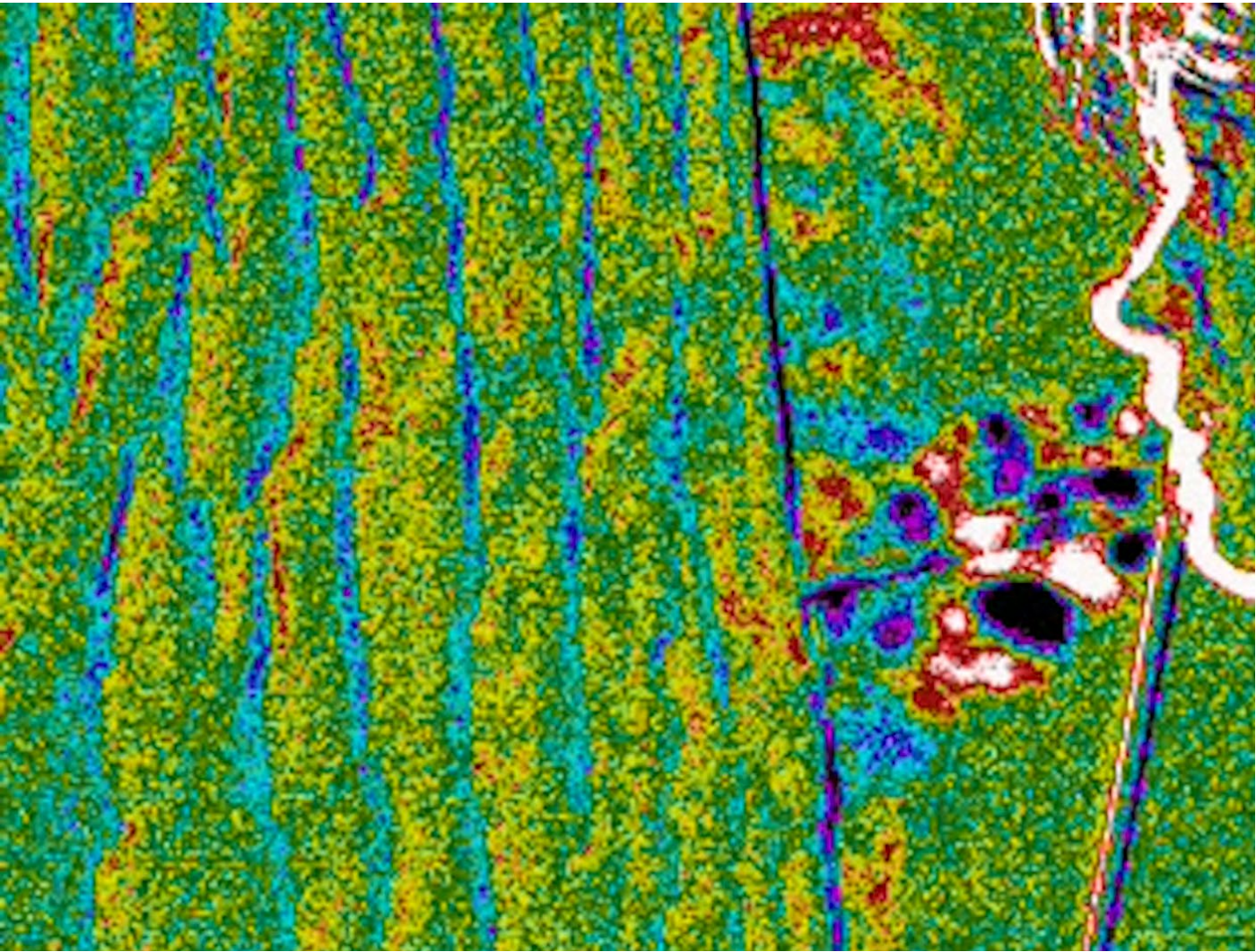
Fig. 11: Video still from Karine Bonneval, *Dendromacy*, 2017.

though Karine Bonneval was not directly involved in our research project, this exemplary project or the film about it is worthy of discussion here.

Dendromacy is a multi-part transmedia project that was created in a three-year collaboration with Claire Damesin, ecophysiologist in ecology, systematics and evolution, and microbiologist Ludwig Jardillier, both from the University of Paris-Sud. As with the projects from *Ecodata-Ecomedia-Ecoaesthetics*, it borrows closely from scientific methods used in forest research, but also appropriates them. The starting point was the measurement of the trunk respiration or rather the mutual breathing between artists and tree by using a temperature and measuring chamber. From a technical point of view, a measuring chamber is an airtight room that is individually adapted to the morphology of the tree, tak-

ing into account the aims of the experiment. For *Dendromacy*, Karine Bonneval installed two measurement chambers: a small one that protrudes from the trunk like a knob, and a large one that goes around the trunk and was accessible like an igloo. The artist entered it and interacted with the tree. The chambers were airtight such that the heat exchange that resulted from her breathing (and pointed to the release of CO_2) could be recorded and represented in a clearly visible way. To this end, she used a special cooled lens gas imaging camera. Such highly thermal sensitive infrared cameras can measure up to a thousandth of a degree centigrade and are used in industry for, among other things, the detection of gas leaks.[95] From these images, a 10' 22" film was created: a noise, red and blue tones, spots that move, change, a bright yellow-red finger strokes something blue, red

[95] https://www.flir.com/products/gf343/ (accessed May 22, 2023)

comes. Then vertical structures become visible. The yellow-red of a hand embraces these structures, it is the bark. When it is taken away, a red imprint remains. It becomes fire, flows over—the whole section of bark is now red. Then again from the beginning: blue bark, a yellow burning figure that gropes, grasps, embraces, leaves its traces. Like an infection, the red spreads, warms the tree, which absorbs the heat. We see the purple-blue grid of the igloo, the lump, a head, is this sex with the tree? In the next sequence everything is vibrating, green, pixelated. Waves, green, brown and blue diagonals, apparently the exhaled air flow, and there, yes, the same colors are found in the vertical structures, in what is the bark of the tree or the inside of the trunk, you don't really know because of the flatness of the image. Third sequence: a forest, same scenario in black and white. The lines and diagonals have become relief-like patterns, corresponding figurations that, despite the rhythmic movements, seem strangely immovable, as if carved in stone.

The film develops its own space, its own language for the oscillating touches between humans and trees, perceptible "only" to trees. It takes the CO_2 exchange, the ecosystem service to which trees are now reduced, and shows it as a transboundary intimate process of breathing, sharing, and becoming-together; visible only as abstract, relational and dynamic patterns. These are reinforced or disrupted by a sound whose instrumental, free-jazz-like character is based on sounds produced by pieces of wood and wooden musical instruments, emphasizing the more-than-human nature of this exchange.[96] Only by looking closely several times does one discover the minimal re/actions that also happen in the tree, revealing the whole as a reciprocal, resonant event. An act of love in which the species boundaries blur: ecstasies that seem unexcited and abstract. Molecular particle sex, exchanges of substances, chemistry, physics.

Technically, the film documents the exchange of heat between humans and trees, which occurs through touching and inhaling and exhaling. The thermal sensors of the camera used cannot measure the composition of the gases, but only temperatures and their changes. Because the camera resolves the entire event into equivalent heat patterns, each structure, each part appears as mysteriously connected to the totality, and

active. It is the transformations of colors, shapes, lines and their touches with sound that make up the actual event: breathing becomes the basic condition of vibrating being-with. This is information—aesthetic surplus—that both uses and transcends the usual framework of techno-scientific measurement. The central role of measurement is made clear not only by the measuring chambers and the optical gas imaging camera, but also by the geodesic semi-dome of the large measuring chamber: with its triangles, it provides the basic geometric structure for the rational recording of space. It is reminiscent of both igloos and utopian architecture: measuring is touching, which folds times, spaces and cultures into one another.

Perhaps the movements of the figure could be read as the (love) service of human to the tree. But this would also suspend the usual master-servant relationship between man and tree—in favor of concern for the fragility of this relationship. It is characteristic of the art of becoming environmental today that the artist-researcher assumes this role of care-bearing. She stages herself in her responsibility as well as in her embeddedness, she does not stand outside but in the middle of what is happening: as a human being as well as a figure in the picture that has become breath and tree, she is—inhuman and molecular—only lines, colors, spots. Molecules attempting to contact themselves and others. Here, too, then: concern through touch.

FABRICATE AND SPECULATE

How can one work together with forest researchers in a trusting way and at the same time question their dispositifs? Agnes Meyer-Brandis is an artist who has mastered the art of distorting scientific dispositifs to perfection. Her fundamental dis/belief in scientific methods and technologies precisely, but always lovingly, deconstructs unquestioned scenographies of the scientific or its subliminal glorifications in art and elsewhere. She does this by means of simulation and imitation, fabulation and speculation, and (self-)irony. This can be funny and fun, affects that have little place in eco-discourse.[97] Meyer-Brandis' engagement with forests and conifers, which spans several transmedia projects,

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[96] Soundtrack by Jean Michel Ponty.

[97] That is why I discuss her work here, even though she, too, was not directly involved in our research project. See http://www.blubblubb.net/OneTreeID/index.html (accessed March 30, 2022). Nicole Seymour laments the lack of irony and wit in the eco-debate and argues for *Bad Environmentalism*.

Fig. 12: Agnes Meyer-Brandis, *One Tree ID—How To Become A Tree For Another Tree*, 2019.

goes back to a residency at the Station for Measuring Forest Ecosystem Atmosphere Relations in Hyytiälä, Finland. While there, she also encountered VOCs.

Her project *One Tree ID—How to Become a Tree for Another Tree* (2019) (fig. 12) is based on the realization that each tree has a specific composition of VOCs that form something like a personal "cloud." From this, she wanted to create a perfume for humans to initiate a molecular, cross-species dialogue. Measurements on roots, trunk and leaves by the Biochemistry Institute for Bio Sciences at the University of Rostock were able to detect around 100 different substances as part of the project. However, since these volatile components cannot be broken down 100% technically, a perfumer was called in to determine them more precisely, "to smell the tree. The collected machine data and nose data /sense data were fused to create the perfumes *Cloud of the Roots, Cloud of the Tree Stem, Cloud of the Tree Crown,* which then [...] led to the synthesis of the *One Tree ID* perfume."[98] Visitors to the exhibition can apply the perfume to themselves and exchange scents with it. In doing so, they not only smell nothing, but also cannot perceive potential approaches of the tree or their own search movements. These take place on a biochemical level and thus on a level that is not accessible to human consciousness. In fact, the installation seems to address primarily the tree and not the human audience: it "degrades" the latter either into a relational being of molecular mixtures that afflicts trees, or into distanced spectators to whom the workings of the installation are explained. The installation itself is both an experimental set-up and a visual layout of its components. It consists of a table in the shape of a cloud, on which are the perfumes that can be applied, and a coniferous tree in a pot. Its "clouds" are measured with tubes and differently shaped measuring chambers: a gas chromatograph with a mass spectrometer, also placed there, evaluates them for the purpose of perfume production. Since the "clouds" are dynamic, a new perfume is produced every day. It remains indeterminate where this happens. A start button on the table allows the visitor to mark the moment when the perfume is applied and becomes bait. While this technology or procedure is not yet available, according to the artist, it would serve to evaluate communication behavior as soon as suitable measurement methods were available for this purpose.

The installation with its promise of a living communication happening is exciting; the focus on more-than-human entities and processes timely. Concomitantly, it

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98   Agnes Meyer-Brandis, project description, http://www.blubblubb.net/OneTreeID/index.html.

contains many unclear moments that are left uncommented upon: is the term *cloud* also applied scientifically in this context, or did the artist herself coin it because it fits her years of cloud research? What does a "cloud of one's own" mean anyway if the whole thing is always in dynamic motion and never quite identical with itself as a result of the volatility of the VOCs? And what about the contradiction that the tree in principle only traces its "own" fragrance cloud when it engages with a perfume wearer? Furthermore, it is also not clear in what time scales the tree lives, whether it can react at all in the available, short-cycled human interaction time. And why are we allowed to see everything accurately, but not the production of the perfume? This unresolvedness is a strategy. It is "a basic approach" of hers and her Institute for Art and Subjective Science, says Agnes Meyer-Brandis, "to create questions and not provide explicit answers."[99] That this is a differentiated and not an escapist attitude is evident from the fact that not only are there no simple answers, but the project also consists of different versions that have different aspects and implications.[100] In addition, the fact that these questions only arise at all if one seeks to understand how the setting works and is not immediately satisfied with everything that is said about it complicates further. With and through the installation, which we trustingly acknowledge and of which we are a part, a desire can arise at the same time—a wish to understand it and to question its dispositifs and ranges. In a certain sense, we can train ourselves here in the seemingly contradictory gift of becoming both open to opaqueness and the other, as well as getting to the bottom of things and wanting to know more. It is a mode of searching, that, as the dialogue with the WSL reveals, scientists also apply. It can even become a strategy of political activism. That public questioning of our politicians, of "those who can be characterized as our guardians today," can be an act of resistance has been demonstrated by Isabelle Stengers using the example of European GMO activism.[101]

Thus, the title *One Tree ID* also reveals itself visibly as a homogenizing construction, in order to produce a personal unity and identity "conifer" from the many volatile clouds. In contrast, however, this phantasm also enables the tree to become a subject, to be recognized as a singular living being. Contradictions appear here, too. Further, the question remains whether quite brilliant artistic research is taking place here, participating in the worlds of trees—beings of which we hardly know anything despite our relations—or whether the conifer here is not rather a pitiable creature: severed and potted, it stands as an isolated laboratory object in space. Whether the tubes with which its VOCs are measured, are tapped and the vapors condensed into perfume, or the scents create compounds that are cut off at the roots remains open. Combine that with the fact that one doesn't really feel at home in this white cube/laboratory of interspecies communication. What the tree senses, we do not know, despite sophisticated measurement technology. That a Technology of Sensing does not work at the push of a button in a precisely measured time scale is made clear by the awkward approaches of the audience. They seem like a paraphrase of interactive media art of the 1990s. The scenario also suggests that a jointly felt and filled moment might not even need the elaborate infrastructure if, as in the case of the perfumer, simple "nose data / sense data" apparently already provide the missing link for missing information. And that the tree would perhaps also interact with you in this way, regardless of whether you are wearing its cloud or not, namely through the mere fact that we are on site and not not there, is also left open by the experimental arrangement.

However, *One Tree ID—How to Become a Tree for Another Tree* clearly brings one question into focus, both in terms of the installation and the subtitle: if becoming a human tree in the dominant culture can only be achieved through the exploitation and commodity production of the tree, how can trees and people come together at all? *A tree for another,* the cryptic subtitle could not be more precise in its poetry and criticism. Three readings suggest themselves: first, the installation attempts via scientific and subjective methods to awaken empathy for the more-than-human and to enable our becoming a tree. Second, it poetically and critically exposes extractivist methods—colonial appropriations about which we must be seriously concerned. And third, precisely because there are no simplistic solutions, this needs to be looked at and worked through. It is characteristic of

99   Agnes Meyer-Brandis in an e-mail to Yvonne Volkart, March 23, 2022.

100   Thus, in addition to the installation, there is also a fleeting "urban guerrilla version with a DIY kit, in which there is a perfume sample. One can walk with it from tree to tree." In this version, you have more freedom to approach the respective trees and play with the different scents and network.

101   Stengers, *In Catastrophic Times*, pp. 35–42, here p. 35.

Fig. 13: Agnes Meyer-Brandis, Tealemetree Station with *Teacup Tools,* Hyytiälä, FI, 2014.

the fabrication and speculation of Agnes Meyer-Brandis and her Institute for Art and Subjective Science that it evokes such im/possible dimensions but does not explicitly "say" that it is, to stay in her figurative language, "cloud." Science and its ways of "observing," even possible commissions by industry are not criticized; on the contrary, the artist acknowledges the scientific achievements as a different way of understanding and dealing with "nature." Yet she interferes. The questions that are thereby raised become politically relevant: do we really need cybernetic circuitry and Big Data for people and trees to come together?

That this is a fundamental question for the artist is revealed by other works from her engagement with forests, such as *Teacup Tools* (2014) (fig. 13). This multifaceted project also contains at its core a measuring and communication device. It measures the cloud above a cup of hot tea, but also, and this is the charm of the cup apparatus, prepares and serves tea. This is heated up by the waste heat produced by a computer analyzing enormous amounts of data. (A kettle standing nearby seems to give the lie to this claim). Depending on the data

structuring, a choreography is created that makes the cups dance. Furthermore, the cups are interconnected as a *Global Teacup Network (GTN)*. The hybrid measuring and (tea) production system becomes a docking station for all those who want to drink tea together and exchange ideas, a transcultural, timeless ceremony of hospitality. At Agnes Meyer-Brandis', tea can be drunk wherever trees are measured: in the middle of the forest, on a noisy city street, in the park. The "tea" is a mixture of everything that happens to fall into it—pine needles, aerosols, fine dust, rain, literally waste. In addition to the poetic wit of these self-enacting tea cups with their diffuse brews, it becomes clear that people and others like nothing better than to come together and exchange ideas. For all the irony regarding possible machine fetishism in the art + science field, the apparatus and its nomadism can also be taken literally: as a gesture of hospitality. Itself the guest of trees and scientific institutions, it celebrates the mixing of materials and sharing of knowledge wherever you are.

ART AND SCIENCE AS TRANSMAKING OF THINGS

The practices described here represent a way of dealing with data and technologies in which artists see themselves as accomplices of the sciences. Infected by a concern for the forest, they search for common ground. They appropriate techno-scientific methods, such as measuring, data collection, establishing an experimental set-up, visualizing and interpreting data, and so on. In so doing, they continue the activity of observing and experimenting, searching and opening up non/knowledge about trees by aesthetic means. These are artistic practices of repetition and translation that, for all their affirmation, do not open up without gaps. Rather, they create and thematize differences, surpluses. As translations, they are perpetual "distortions" whose strength lies in making things foreign, becoming foreign.[102] Project partner Andreas Rigling of the WSL supports this assumption when he says: "Rasa Smite's work for example is inspiring to us because it is both a completely different interpretation of this forest which we know by heart, and a revealing of the fascination of the trees and the forests."[103]

Thus, scientific methods of measurement and their interpretation become eco-events,[104] which include people as nodes and actors, but do not prioritize them. Instead of following numbers, curves and diagrams, the audience can become part of vibrating events whose strange opacity touches or even enchants. With Walter Benjamin, one could say that these artistic activities of translation evoke "the echo of the original," a process that leaves the original not unmolested but retroactively different.[105] But what is the "original," in a scientific scenario that studies trees? Certainly not the tree in its treeness. Rather, the tree, cyborg, diffracted by the observatory and the knowledge about trees gained from it. The artistic "echo of the tree" thus makes clear through its mediality and "falseness"—insofar as an echo is always an aping of the supposed original—that there is no undisguised access to an untouched original (tree). At the same time, it does not give up—it seeks and problematizes and affects the ontology of the tree. And finds radical transbecoming: (species)transcending couplings, possibilities of tree-being that operate or await fulfillment in the "tree" under investigation.

The value of artistic practices of translation, distortion, and alienation, especially when they see themselves as accomplices in scientific research, does not lie in the visualization of scientific results and findings. Nor does it lie only in the transposition of "cold, abstract data" into a language that touches and (politically) activates.[106] Rather, it lies in transducing, in trans-making, in making things indistinguishable and undecidable. And it lies in the disturbing effects that such acts of disfiguring and foreign-making trigger: in the creation of cross-species commonalities where only othering prevails in the dominant discourse; in the *dissémination* (Jacques Derrida) of certainties around the fabrication of knowledge, in our expulsion from the safe zones of teaching and learning. The artistic practices of super-setting the knowledge of the forest transfer us into a becoming-exposed in and as the forest. In doing so, they aesthetically contribute to what is at the core of science, art, and indeed life: confronting unpredictability. At the same time, they destroy what scientific measurement is supposed to do: predictions of a calculable future. They remind us that measurement itself is a form of translation: transposing the world into numbers that guarantee repeatability and thus understandability and facticity. Kelvin's statement, which precedes this chapter as a motto, ties knowledge to numbers and their measurability. In his worldview, only rational knowledge counts as true knowledge. Actions, like touching and feeling can only be "of meagre and unsatisfactory kind."[107] Kelvin is often quoted in engineering and industrial contexts

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[102] According to Barbara Johnson, who refers to Walter Benjamin and Stéphane Mallarmé, among others, translation is perpetual disfiguration; it is in the alienation and defiguration of the mother tongue that the strength of translation lies. Barbara Johnson, *Mother Tongues: Sexuality, Trials, Motherhood, Translation* (Cambridge, Mass. and London: Harvard University Press, 2003).

[103] Andreas Rigling in the video interview (long version) on the *Ecodata-Ecomedia-Ecoaesthetics* project website, https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-iagn/ecodata-ecomedia-eco-aesthetics/forest-science (accessed August 18, 2023).

[104] With the term event, I make reference to Stengers' *In Catastrophic Times* and Puig de la Bellacasa's "Making time for soil." Both use *event* in its etymological meaning, from Latin *evenire*: "to come out," "to happen." It is the evolving becoming-into-being from an ecological and political perspective.

[105] Walter Benjamin, *The Translator's Task*, trans. Steven Rendall, in *TTR: traduction, terminologie, rédaction* 10(2) (1997), pp. 151–165, here p. 159, http://id.erudit.org/iderudit/037302ar (accessed May 18, 2023).

[106] See the citation by Brian Holmes in Chapter 1 of this publication, p. 11.

[107] Kelvin, "Electrical Units."

that aim at repeatability and predictability, at creating certainties and securities of complex physical processes qua industrial technologies.[108] But if we follow another track, for instance Karen Barad, whose argument draws from feminism and particle physics, measurement is always touching, and touching is always "an involution, invitation, invisitation." "What is the measure of closeness?"[109] is the rhetorical question at the beginning of her text, which attempts to confront the unanswerability of what relationality can be. She ends it with a plea for materialities to become together:

> Living compassionately, sharing in the suffering of the other, does not require anything like complete understanding (and might, in fact, necessitate the disruption of this very yearning). Rather, living compassionately requires recognizing and facing our responsibility to the infinitude of the other, welcoming the stranger whose very existence is the possibility of touching and being touched, who gifts us with both the ability to respond and the longing for justice-to-come.[110]

Karen Barad's plea for touching, for allowing alterity and the resulting bodily form of responsibility, gets to the heart of what the interplay of art and science can open up: allowing the radical strangeness and unpredictability of our modes of existence as we explore them. Also to the point is what has changed in the techno-ecological art practices of the last 15 years: practices around *Ecodata-Ecomedia-Ecoaesthetics* have become *Technologies of Care*.[111] Basically, ecomedial strategies of translating data from non-human spheres into human levels of perception still play an important role today. At the same time, the differences, surpluses, and coincidences that occur through these media-aesthetic transpositions come more into view, revealing themselves as generative, more-than-human ecosystems in which many actors are responsively involved. Ecomedial signal transpositions have shifted to relational strategies of intervening, cooperating, and becoming-together; building and maintaining cross-species relationships has become central. In all the projects discussed here, sensing technologies are always also technologies of sensing. They track *and* accompany actors such as chemical molecules, bird calls, or human hands in order to make their existence as singular modes of existence in entangled contexts tangible. Ecomedial, data-based strategies have morphed into aesthetics of participation and sharing that are not afraid to develop empathy towards non-human living beings. The works cited here do so with a relatively cool-looking, techno-affinity presentation setting, as if the question of caring had to be brought not only into art but also into the technosciences, or everyday life with its technogadgets. At the same time, this aesthetic "coolness" gives the audience the necessary space to establish empathetic relationships. After all, projects that are about sensing, empathy, sensitivity, love, affect, and so on always run the risk of becoming pathetic or talking things to death. On the other hand, creating contradictions, as presented here, are aesthetic methods that create unrest. Perhaps that is why they are able to affect more than those that want everything to be understandable.

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[108] For example, in a presentation by a speaker from 3M: https://www.nist.gov/system/files/documents/2018/01/09/burns-applying_weathering_science_to_predict_the_future_-_the_reliable_approach_to_estimating_product_service_life.pdf (accessed May 22, 2023).

[109] See Barad, "On Touching," p. 1, and Chapter 1 of this publication, pp. 7 sq.

[110] Barad, "On Touching," p. 10.

[111] In 2018–2019, we three curators of *Ecomedia*—Sabine Himmelsbach, Karin Ohlenschläger and I—again curated a joint exhibition in Basel and Gijon on the topic, where we wanted to find out what had changed, as with the ongoing SNSF research project *Ecodata-Ecomedia-Ecoaesthetics*. See footnote 3.

EXCURSUS—
PERSPECTIVE OF FOREST SCIENCE IN THREE PARTS

In this section, some of the concerns, topics, and methods of our research partners of the WSL involved with the Pfynwald are discussed.[112] Its goal is to provide a more specific background to forest science, and the way they work with data, as well as to strengthen the many-voiced and, as Andreas Rigling pointed out, "controversial" approaches to "the forest": "In general, the exchange between us, the natural scientists, and artists, is stimulating, because artists come from completely different positions. They have different views, different technologies, also different expectations towards or of forests, to climate change and to our data. Different worlds muse about the topic… this, let's say, controversial discussion and this controversial approach to the same topic, is extremely important."[113]

From 2019 to 2022 various conversations, video interviews and e-mail exchanges between the team members and the partners of the WSL took place. The following excerpts are taken from Rasa Smite's video interviews with Andreas Rigling and Arthur Gessler (2018–2019), and Yvonne Volkart's e-mail exchanges with Arthur Gessler and Kaisa Rissanen (2022).

Andreas Rigling is a forest ecologist. He is professor for "Forest Growth and Global Change" at ETH Zurich. From 2009–2022, he was head of the research unit "Forest Dynamics," and member of the directorate of the Swiss Federal Institute for Forest, Snow and Landscape Research. Arthur Gessler is director of the Long-term Forest Ecosystem Research (LWF), group leader for Forest Growth and Climate, and adjunct professor at ETH Zurich. Kaisa Rissanen was at the time of writing visiting doctoral candidate from the University of Helsinki, and investigated the Biogenic Volatile Organic Compounds (BVOC) release of 6 trees in the Pfynwald.[114]

PART 1: RESEARCH PLATFORM PFYNWALD—*FORESTS IN A DRYING AND WARMING WORLD*

Andreas Rigling: The WSL is a federal institution which is among others responsible for the monitoring of terrestrial ecosystems in Switzerland. Climate change, and its effects like heat and drought, is one of our main topics. In my research area—forest dynamics—we investigate their impact on forests and their functioning; we do so for science and its application.

In 2003, we started our research activities in the dry environment of the Pfynwald, because we realized that drought is becoming more and more threatening to the functioning of our forest ecosystems. We started an irrigation experiment with the goal to reduce drought stress. We wanted to compare the functioning of the trees which suffer from natural drought with those which are growing in improved conditions. We were the first at that time to start such a climate change experiment, which has run now for almost twenty years—it will end in 2030—and we have generated a remarkable data set, which is very interesting for the scientific community.

2003 was one of the driest years of the past decades. The idea was to irrigate a large area in the pine forest to be able to analyze the response of an entire forest ecosystem and not just of a few trees only. Therefore, we have almost one thousand trees in the experiment, half of them are irrigated every night during the growing season, and the other half is not irrigated, acting as a control site. Artificial irrigation lasts from April to October, with the aim of doubling the normal annual rainfall.

The Pfynwald irrigation experiment is unique: first, because we have now completed almost 20 years of

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112 For a short summary of the Pfynwald, see pp. 39 sq. in this chapter.

113 Andreas Rigling in the video interview with Rasa Smite, "Forests in a Drying and Warming World" (2018), see website: https://www.fhnw.ch/de/forschung-und-dienstleistungen/gestaltung-kunst/forschung/forschungsprojekte-iagn/ecodata-ecomedia-ecoaesthetics/forest-science (accessed May 18, 2023).

114 See all video interviews on the project website; Kaisa Rissanen "How drought affects resin in Scots Pine," https://www.youtube.com/watch?v=Z8crVHuVbPM; Kaisa Rissanen et al., "Drought effects on volatile organic compound emissions from Scots pine stems," *Plant, Cell and Environment* 45(1), (2022), pp. 23–40, https://doi.org/10.1111/pce.14219 (accessed May 11, 2023).

irrigation, allowing for an analysis of long-term acclimation and adaptation—nobody else has such a long experimental time; second, because of the size of the experiment with the almost one thousand trees, which allows us to study the whole system response. There are other irrigation experiments: one is in Israel; another is developing in France. But overall, there are very few similar experiments worldwide.

These years of irrigation have provided us with a better understanding of the resilience of our forest ecosystems—in this case the pine forest—to drought and to varying water supply. Now we learn how flexibly our forest can react to changes in water availability, from extreme drought and drought release. Such long-term experiments are crucial to improve our system understanding, but they are also very important to optimize our modelling approaches, to upscale from a single tree to an entire forest stand, to generalize from one tree species to another, and to test the response to different drought scenarios, which might become reality in ongoing climate change. Hence, the Pfynwald experimental platform, which combines experimental with modelling approaches, is a window onto the future of this pine forest but it also broadens our understanding of forest functioning in a European context.

In the past few years, we focused on the extreme sides of forest dynamics: we focused on the cold limited forest ecosystems at high altitude and latitude, where increasing temperatures induced by climate change are pushing the limits: the forests are expanding to the north and to higher altitudes, tree regeneration is favored, the trees are growing better than in the past and the whole forest dynamics is changing. And we focused on the drought limited forest ecosystems, as in Pfynwald. And in-between? What is the impact of climate change on more moderate ecosystems? They are highly relevant not only because they grow in large areas in Central Europe, but also because they produce many ecosystem services of utmost importance for people, including, for example, timber, clean water, and recreational areas, and they are real biodiversity hot spots. So, we currently move from the dry pine forest and the tree line ecosystems to the more moderate mixed species forest ecosystems and we try to learn from our experiences from the extremes. This is one new topic.

From our Pfynwald experimental platform we learnt that only the whole systems approach allows for the study of interactions between individuals. Hence, we intend to focus in the coming years more on interactions between species and trophic levels. We want to expand from cold, drought and heat in the forests to pests, diseases and generally to aspects of functional biodiversity.

PART 2: IOGENIC VOLATILE ORGANIC COMPOUNDS

Yvonne Volkart: *Rasa Smite's project relates to your research on Biogenic Volatile Organic Compounds, VOCs for short, and the symptom that pine forests appear to both increase and decrease VOC emissions under drought stress. What are VOCs and what is resin?*

Arthur Gessler: Most trees emit VOCs—these are low molecular weight compounds such as acetaldehyde, acetone, methanol, or terpenes; the latter are also the volatile components of resin which contains other more solid substances such as rosin (colophony) and resin acids. Volatiles are part of the defense system against heat, pests, and diseases of trees, and also serve as means for communication between trees. The tree produces resin and stores it in the resin ducts in bark and wood. So, if there are small subtle injuries, for example, bites by beetles in the bark, then the tree can defend itself by releasing the resin, which is partially antibiotic and antiseptic, but also a mechanical protection against the beetles. VOCs are emitted from leaves and needles, as well as from the trunk through the resin. In the atmosphere, they contribute to the formation of aerosols and thus to air pollution, but also to cloud formation. Therefore, they affect the climate.

Kaisa Rissanen: Because of the effects that VOCs have on the climate and air quality, it is important to understand quite precisely where, when, and how much VOCs are emitted.

AG: In the Pfynwald, we have control sites, which are exposed to very dry conditions, and we have irrigated plots. The idea was to examine how irrigation and, thus, drought release would affect the emission of volatile compounds, which play an important role in trees' defense against pests and diseases.

YV: *What are your results and in what way do they contribute to state-of-the-art research?*

KR: We know that the amounts of VOCs emitted into the atmosphere from plants and soil varies from one biome and ecosystem to another, and that forests generally have large VOC emissions because of their dense foliage. However, until recently we have paid little attention to other compartments of the forest than the tree foliage. In our research in Pfynwald, we could show that the pine stem with its resin is also an important emitting organ especially in stressful situations. This is a new

insight and an innovative contribution to international research.

YV: *Kaisa, unlike other research on VOCs, you specifically explore VOC emission via resin and stem. So, what exactly is the role of resin? Does climate heating enforce resin flow in conifer trees, or is resin flow accidental?*

KR: In conifer trees, resin exists to block bark beetles or other pest insects from entering the sugary phloem tissues beneath the tree bark, or from eating tree needles. It is a mechanical barrier due to its high pressure, and it also contains compounds that are toxic to insects in high concentrations. As Arthur mentioned before, it also seals wounds on the bark surface and prevents fungal infections. In many areas of the northern hemisphere, climate change may provide more opportunities for bark beetles. Thus, the defence capacities of the tree resin will be tested more and more, which may in turn increase the VOC emissions from exposed resin.

YV: *Did you measure the VOCs which the resin released? And did you compare it with the VOC emissions from the needles?*

KR: We compared the composition of VOCs in the stem emissions via the resin and in extracted stem resin to see if the resin was potentially an important source of the stem VOC emissions. And indeed, the composition of VOCs called monoterpenes were similar between the emissions from and the resin in the stem. When we did the same analysis for needles, there was more variation between the emissions and the extracted resin. This was expected because according to earlier research an important component of the VOC emissions from the needles comes from recent production on top of the release from resin storage.

YV: *What were your methods and technologies to measure the emissions?*

KR: We captured the VOC emissions from the Pfynwald pine stems with measurement chambers around the tree stems made of plastic. We used meters and meters of tubing to feed ambient air into the chambers and to pull air from the chambers into an instrument that analysed the concentrations of defined VOC groups in the sample air. The instrument was a commonly used gas-analyser called a proton-transfer-reaction mass-spectrometer, or PTR-MS. In this way, we monitored the stem VOC emissions of 6 Scots pine trees–3 dry trees and 3 irrigated trees, over the whole summer of 2018.

AG: With a PTR-MS, the VOCs are ionized, i.e., converted to charged particles, then accelerated in an electric field and separated in a magnetic field according to their masses, and the amounts of the single compounds are quantified with a sensor. The quantity is calibrated using standards of different concentrations. The measurement takes place almost in real time. To detect different monoterpenes, a gas-chromatograph mass-spectrometer (GC-MS) can be additionally used. Using a chamber containing a known area of a stem or of leaves and applying a defined gas flow from the chamber to the PTR-MS it is possible to investigate how many different VOCs are emitted per square meter of the plant surface against time. These data are then correlated with environmental parameters (temperature, soil moisture, etc.).

YV: *If I understood your results well, then we can observe two somehow contradictory events: if drought and heat is increasing, then the emission of VOCS is decreasing, as if all life were slowed down. Nevertheless, I got the impression that climate change (that is, drought and high temperature) increases the emission of VOCs. Can you expand on this?*

KR: Yes, let me talk first about the drought effects:

In our results, we saw that increasing drought stress towards the end of the summer generally reduced the VOC emissions from the tree stems. According to previous research on VOC emissions from foliage, severe drought can reduce the VOC emissions. This is because drought slows down photosynthesis—the conversion of light, water and carbon dioxide into oxygen, sugars and starch. Therefore, drought decreases the availability of sugars and starch for VOC production. However, there were big peaks of certain VOC compounds from the trees on the dry plots that could originate from resin leaks and extreme stress conditions of these trees.

Second, heating effects, in combination with drought: in the heating climate, the effects of increased temperature, drought and higher CO_2 concentrations will interplay in their effects on forest VOC emissions. Higher temperatures cause higher VOC emissions because they increase the volatility of the compounds, and potentially also because of the trees' need to protect themselves against heat stress, which also occurs via VOCs. Drought can either increase or decrease emissions as also shown by our research, depending on the time scale and the severity of the drought stress. Heat and drought can also increase the activity of pest insects, which can cause large peaks in the emissions of VOCs that are directly related to tree defence against biotic stress.

Third, effects of increased carbon dioxide: on the other hand, there are indications that increased CO_2 concentrations can suppress the emissions of certain VOCs, such as isoprene, at the scale of one leaf but not necessarily at the scale of the whole tree. Because this effect offsets the effects of increasing temperature, it is possible that the VOC emissions increase less than expected based on the higher temperatures only.

YV: *These correlations between climate change, intrusion of bark beetles, production of more resin and more VOCs seem to be a good example of the interactions between the climatic variables and biotic agents such as pests and diseases about which Andreas Rigling spoke in the beginning: interactions or correlations seem to make the complex things even more complex.*

KR: Yes, the interactions between many environmental factors and tree responses make things more complicated—and more fascinating... at this stage of research we don't necessarily understand the mechanisms of the potential causations between them.

YV: *What do you say to some popular articles which call trees the new ticking time bombs?*

AG: In the end, I think there are still a whole lot more positive effects than negative ones of trees.

PART 3: DATA

YV: *The long-term surveys of your Pfynwald research station are unique, among other things, because they provide relevant data on forest dynamics. What is relevant data and how is it generated?*

AG: What constitutes relevant data is difficult to define and depends on the research question. First, the data must provide information that is useful for a particular question and for testing hypotheses. This information is not always obvious and one needs *a priori* knowledge to be able to read it. Of course, there is also the possibility to analyze all available data, for example, those about an ecosystem, and find patterns that might reveal new, yet unknown relationships. This so-called hypothesis-free approach was found very often and is still found to some extent in systems biology. For example, there are huge data sets on gene expression, but not all genes and their functions are known. So you do an experiment (for example, heat stress, dietary change), look at the resulting

patterns and generate new hypotheses, which are then tested in more detail.

YV: *That means that you in forest research, in contrast to systems biology, proceed in a less hypothesis-free way?*

AG: We work mostly hypothesis-driven. As part of such a hypothesis-driven experiment, we sometimes look at patterns, such as in our drought stress experiments with trees. We're doing analyses of how drought stress affects metabolites. That's where we analyze hundreds of compounds, look at the patterns, and try to explain changes in the concentration of metabolite groups *a posteriori* and based on the scientific literature. If we find something interesting, we look very closely at a particular metabolic pathway, for example. But important for the relevance of data is also the data quality.

YV: *How is quality defined, then, as distinct from relevance?*

AG: Relevance is basically about whether the data sets are suitable in terms of content to test the hypotheses. If the hypothesis is heat reduces photosynthesis, then I have to measure relevant data on photosynthesis. In this case, data on root growth are of no use for the time being. Maybe as additional data, but not as a core data set. Quality, on the other hand, implies reproducibility, number of samples and, in the case of time series, also consideration of data gaps or sensor drift: that is, the deviation in measurement accuracy due to wear or contamination of the sensors. Because of this, sensors are regularly calibrated (adjusted) with standardized measurement results in order to correct this drift.

YV: *What creates more relevance and quality, the type of survey before or the intervention after?*

AG: For testing hypotheses that are based on or derived from *a priori* knowledge, structured surveys are usually most helpful, but not always available. Often, especially if you want to test new hypotheses, you also have to use past, long-term data—simply because you need long time series for testing. Then you have to take what is available, and these are often heterogeneous and also very large data sets. There are new, so-called data-model-fusion approaches. In these, known mechanisms are implemented in mechanistic models and these models are fused with complex and heterogeneous data sets. The data is then used to repeatedly compare the model results with "reality" and to trim them to the data.

YV: *"Matching with reality and trimming data" means making new experiments and collecting data for them in turn?*

AG: Not necessarily in this case. Models are usually calibrated with data and validated with further test data, which are often already available. Trimming data means that model results are compared with existing data after one or more model runs and the model results are adjusted (within a certain framework) to the measured values. For example, tree growth in Switzerland can be modeled in this way. In the data-model-fusion approaches mentioned above, the model is additionally compared and trimmed at regular intervals with existing (growth) data on different plots, because the model should not deviate too much from reality: The model is trimmed with data from (many) individual stands. With such a model, which is always set against different realities due to the many locations, the whole area of Switzerland can be described—even places for which no data are available. For such model-data-fusion approaches, we have also already used very heterogeneous data series.[115]

YV: *How clear are data, for example, on Volatile Organic Compounds?*

AG: The data first show how many VOCs are emitted over time. In a further step, we use statistical models to try to quantify the influence of different environmental factors on emissions and to find correlations. And then we test, for example, whether increased VOC emissions can be found at higher temperatures.

YV: *What are correlations?*

AG: By correlations, I mean statistical relationships between two or more variables. However, correlations do not mean that mechanistic, i.e. causal, relationships exist: correlation is not necessarily causation.

YV: *Already above you used the word "mechanisms." In art, mechanistic has a negative connotation because it is reductionist (input-output). This does not seem to be the case with you.*

AG: Exactly—we always try to recognize mechanisms, be it differential equations in mechanistic models or probability distributions in statistical models. This is in contrast to the black box, which we use for pure input-output representations, without being able to see what is happening inside the box. In molecular biology, for example, to understand mechanisms in the plant, we turn off a gene and study how that affects the plant's appearance and function. In an ecosystem, studying mechanisms is more difficult because so many different factors (not all of which can we even measure) interact. That's why we often use models that describe the system as simply as possible but also with as much complexity as necessary.

YV: *How do you find correlations? And how do you deal with the inconsistency of data?*

AG: Correlations can be (a) discussed by *a priori* knowledge about possible known mechanistic relationships or (b) investigated by further experiments. In such experiments, at best, only one potential (environmental) parameter is changed and the effect on the target variable is investigated at as many different levels as possible; for example, from gene expression to physiology to growth. Such experiments can be partially simulated with statistical methods. We test hypotheses and try to falsify them. If the data require rejecting the hypothesis, we have to reformulate the hypothesis; if we cannot reject it, the result goes into the state-of-the-art research and is used to derive further hypotheses. The goal is always to challenge the state-of-the-art research: unclear statements need more data and more experiments.

YV: *Do you try to understand reality with the data you collect, for example, about VOCs, or do you simulate future scenarios with them? And how do you create comparability and meaningfulness?*

AG: We try to understand principles based on a concrete case and then generalize them in a next step. Models are very good tools to test generalized hypotheses. The mechanisms in models are actually complex hypotheses that are then let loose on reality. If they describe reality well and not just special cases, they can be used for projections.

YV: *By projections do you mean hypothetical ideas?*

115 See our paper, Volodimir Trotsiuk et al., "Assessing the response of forest productivity to climate extremes in Switzerland using model-data fusion," *Global Change Biology* 26 (2020), https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15011 (accessed May 29, 2022).

AG: Projections are quantitative "predictions" made by models for certain defined framework conditions (scenarios). Nonetheless: "All models are wrong, but some are useful" (George E. P. Box).[116]

YV: A lot of eco data is used to make catastrophic predictions. You seem to be more cautious, maybe more modest. How so, and what is your concern with the data? Is the change in the Pfynwald a catastrophe from your point of view, or in what way would you describe it?

AG: I don't see that the predictions are too catastrophic. The Earth System Climate Models describe the changes in climate and biosphere (for different CO_2 emission scenarios) as the current state of knowledge allows. Interpretation is tied to what is perceived to be acceptable or unacceptable to us humans.

The same with us at WSL. We will soon submit a paper which considers it very likely that in the not too distant future the pine stands in valley locations in the Valais will collapse. This will lead to problems there with the function of the forests as protective forests—probably not a problem for the forest ecosystem *per se*, but rather for us humans. It's a question of frame of reference. We try to process such information for the public[117] and also to advise politicians.

YV: You say "probably not a problem for the forest ecosystem per se": can you elaborate on that? Do you mean if in the Pfynwald the (pine) forest goes, another forest comes and this is actually not a problem from the perspective of the non-human beings living there, because they then also move on? But isn't this very circumstance hugely problematic in other places because it leads to massive species extinction and loss of biodiversity and is therefore a highly anthropocentric view?

AG: That is difficult to answer and certainly always anthropocentric: but disturbances are normal in nature. What is extraordinary at the moment is the speed of the change or disruption and that it is global. But if you look at the history of the Earth, there have already been several global catastrophes that led to mass extinctions. Maybe now man is the catastrophe. But, "life finds a way" (Ian Malcolm played by Jeff Goldblum in *Jurassic Park*[118]).

YV: What is your primary "concern" at WSL, or what is your primary perspective: human / social / political or forest?

AG: I can only speak for myself: I try, as far as possible, to find objective knowledge—in the sense of Karl Popper's evolutionary epistemology. I do that first absolutely without prejudice, in order to then show in the next step on the basis of these realizations the consequences of human behavior. But political decisions have to be made by others.

YV: WSL admits that things don't always turn out as expected, for example in the case of acid rain. How is it that you made assumptions that are "false" from today's perspective? Did you learn from this to deal differently with predictions, or is that simply part and parcel of research that you don't know exactly how things will develop?

AG: The "forest dieback," and the fact that it did not happen, is above all a success story that shows how science and science-based action in politics can avoid worse events (as was also the case with the hole in the ozone layer). There was perhaps a bit too much alarmism among some or rather a few scientists, but definitely not in general. In terms of publicity, it was rather a lesson in "there is no glory in prevention."

YV: Does that mean that politicians reacted to your proposals and took measures that prevented forest dieback in Switzerland? If so, what measures were these? And would that mean that we should actually celebrate that, since this successful interaction of science and politics has never been fully appreciated, but that we are already on to the next catastrophe, such that the appetite for celebration has passed?

AG: I say again "there is no glory in prevention": precisely because events have not occurred—among other things, because avoidance measures have been taken—criticism is very vocal, as the example of the Corona epidemic also shows. At that time, it was easier because relatively simple and inexpensive measures could contain acid rain (flue gas desulfurization and denitrification, catalytic converters on cars, and so on).

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116 George E. P. Box, "Science and statistics," *Journal of the American Statistical Association*, vol. 71, issue 356 (1976), pp. 791–799, https://doi.org/:10.1080/01621459.1976.10480949 (accessed July 12, 2023).

117 See "Forest functions and climate change," National Centre for Climate Services, last modified December 15, 2021, https://www.nccs.admin.ch/nccs/en/home/the-nccs/priority-themes/forest-functions-and-climate-change.html (accessed May 10, 2023).

118 *Jurassic Park*, directed by Steven Spielberg (1993; Los Angeles, Universal Pictures).

YV: *Are we today again at the point with the Pfynwald, with the European forests, that things could still be prevented? Or has the scenario shifted towards the rainforests, the Amazon, Southeast Asia and the like?*

AG: Climate change is much harder to contain because globally we have to switch from a reliance on fossil fuels to renewable energy; it is technically much more complicated, expensive at the beginning, and our societies are energy hungry. And here in Switzerland, climate change is the main factor behind the problems with the forest. The rainforest: this is also very complicated; we see here how climate change and over-exploitation of natural resources destroys unique ecosystems and what massive feedback this has on the regional and global climate. But that would also require a digression into global inequality.

3

PAYING ATTENTION: FROM THE LABORATORY TO LABBING[119]

Social morphogenesis has to be re-thought from the point of view of the biological metaphor of recombination ... not from the point of view of the metaphor of astronomical revolution. Mutating cells may arise from the rotting organism of capitalism...[120]

Why is it that so many exhibitions and artistic projects that specialize in media, ecology, and artistic research look like museums of natural history or laboratories? I asked myself this question many times over when I viewed exhibitions such as *Exo-Evolution* (2015–2016) or *Critical Zones* (2020–2022) at the ZKM Karlsruhe or the competition submissions for Ars Electronica. There were also projects that adopted or displayed the laboratory aesthetic in the group exhibition *Eco-Visionaries* (2018–2019*)*, which I co-curated. And the group exhibition *Shared Habitats* (2019*)*, in which I participated, operated and in fact largely acted as a laboratory.[121] Beyond this, the probing of a special attentiveness as a technology of care toward other-than-human beings played an essential role. I would like to take this coincidence as an opportunity to pursue this question and expand on it by taking five artistic projects as examples. Three of them were presented within the scope of the exhibition *Shared Habitats*. To return to my original question, what makes "the lab" so attractive in current ecomedia-re-

lated research and exhibition practice? What discourses and dispositifs does it make reference to? What opens up its aesthetic staging, and what kind of experiences does it facilitate? Over the course of my research, I have gained the impression that it was as if essentially two antagonistic forces at work in the concept of the laboratory fascinated many artists: on the one hand, there is the laboratory as an innovative institution of technoscientific research, the manufacturing of knowledge, and its (powerful) engendering of the world,[122] and, on the other hand, there is the laboratory as a space for experimentation that is occupied temporarily and in which certain things—precisely because this site is so deserving of posing questions—can be retested in different ways.[123] A large number of social and aesthetic norms as well as particular artistic interests slide into these two forces, to which, besides the requirements of socially and collectively arranged movements, also belong formalist baubles or a hidden flirtation with scientism. The projects presented here reveal that, in the context of art, the lab has to measure up to specific aesthetic and functional aspects so that it does not become a new white cube for artists interested in scientific discourse. In the best cases, where ideas of "shared habitats" take hold, the laboratory becomes the site of playful laboratory work, of the development of other forms of relationships, and,

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119 Translator's note: The term *"Laborieren"* as used by the author cannot be adequately expressed in English. It makes reference to the laboratory and means doing or performing laboratory work, and is therefore associated with experimenting and probing. In a wider sense and with reference to its etymology from the Latin verb *laborare*, it can also mean "to take pains," "to labor away," which, in this case—as suggested by the verb "to elaborate"—is positively connoted. For the purpose of stressing its active, independent quality, it is therefore translated here as "labbing."

120 Bifo-Franco Berardi, "transverse/transversal," in dOCUMENTA (13), *The Book of Books: 100 Notes—100 Thoughts*, no. 94 (Ostfildern: Hatje Cantz, 2012), p. 611.

121 "Shared Habitats: A Cultural Inquiry into Living Spaces and Their Inhabitants," http://shared-habitats.eu (accessed May 5, 2023).

122 Karin Knorr-Cetina, *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science* (Oxford: Pergamon Press, 1981); Bruno Latour, "Give Me a Laboratory and I Will Raise the World," in *Science Observed: Perspectives on the Social Study of Science*, ed. Karin Knorr-Cetina and Michael Mulkay (London: Sage, 1983), pp. 142–170, http://www.bruno-latour.fr/sites/default/files/12-GIVE-ME-A-LAB-GB.pdf; Henning Schmidgen, "Labor," *EGO Europäische Geschichte Online* (2011), http://ieg-ego.eu/de/threads/crossroads/wissensraeume/henning-schmidgen-labor (accessed July 15, 2020).

123 On this, see Mindaugas Gapš;evič;ius, "A Shift in the Role of an Artist," in *Shared Habitats*, ed. Ursula Damm and Mindaugas Gapš;evič;ius (Bielefeld: transcript, 2021), pp. 294–317.

indeed, even where care for more-than-human beings is rearticulated. I suggest that under certain aesthetic conditions, the lab can become a model that tests practices of attention, self-forgetfulness and participation, and the construction and rendering of the sharing of experienceable worlds. At the same time, this exploration of other forms of relation to our fellow beings is always overlain by the historically institutionalized power of the laboratory to generate forms "of observation," of the "extraction" and the construction of knowledge about "the others," in order, in the "ideal" case, to offer it up to exploitation—economic, militaristic, and so on.

LAB-AESTHETIC REPRESENTATION MACHINES

Pinar Yoldas' highly regarded project *Ecosystem of Excess* (2014) (fig. 14) uses "the laboratory" in its most general, metonymic sense[124] and, at the same time, comes within a whisker of what I would more precisely declare to be a "lab-aesthetic representation machine": hence the various large jars placed on white cubes, full of strange mutations, seem to suggest that not only has the artist's studio become a laboratory, but that the entire world has become a field for experimentation with an uncertain outcome. *Ecosystem of Excess* makes reference to the geological immutability of plastic and prompts the speculative questions: What would "we"—human and other-than-human creatures—look like if the primeval soup out of which life on planet Earth evolved had been full of plastic like that which has accumulated in the Great Pacific Garbage Patch? What kind of sensoria and organs would we have developed?[125] Various exhibits and patterns of order stage this fiction of an alternative evolution: the works' labels point out that these seemingly organic, varicolored formations are the organs of new types of marine creatures that have completely adapted to their plastic-littered habitat. The "organs for sensing & metabolizing plastics," such as the "e-plasticeptor," is a "sensory organ for the perception of the plastisphere," specifically for polyethylene, while the "petrogestastive system" is capable of digesting plastic. A wall with drawings and a lexicon provide a detailed explanation of how

they function. The exhibits on display, which are illuminated by a single light source, are reminiscent of specimens preserved in formaldehyde at museums of natural history or in cabinets of curiosities. At the same time, the interconnected cords or tubes suggest that they are living organisms in a nutrient solution. The arrangement with the small test tubes indicates that experiments are performed using the preserved specimens.

On the occasion of my first encounter with parts of this extensive installation, I spontaneously assumed that it dealt with preserved specimens of mutated organs from unknown marine creatures. On closer inspection, the artificiality of the plastic caught my eye, resulting in my reading them as models of bacteria and marine creatures. It was only gradually that I recognized the project's fictive and material-based, metonymic approach: the material selected for the exhibits—plastic—performs its excess by presenting itself. In view of the fact that the additional information refers to previous marine-biological research that detected bacterial mutations and the adaption of their metabolism to the sea of plastic, my initial confusion was surely no accident. The primary strategies of this work are the initiation of speculation or "narration,"[126] the confusion of fact and fiction, playing with the audience's lack of knowledge with respect to biological processes and their investigation, as well as with the creation of a non-transparent laboratory atmosphere. Yet as soon as visitors recognize the fiction, all one sees are "merely" representations of speculative thought experiments. I do not mean "merely" in a derogatory way. In the exhibition space, art normally has a presentation character and attempts to affect visitors by appealing to them visually or auditorily. However, this work gradually appropriates and mystifies the representative scenario of scientific presentation and viewing. And yet in terms of content, the museum of natural history or the laboratory does not seem to play a compelling role at first. For if we follow Pina Yoldas' narrative, then the fabricated mutants are not the products of a biotechnological laboratory, but of evolution, of the world outside. They are adaptions to the world in the Wasteocene, our age, in which the entire planet is being transformed into a garbage dump and a quasi-lethal trap. The entire world has become a laboratory[127]

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[124] Metonymic means that parts stand for the whole (*pars pro toto*), that the jars and prepared specimens say "laboratory."

[125] "Pinar Yoldas," https://www.pinaryoldas.info/WORK (accessed July 15, 2020).

[126] Léa Perraudin, "Tales from the Great Pacific Garbage Patch: Speculative Encounters with Plastic," in *Müll. Interdisziplinäre Perspektiven auf das Übrig-Gebliebene*, ed. Christiane Lewe, Tim Othold and Nicholas Oxen (Bielefeld: transcript, 2016), pp. 143–165.

[127] For more on this, see "Of a World Becoming Alien," in *The Laboratory Planet No. 5. Alien Capitalism*, ed. Ewen Chadronnet and Bureau d'études (Paris, 2016), p. 1, https://laboratoryplanet.org (accessed July 15, 2020).

Fig. 14: Pinar Yoldas, *Ecosystem of Excess*, installation view Schering Stiftung, Berlin 2014.

of human and capitalist exploitation that consumes bodies and matter and turns them into waste. The world inside is also the world outside, and vice versa, regardless of whether ocean (of plastic), laboratory, or museum of natural history. The world is trapped everywhere and at all times and turned into garbage that is accumulated, extracted, and relocated. Whereas specific entities and objects are collected, selected, and presented in a museum of natural history, in the laboratory they are bred, isolated, observed, and quantified. After their use in interpretation or quantification, they are disposed of. Human beings invent apparatuses and procedures in both institutions for the purpose of investigating or exploiting more-than-human beings and objects.

In *Ecosystem of Excess*, these powerful dispositifs seem not particularly reflected on. Nor does the extensive activity of polluting make reference to laboratory techniques. Retrospectively, Pinar Yoldas claims the installation to be "an archipelago of different displays, each

of which communicate a scientific publication… of scientific data about various forms of eco-destruction."[128] This, in fact, might reveal the laboratory, as discussed in the preceding chapter "Being Concerned," as site of witnessing and critique. The narrative, though, provokes a certain irony or amusement, since the garbage of one turns into a breeding ground for the other. This brings to mind the fact that the subject-object hierarchies will have turned around in the future, as the preserved objects of today are what people will be tomorrow or what they were yesterday: strange marine creatures, in a state of permanent transformation. However, with the scenography of the laboratory as a cabinet of curiosities, Pinar Yoldas also uses the anachronistic and limiting atmosphere of knowledge production to generate elements of truth and magic, nobility and scurrility, and to lend particular credence to its fiction. In other words, she appropriates and ennobles institutionalized representations of research and knowledge without per-

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[128] Pinar Yoldas, "From *An Ecosystem of Excess* to *Hollow Ocean*: Affective Learning in the Service of EcoActivism," in *Plastic Ocean: Art and Science Responses to Marine Pollution*, ed. Ingeborg Reichle (Berlin and Boston: de Gruyter, 2021), pp. 80–97, here p. 87.

forming institutional criticism. This is especially true if we bear in mind that the project was produced for the Schering Foundation, an institution that supports science and the arts, and is funded by the pharmaceutical giant Schering, against whom actions were underway at the time of the exhibition because of a hormone compound that had led to fetal deformities in the past.[129]

Today, a noncritical or naïve approach to institutional power dispositifs—in this specific case, in the laboratory—and hence to a lab aesthetic that can almost be called formalistic, can frequently be found in the context of art-and-science or artistic research, in Bio Art in particular. It often results from a certain limitation, naïvety, or a metonymic understanding in dealing with artistic means. Indeed, it is essentially scientist or opportunistically rests on the tendency to view interdisciplinarity or hybridizations of art with technosciences as pioneering by definition. Numerous artists have developed relationships with scientists in laboratories and keep track of what is done there, or experiment with lab practices themselves. Hence it seems natural to represent the laboratory in a museum, even if it is not at all negotiated or specified. Preference is often given to the use of these "lab-aesthetic representation machines," as I like to refer to this formalistic laboratory aesthetic and art in an exhibition context. In order to expand one's own artistic language instead of to deconstruct its episteme, their consolidation is renewed time and again.

I would not criticize Pinar Yoldas for the latter, since it is with this fiction and conspiracy between art and science's criticality that she succeeds in going beyond the field of art and produces an affective audience response addressing the concerns of and for the oceans. The strength of her aesthetic fiction of monstrous subjects resides not least in the fact that our excessive production of waste and its immutability can be recognized as performing laboratory work on the world—a world of evolving actants that reacts to various inputs and manipulation with feedback and excess, and demonstrates that there is no control. In the final analysis, Yoldas' laboratory art could itself be read as working on and with objects in the laboratory. She speaks herself of trying to provide situations of "Affective Learning."[130] Hence her

preserved specimens are in a position to trigger a broad discourse on planetary responsibility as well as the role of art in this, even if the aesthetic potential of excess and transgression, with the installation's non-critical reproduction of the clean laboratory, is not entirely used.

"ALLIANCES OF ACTIVE CARE"

A tracking shot against a blurred, flesh-colored background; before it, white, clotted strands full of black fine dust particles that become increasingly discernible. The camera scans the tiny hairs along the surfaces before we hear the voiceover pose the question: "Can humans hire plants?" The video essay *Botanomics: Towards a Plant-Based Economy for the Common Good* (2019) (fig. 15), presented as an installation, is the tentative final chapter of *Dust Blooms* by Alexandra Toland, an interdisciplinary and transmedia-arranged artistic research project that has been ongoing since 2015. Typical for artistic research and its process-oriented approach, the results have found expression in various media and exhibition formats—the artist speaks of "narrations."[131] The video essay begins in a quasi-material, semiotic no-man's-land where everything is matter, body, regardless of whether human being, plant, or filth. In the next shot, we see a field of grain, the air thick with dust that is being swirled up by heavy agricultural machines. We hear reference made to the concept of Ecosystem Services (ESS), which counter the exploitation of the world with the strategic economization of nature.[132] Two such services are presented in the video: Biofiltration Services, the dust-filtering function using flowers; and Bioextraction Services, a form of heavy-metal extraction using plants that still seems to be in the laboratory stage. The potential of agromining is being researched in a similar laboratory in France: so-called hyperaccumulators—plants that grow on soil contaminated with heavy metals and sequester them—are dried, burned, and subjected to further processes in order to reclaim these heavy metals from the ash. As Marie-Odile Simmonot (University of Lorraine, ECONICK Laboratory), the head of the project, acknowledges, for many of the retrieved materials, such

[129] Jesse Olszynko-Gryn, "Primodos was a revolutionary oral pregnancy test. But was it safe?," *The Guardian*, International Edition, October 13, 2016, https://www.theguardian.com/science/the-h-word/2016/oct/13/primodos-was-a-revolutionary-oral-pregnancy-test-but-was-it-safe (accessed July 12, 2023).

[130] This is the subtitle of Yoldas' text, "From *An Ecosystem of Excess* to *Hollow Ocean*: Affective Learning in the Service of EcoActivism."

[131] "Alexandra Regan Toland," https://artoland.wordpress.com (accessed July 15, 2020).

[132] See Chapter 2, pp. 19 sq.

Fig. 15: Video still from Alexandra Toland, *Botanomics—Towards a Plant-Based Economy for the Common Good (small-cropped dandelion)*, 2019.

as, for instance, arsenic or lead, there is no market. Even sought-after nickel is currently still cheaper to obtain by means of conventional mining methods—that is, environmentally damaging methods that remove vast quantities of rocks—than by recycling by means of agromining. Hence, while a form of "biofiltration purification service" discharged by plants has already worked for millions of years—even though it has not yet been scientifically investigated down to the last detail—agromining seems to still be in the experimental stage. It may also be that it is not industrially applied at a large scale, because it cannot currently keep up with the low price of raw materials acquired by conventional extraction methods, but that is a situation that could change. The laboratory, which has shifted into the picture, therefore becomes a site of innovation and of a potential that, for economic reasons, is not exploited. At this point, the video essay leaves the question of whether this is a good or a bad thing unanswered. It will not be until afterwards that the thought crystallizes that agromining is also a method of extraction and that nothing can be

had for free: instead of ruining the lands of indigenous peoples, plants are now being "sacrificed"—plants that evidently flourish well in such soil. But does that mean, one begins to quietly ask oneself, that one is therefore permitted to downgrade them in a doubled manner, to being the disposers and the providers of human needs? Does this not also point out that the *homo oeconomicus* not only wastes everything but would also be given license with these "green" methods to carry on as we always have ad infinitum: namely, to accumulate, to extract, and to displace—in short, to waste the world?

As the video essay progresses, it becomes clear that the ESS are anthropocentric and that the limitation of their potential also resides therein. The next plant is *Ambrosia artemisiifolia*, introduced as a negative example because it performs a "dis-service" to humans: the camera zooms in on the plant; every tiny hair, every crevice, every recess becomes visible and indicates morphological (surface) characteristics that, as one has heard based on the example of other plants, perform biofiltration services. Yet, in this case, these characteristics appar-

ently do not count, since ambrosia is an invasive plant that was introduced by humans from North America and distributed over wide areas of Europe via bird feed. Ambrosia is also a common allergen and for that reason is being decimated. Ecologist Birgit Seitz from the Technical University of Berlin, who was interviewed for the video, puts it in a nutshell: "It is of no use to us, hence it's not supposed to be." The common name for Ambrosia is ragweed: what is of no use is waste, and at most it is acting as a "rag," cleaning up after people.

That is the logic of the Wasteoscene, an epoch that has to end and be replaced by one that gives priority to forms of equality and cooperation with more-than-human beings. Toland's video cites the anthropologist Natasha Myers: "The Planthropocene is a call to change the terms of encounter, to make allies with these green beings. These alliances could be framed as active care, involving labor and multiple science. It is a shift from exploitation to reciprocity, a shift from Ecosystem Services to a multispecies economy." Hence the video essay takes a stance and answers the question raised at the beginning, of whether humans can hire plants, with a resolute "no": "Botanomics proposes that humans can hire plants, but only when you repay them for their services." With these final words, the aspects of attention, dependency, blame, and care come into play: the existence of the human species in general is based on the existence of other living things, particularly plants, which produce oxygen and nourishment. Philosopher Emmanuele Coccia writes: "To live is essentially to live the life of another: to live in and through the life that others have been able to construct or invent. There is a sort of universal parasitism, a universal cannibalism, that belongs to the domain of the living: it feeds off itself, without realizing that it needs other forms and modes of existence."[133] Unlike animals (a category to which humans also belong), plants do not eat other plants: "They require nothing but the world, nothing but reality in its most basic components: rocks, water, air, light."[134]

The video essay *Botanomics: Towards a Plant-Based Economy for the Common Good* raises awareness of the fact that human beings are not the autonomous beings that they have constructed themselves as since the Enlightenment. At the same time, the video essay calls for a way of thinking and acting that takes into account this dependence on others and the guilt that comes with it. If we take this piece seriously, then from now on we have to always consider how we behave toward or even show our gratitude toward what is simple and what we are given. The video does not address how that might look in concrete terms. The move undertaken in the video, and in its title, from the concept of "service" to that of "common good" and to the neologism "Botanomics"[135] puts forward that forms of co-existence, sharing, and caring have to be re-articulated. These forms have, not lastly, already existed in the practices of the commons as well as the subsistence economies of indigenous peoples which have been suppressed by the industrialization of agriculture.

This conclusion suggests itself based on the mode of the presentation of the work, in which old and new forms of knowledge generation come together. In the exhibition *Shared Habitats*, two digital etchings frame the video in an installation entitled *Probing the Planthroposcene: Excerpts from a Dis-Service Society*. The etchings present an *Alyssum murale* (a nickel hyperaccumulator) and an *Ambrosia artemisiifolia* (fig. 16). They synthesize scientific ways of representing these and similar plants over the past five hundred years. In doing so, they evoke conventions of scientific representation at a single glance, yet also associate old knowledge about remedy plants. Hence they assemble old and new ways of displaying knowledge about plants, both in terms of representational, media-related, and material techniques—the pigment is a mixture created by the artist out of fine dirt particles and gold. This, in turn, combines alchemical, scientific, and artistic practices. The installation is basically reminiscent of a simple museum staging, which has scarcity value in the context of the Ars Electronica. The aesthetics of its representation are also unusual within the scope of *Shared Habitats*, which assembles projects with ecomedia-related test arrangements.

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[133] Emanuele Coccia, *The Life of Plants: A Metaphysics of Mixture* (Cambridge: Polity, 2018), p. 7.

[134] Ibid., p. 8.

[135] The word is a combination of botanics and the suffix -omic as the study of the multiple interplays between all plants and their companion species. "The branches of science known informally as omics are various disciplines in biology […]. Omics aims at the collective characterization and quantification of pools of biological molecules that translate into the structure, function, and dynamics of an organism or organisms." Wikipedia, "Omics," https://en.wikipedia.org/wiki/Omics (accessed June 30, 2020). Crucial for botanomics, as opposed to botanics, is that botanomics have an eye on collectives and their relations and not on single organisms.
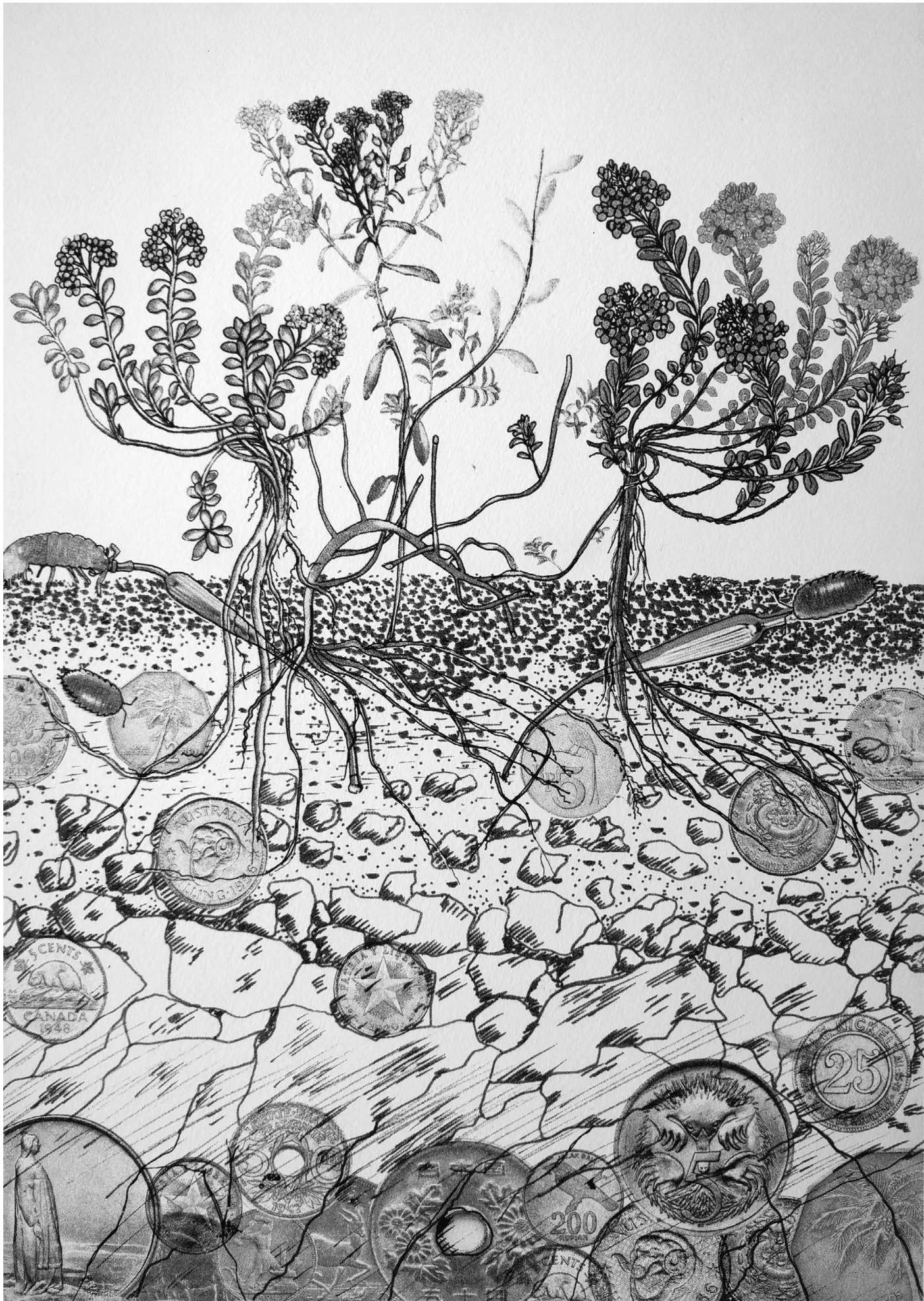
Fig. 16: Alexandra Toland, *Probing the Planthroposcene: Excerpts from a Dis-Service Society*, etching of a digital cliché made out of historical illustrations, engraved with hand-pulverized street dust and shell gold, (Allyssum murale), 2019.

However, as part of the overall project *Dust Blooms*, it is fundamentally based on processual test arrangements. In collaboration with various scientific institutes and laboratories, the artist examined the dust-filter function of flowers. In the course of Alexandra Toland's fieldwork, she collected flowers and, with the aid of a grid, counted under a microscope how many grains of fine dust a flower captured. She referred to the ESS from the very start and initially concurred with them. In 2017, she received an honorary mention for *Dust Blooms* at Ars Electronica in the category of Hybrid Arts, and she presented another iteration of the installation at the OK Center for Contemporary Art in Linz. During its presentation there, the museum of natural history as a venue for presenting specimens as well as the laboratory as a site of innovative research and field-based methods of measurement, observation and interpretation played an important role. Hence, along with a wall that presented dust etchings and photographs of the habitats of the plants addressed, two microscopes as well as a meadow sample were on display. However, the microscopes were not only meant to be narrative elements, but visitors themselves could also use them to look at and count the dust particles on flowers and therefore apply scientific vision. The meadow sample contained a mixture of real and artifactual plants—on the one hand, plants the artist found on the roadside and examined, and, on the other hand, their morphological replicas made out of household cleaning equipment such as brushes and microfiber cloths. In addition, the installation also included a sensor-based measuring station operated by an Arduino board that measured the dust content in the air and translated it into a readable diagram by means of software made available by the open source database luftdaten.info.[136]

Alexandra Toland also combines various methods of examining "objects," specifically measurement, representation, and perception/distinction. This reveals that the "truth" about dust deposition and dealing with it is always coupled with specific techniques, technologies, and the respective time-based mode of perception. Moreover, it permeates across the compartmentalization of science, technology, and "nature." The installation *Dust Blooms* basically turns the exhibition space into a DIY laboratory—at least to the extent that it renders it possible for the public to appreciate the process of labbing and media-related differentiation. By contrast,

in the exhibition *Probing the Planthropocene*, labbing, or "probing," as the title suggests, is no longer linked with the functionality and aesthetic of the laboratory in terms of its scenography. Rather, it seems as if the artist is placing new trust in aesthetic vision and combination as provided by the museum setting. The laboratory becomes perception and reflection and in that respect undergoes a transformation from concrete to immaterial object; it changes from an institution and a site of hands-on practice into the theoretical practice of reflecting or rethinking. However, the laboratory as an institution of experimentation and innovation has not fully disappeared. A high-tech version of the lab is now dealt with in this video, yet it seems distinctly more ambivalent—it remains obscure whether the "agromining" performed in the laboratory is a blessing or a curse, since the suspicion grows that the centuries-old activity of the pollution and extraction of the world simply continues by way of plants.[137] What is clear is that those operating the university laboratory do not reflect on the question posed by the video of how plants should be paid for their "services." I wrote earlier in the text that the laboratory manifests as a site of potentiality for environmentally friendly mining that, for economic reasons, is not exploited; one can now add that it also leaves the potential for thinking differently, for "probing the Planthropoecene," unexploited. The exhibition setting could suggest that it occurs elsewhere—outside of the laboratory—and that scientific practices other than laboratory work have to be invented when it comes to developing possibilities for feedback ("repaying them") and care.

CARING FOR COLLECTIVE LABORATORY WORK

Mindaugas Gapševičius's laboratory adds a new aspect. His *Introduction to Posthuman Aesthetics* (2016–2019) toolkits occupy the art space and turn it into a laboratory and, in this case, into a site of trans-species experimentation (fig. 17, 18). Access occurs on two levels: On the one hand, Gapševičius presents toolkits complete with video tutorials and manuals; more precisely, he makes them available for instruction, imitation, and use. On the other hand, he invites additional artists to conduct workshops. This arrangement results in a disseminating,

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136 *Luftdaten selber messen mit Citizen Science*, Stuttgart. https://luftdaten.info (accessed July 30, 2020).

137 See Myra Hird on the "sacrifice" of the Russian thistle in nuclear-contaminated areas. Myra Hird, "The Phenomenon of Waste World Making," *Rhizomes: Cultural Studies in Emergent Knowledge,* 30 (2016), p. 18.

Fig. 17: Mindaugas Gapsevicius, Julian Chollet, Juan Pablo Diaz: Presentation workshop "SCOBY, Shit, and Humus" (as part of *Introduction to Posthuman Aesthetics*), MO Museum, Vilnius, 2019.

open, and, in terms of its impact, incalculable hands-on atmosphere in the space of the museum. A broad public made active use of it in Vilnius.

For Mindaugas Gapševičius the laboratory not only "provides tools to work with the interaction of microorganisms" but also "introduces the symbiotic relationships between living organisms and non-living things."[138] Defining the artist as a "mediating figure," he attempts to generate and communicate knowledge about the life of microorganisms and their coexistence with human beings. This thematically ties in with the insight gained by the sciences, permacultural practices, and Bio Art, which have recognized the fundamental importance of microor-

ganisms for organic life and their symbiosis with human beings, and are currently enhancing and using them.[139] Besides forms of care, this is naturally also a question of new possibilities of exploitation. As in the case of agromining by means of plants discussed above, in the microbial field, it has also been suggested that the service of bacteria could solve numerous problems (caused by the *homo oeconomicus*) in the context of the impending shortage of resources, from the purifying of contaminated soil and the reclamation of e-waste to the manufacturing of bioplastic and bioleather. Bacteria could become our new robots and slaves. Yet many experiments are still in the laboratory stage, as the control of microorganisms for

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[138] Gapševičius, "A Shift in the Role of an Artist," p. 294.

[139] "The importance of microbial life to soils is driving a shift in conceptions of soils from inert media to living ecosystems which demand respect for their intrinsic value and an ethics of care, a sentiment now articulated even by the European Commission (EU Horizon 2020 Mission for Soil Health and Food Mission Statement)," write Anna Krzywoszynska and Sam Outhwaite in "Unsettling Soils."

Fig. 18: Exploring *My Collaboration with Bacteria for Paper Production*, toolkit at Academy of Fine Arts, Leipzig, 2017.

economic purposes is complex and also more cost-intensive than conventional industrial processes.[140] *Introduction to Posthuman Aesthetics* intervenes in this controversial field and reveals the complexity and entanglement of this conflict based on the example of everyday products and phenomena. By occupying the art space, the installation of simple laboratory tools, and the inclusion of a nonscientific public by means of do-it-with-others practices, Gapševičius's project enables fundamental experiences with the unfamiliar-familiar. Moreover, it recommends possibilities for action; they do not necessarily aim to solve the problem of pollution and global sustenance, but instead attempt to intersect the re-installed dispositif of the subject-object, human-non-human hierarchy with each laboratory and open up a field of action that goes beyond extractivist thinking. Even without dispensing with certain techniques and (laboratory) technologies, *Introduction to Posthuman Aesthetics* makes palpable how

fundamental microbial life and hence the exchange and cooperation with more-than-human beings is for life on Earth. These are relationships and experiences that not only go unaddressed in technoscientific laboratories but are also contrary to the "narrative" that microorganisms threaten humans.

In *My Collaboration with Bacteria for Paper Production*, one of the chapters from the overall project *Introduction to Posthuman Aesthetics*, Mindaugas Gapševičius works with SCOBY, a so-called "symbiotic culture with bacteria and yeast," a culture that is also an old fermentation technique, related to cooking. In his video tutorial, which is in no way inferior to the popular tutorials on YouTube and sounds like the algorithm of a recipe, he presents a step-by-step introduction to the mimetic possibility of imitation. In doing so, Gapševičius quite generally refers to developmental psychology (where the young learn from the old and vice versa—a form

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[140] With this assessment, I make reference, as in the discussion of agromining above, to the insight within the scope of our SNSF research project *Times of Waste*.

of knowledge exchange that is being consciously eliminated in the neoliberal labor market), and activity-oriented and aesthetic conditions of existence, with which are also associated old and new techniques of relationally controlled and physically experienced instruction, sharing of knowledge, and learning from one another. In addition, its collective character and easily recreated setting also make for just plain fun. It is therefore a question of creating knowledge that is parascientific and that arouses palpable and manifest joy and excess— transgressing human boundaries. It is relational, embodied knowledge; it is posthuman, as it is simultaneously human and nonhuman. This new-old knowledge about things that are consumed on a day-to-day basis (such as kombucha or yoghurt) can only be generated by means of a hybrid, techno-aesthetically operating laboratory setting, as it is not a question of the production of kombucha or yoghurt, but rather of the reproduction of and learning about the living conditions of the organisms co-responsible for them. This takes place as processual test arrangements under laboratory conditions, since specific relationships have to be systematically disabled and observed. However, as the tools demonstrate, these structured processes can be carried out with very ordinary things. The toolkits created by Gapševičius and the guests he invites to his workshops do not directly intervene in molecular structures or modify DNA. Instead, they remain on the level of "kitchen philosophy." In an etymological sense of the word, they allow the household (*oikos*) to be experienced as a vibrant, relational ecosystem and open it up for the more-than-familial.

Molecular biologist Julian Chollet, who works in artistic contexts, proceeds in a similar way. In collaboration with Chollet and Juan Pablo Diaz, Gapševičius conducted the workshop "SCOBY, Shit, and Humus" in Vilnius as part of the self-repair labs that were installed at *Shared Habitats*. Among other things, participants took various soil samples, investigated and mapped them, and attempted to develop a non-anthropocentric view in subsequent experiments.[141] Because I only briefly attended this lengthy workshop, in the following I make reference to another, shorter workshop conducted by Julian Chollet that likewise dealt with humus (fig. 19).[142] It can generally be said that the experiments carried out with him

did not render soil experienceable as an inert mass, but rather as a biotope consisting of co-existing beings, and that, as is the case with Gapševičius, they are about creating awareness of human beings as implicit. Whereas many of Gapševičius's experiments include participating "humans" by means of cooking and eating, hence by means of material "incorporation" in addition to the element of activity, in Paris, Chollet joined the participants to produce ecomedia-based aesthetic image settings. He captured humus life under the microscope on video and projected it onto the wall to enable people to perceive it themselves as a media-based part of the image machine. The resulting images were not only beautiful, but also affected participants through the knowledge that they were living beings of which one is a part.

Being together with microbial life while performing laboratory work can thus elicit aesthetic sensations that burst the functional arrangement of microscopes (these are necessary so that people can see the different microorganisms in the soil), jars, petri dishes, and so on, and open up the notion of life as an experimental coming-into-being. At the same time, however, one important point is that these experiences of shared life are not situated outside of discursive practices; in fact, two-way discussion and theorizing are a fundamental part of them. This rearticulation and visualization of practices and discourses is also one reason why the workshops continue to take place in an exhibition context and perfect Gapševičius's toolkits. And so the artist operates not only as a "mediator," as proposed by Gapševičius,[143] but as a "curator" (from Latin *cura* which etymologically is not related to *care* even though its signification means *tending*)—as that being who tends to the constitution and continuation of a collective elaborated context.

PAYING ATTENTION AS AN EVENT

I would like to conclude this chapter with Ursula Damm's *Drosophila Karaoke Bar* (2019) (fig. 20). I read this installation as a machinic assemblage to learn to pay attention to and play with fruit flies (*drosophila*) and others; as a machine for the development of an ecology of sensing and caring for insects, and its celebration.

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[141] "Case #1. SCOBY, Shit and Humus," http://triple-double-u.com/case-1-scoby-shit-and-humus/ (accessed July 30, 2020).

[142] I make reference to the workshop I co-organized, "Open Soil Research," which Julian Chollet conducted on the occasion of the conference "Seeds and Soil" at the Swiss Cultural Centre, Paris, March 7–9, 2019. Review http://www.makery.info/en/2019/03/11/vous-aussi-devenez-humus-sapiens/ (accessed July 20, 2022).

[143] Gapševičius, "A Shift in the Role of an Artist."
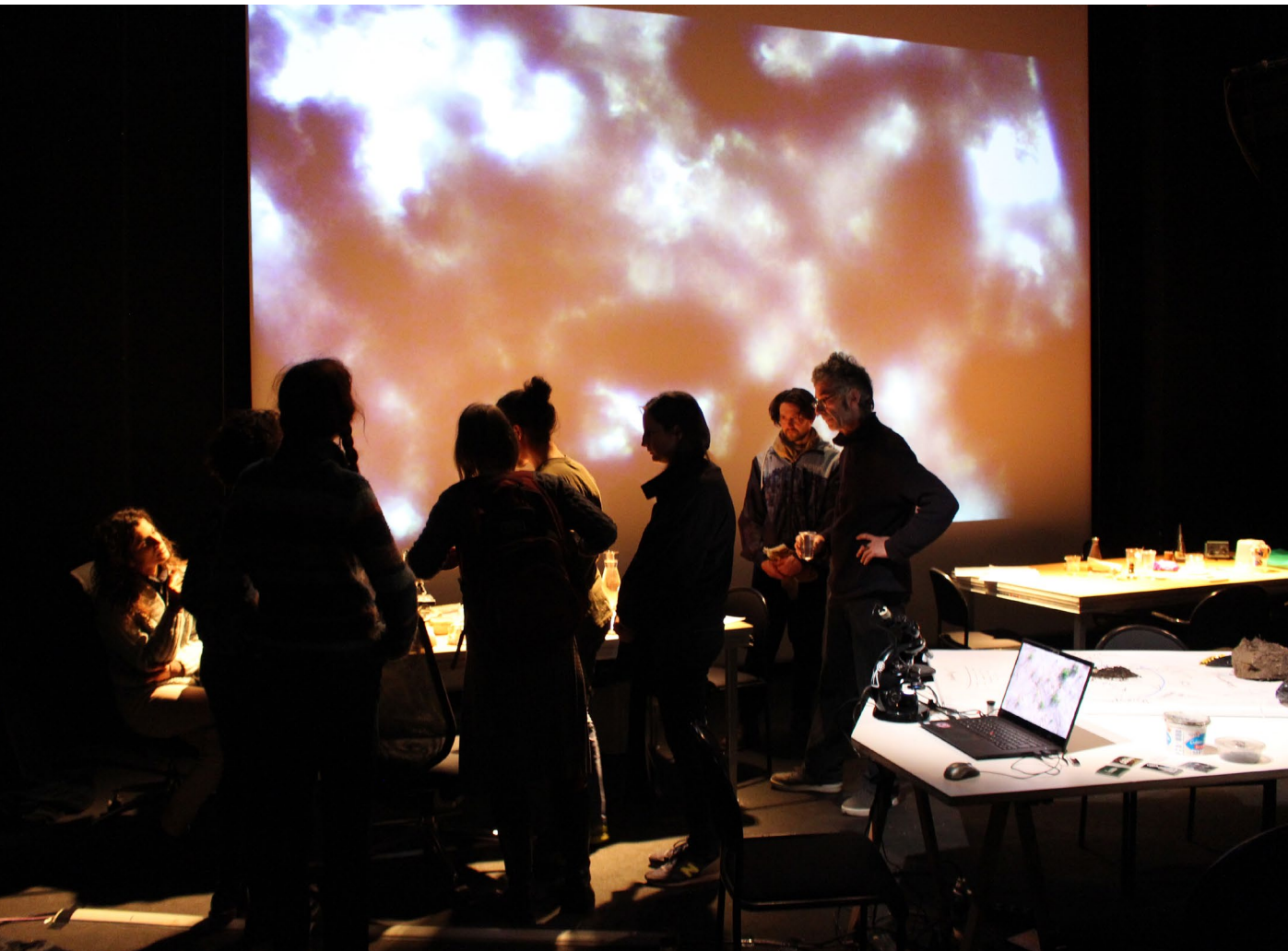
Fig. 19: Julian Chollet/Humus Sapiens, *Open Soil Research*, Centre culturel Suisse, Paris, 2019.

For many, the installation with the fly habitat under a muffling pile of sand and the various technological apparatuses initially comes across as a classic laboratory situation in which humans observe non-human beings, incite them to react, and capture them in various manners of representation. Those who expect the usual stimulus-reaction scheme that many interactive, laboratory-based works reproduce are inevitably disappointed, since the reaction of the fruit flies does not unequivocally conform to this pattern. While visitors are encouraged to sing along with or simply for the flies, software transcodes the human sounds into ones that can be perceived by the flies, and conversely amplifies the song of the flies so that it is perceptible to the human ear. One nevertheless has to engage intensely with this process in order to enter a form of communality. And even after one has listened to the comments by the neuroscientist Birgit Brüggemeier on the function of fly songs in the corresponding video, before one seeks to apply what one has learned, it still requires a great deal of patience, calm, and joy in playing. For if all one does is speak into the microphone, the fruit flies are frightened and do not do anything at first—even though a vocoder adapts the human voice to the sound sequences and auditory pattern recognition in flies—visitors also hear themselves speaking fly language, as it were. One has to tune into their temporality so that they calm down and become active.[144] One has to "become a fly."[145]

As the title of the *Drosophila Karaoke Bar* indicates, the installation is a stage, a machine for an event where

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[144] It was especially difficult at Ars Electronica, where streetcars rumbled past at regular intervals, but it worked well at the museum in Vilnius.

[145] Ursula Damm on the cellist Christina Meißner performing with flies, e-mail to Yvonne Volkart, May 2018.

Fig. 20: Ursula Damm, *Drosophila Karaoke Bar*, 2018, Installation view at Haus der Kunst, Munich, 2023.

people, machines, and flies can enter a shared space-time concatenation. The event is the coming-into-being of things, their opening-up to transversal movements beyond the logic of teleological progress, as well as the sense of accomplishment that can result from coming-into-being with others. It is presubjective coming-into-being in a relational process and corresponds with that logic Félix Guattari called "eco-logic": "The logic of intensities, or eco-logic, is concerned only with the movement and intensity of evolutive processes. Process, which I oppose here to system or to structure, strives to capture existence in the very act of its constitution, definition and deterritorialization."[146]

In *Insect Songs* (2018) (fig. 21), a preliminary version of *Drosophila Karaoke Bar*, an essential factor for the success of the work was the stage-like machinic assemblage, collective playing, listening to one another, and

forgetting oneself in a trans-species, relational occurrence. In a demanding process of making music, and in the etymological sense of the word *attention* (Latin *adtendere: to stretch toward*)[147] the cellist Christina Meißner reached out, "attended" to the midges, over the course of which she reduced her human dominance: "Christina Meißner did not want to force the midges to react; rather, she wanted to 'become a midge' herself and 'sing with them.'"[148] "Becoming a midge" as a music event hence means an aesthetically supported form of environment-related subjectivity: human and non-human beings and technologies come together in an ecological event, create a machine, and see to it that they grow together, thrive together. The event is a process of paying attention, sensing, seeking in the here and now and is produced by means of various aesthetic and technological elements, such as an independent temporality

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[146] Guattari, *Three Ecologies*, p. 44.
[147] Ingold, *Anthropology*, p. 20.
[148] Ursula Damm, email to Yvonne Volkart, May 2018.

Fig. 21: Ursula Damm, *Insect Songs*, live images of the mosquito trails in the swarm, 2017.

of listening through the unpredictable interactively arranged timing of the sound, the foreignness of the tones, the self-imposed concentration, and the various images. As Christoph Brunner has shown, aesthetic timing, as the experienced and shared time in the here and now, provides the condition for what he, in connection with Brian Massumi, calls an "ecology of relation."[149] What is meant by this is a specific form of temporality that touches those present on an affective level and "calls on" them in their physicality and relationship to others in the room as a plurality of pre-individual entities in embryo, in this case: faces, flies, sounds, movements, technologies, signals, traces, and so on. The abandon experienced by each individual in this event, which extends over a long period of time without a specifically announced beginning or end, becomes a consciously perceived experience of shared participation; Ursula Damm speaks of "shared experience," or "shared habitats." This

is based on communication that initially appears to be completely meaningless because it is situated outside of human linguistic codes and serves no apparent purpose. However, the communication becomes meaningful if it can involve a different kind of "understanding," of empathy, of collectively created and shared collective temporary temporality. In this sense, it provides an aesthetic excess of pure becoming and goes beyond any purposive rationality—as mentioned, for example, in the "Ecosystem Services" cited above. On the contrary: in this case, a great deal is demanded from human beings in order to facilitate a successful encounter.[150]

Ursula Damm writes: "The actual media-related aspect is that we humans have to become quiet in order to hear the flies. Admittedly, we use technology to enable ourselves to hear them, and we in turn use technology to examine the impact our music has on the flies."[151] But they are simple arrangements, not sensors: "For me, it is

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[149] Christoph Brunner, "Affective Politics of Timing: On Emergent Collectivity in Ragnar Kjartansson's *The Visitors*," in *Timing of Affect: Epistemologies, Aesthetics, Politics*, ed. Marie-Luise Angerer et al. (Berlin and Zurich: diaphanes, 2014), pp. 245–262.

[150] The performance at Musikfestival Berne, September 2–4, 2021, seemed not to be successful at first sight, as the midges, distraught by the loud laboratory building in which they were kept by the organizers against the artists' advice, did not tune into the cello play and did not sing during the time slot given by the festival's schedule. It took a lot of patience, time, and energy from all involved beings to let things happen in their own way, and, finally, almost already unexpected, the midges started to sing …

[151] Ibid.

an aesthetic decision not to employ any additional technology, but to work on my attentiveness (being quiet, watching at length) or to simulate the habitat of the flies (a fly box). … One senses and develops meaning for each other."[152] It is the capacity of "paying attention" as a pre-intentional technology of caring for the other: pleading that its respective transversal potential—particularly in the arts—is to be sought in experiences of co-existence with our fellow beings, and not in the perpetual deployment of innovative technologies. They are undoubtedly "technical" technologies of sensing conditioned by their material configurations and their possibilities afforded by such assemblies. But, beyond that limited view, they also afford "non-technical" methods for carefully forging relations with unfamiliar entities; sensing is tactile, physical, material, and thus, also indelibly involves building relationships.

Hence, upon closer inspection, the *Drosophila Karaoke Bar* proves to be a laboratory of a different kind, namely, with respect to the etymological meaning of "laboratory" used in the Middle Ages, as *work* or a *task* (Latin *labor*: exertion, effort, work).[153] It becomes a model for how human beings, fruit flies, and machines can join forces to "co-laborate," how they can play together or not, and collectively ensure that this event is not interrupted before it has been accomplished. This aesthetic form of generating attention and knowledge, almost ritual in its song-like quality, bursts both the scientific format of the laboratory, and the exhausting connotation of work (as labor). Ursula Damm prefers to situate the setting of the installation in the studio and an exhibition context than in the laboratory. This wish is quite possible, since on some days, her studio, where she also lives, seems like the laboratory of a compulsive hoarder and clutterer: she breeds *drosophila* in her kitchen and leaves fruit lying around, stretching the tolerance of many of her human visitors to its limits. In contrast, the studio is that historically sanctioned site of artistic experimentation that, over the course of the modern era, has become detached from scientific experimentation and devalued in terms of its potential for gaining insight. Hence it seems as if the *Insect Songs* and the *Drosophila Karaoke Bar* have taken it upon themselves to suggest a search for knowledge that the sciences have not provided in this form. And indeed, Ursula Damm points out multiple times that her "sing-along" integrative form of fly

experiments also brought to light insights into fly research.[154] For instance, she and Brüggemeier created a habitat unlike those common in laboratories and did not isolate the flies for the sound recording. Instead, they recorded the sound of a fly flying by. This subsequently led to different results, for example, merging the individual sounds of the flies generates harmonies, such as octaves, fifths, and fourths—a remarkable aesthetic phenomenon that is not documented in the sciences. Damm and Brüggemeier use special microphones so that exhibition visitors can discern the differences and the harmonies in the voices of the flies. Technology also comes into play again as a possible media-based element of precision within a more broadly defined machinic assemblage of evolving processes. Other elements, such as extraneous or incidental noise, are not automatically filtered out but integrated. For Ursula Damm, this manner of dealing integratively with what is normally treated as waste is the eco-logic needed to overcome the Wasteoscene.

THE ART OF LABBING

If we sum everything up, then it becomes apparent that the most promising aspects in the context of laboratory art or the art of labbing are those evolving, relational, trans-species, and trans-material processes between the entities that are neglected or excluded by the sciences. As these case studies clearly demonstrate, merely referring to or metaphorizing the laboratory as an innovative, transboundary site is pointless: like the artist's studio or museum space, the laboratory is also overcoded with dispositifs and norms that one cannot invalidate by means of a simple substitution. On the contrary, they continue to secretly smolder. Added to this is the fact that, since the modern era, art has defined its power of innovation through the expansion and transgression of its zones. That artists are increasingly conducting artistic research and applying methods such as fieldwork and setting up test arrangements can also simply be the time- and context-related artistic language of our day and age, transforming the world into a laboratory. Such practices are timely, but not automatically critical. What Alexandra Toland says with reference to artists who work with soil also applies to those who work

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152 Ibid.

153 Schmidgen, "Labor."

154 Telephone conversation between Yvonne Volkart and Ursula Damm in June 2020.

with the kitchen: they never actually define themselves in the context of laboratory-friendly Bio Art, because, I would add, they keep their eye on the bigger picture, the *Shared Habitats*. Instead of lab-oriented dividing, dissecting, and recombining, they attempt to carve out and reinforce what is already there—that is, of course, *the* ecological method in the discourse on trans-species coexistence, for example, when gardens or fields seem to be "inundated" by "weeds" or "snails."

As Anna Krzywoszynska and Sam Outhwaite recorded with respect to the research project they carried out in the context of agriculture, the "laboratorization of agriculture" leads to frequently invoked local actors as a possibility for the more careful cultivation of agriculture not automatically immune to the "productivist and exploitative logics of human-nature relations."[155] In the course of their fieldwork, it became apparent that farmers are increasingly insecure and lend more substance to the laboratory techniques developed by academics than to their own observations, even though those observations have resulted from years and years of working with soil on a daily basis. Interestingly enough, in their field, Krzywoszynska and Outhwaite come to the same conclusion as I have in the field of art: the dispositifs have to be changed and technologies of sensing used. In Krzywoszynska and Outhwaite's words: "It demands of the locals that they cultivate a new regime of sensitivity which acknowledges and responds to the material world … Gaian apparatuses" have to be developed, "apparatuses for cultivating the art of paying attention to Gaia."[156] What Krzywoszynska and Outhwaite say here can be transferred to the arts: only in those places where techniques take hold as technologies of sensing, as techniques of learning from one another and ensuring the continuation of collective "playing" and "probing," will the powerful dispositif of the laboratory as a site of control and wasting the world be burst open. Life can open up only in those places where, utilizing time and energy, an evolving and responding event, instead of evolution in the biotechnological or Bio Art laboratory, is *elaborated*. And then noise will turn into sound, filth into gold, and garbage into compost. And vice versa.

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[155] Krzywoszynska and Outhwaite, "Unsettling Soils."
[156] Ibid.

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GOING ALONG: WASTEMACHINES

> If media can make a difference in investigating the ecological crisis, we need to begin with media technology itself.[157]

Picture this: two machines that we encounter more and more frequently in the streets. One is a pair of white Apple AirPods, the other a black Tesla. One is a mini-computer, the other a hypercomputer. One stands for immateriality and networking, the other for the speed of green technologies. Both are beautiful, cool and in mint condition, fetishes of mobility and digitalization. Both base their vitality on batteries, or more precisely on rechargeable lithium-ion batteries. And ultimately, both are—so my claim goes—waste machines.

The battery can be described as the hub of our current form of the digital.[158] As such it appears mobile, autonomous or intelligent—the whole world as a "smart grid." With its dual capacity as a reserve and supply of energy, the battery is the heart of current and future digitalization: with one and the same battery I can drive a car, heat a house, power a server or interconnect disparate objects. If electricity were self-generated and shared like open source software, this could lead to new, collective forms of distribution and use of machines. The small car based on the internal combustion engine as a haven of privacy and intimacy, for example, would give way to an interchangeable chassis that would be occupied and used by many, but no longer owned. The battery is both the strength and the weakness of any electronic device: not only is it generally the battery that is the first component to malfunction, turning a working device into

e-waste, but it is also the battery that turns any electronic device into a ticking time bomb: suddenly exploding smartphones in the pockets of fertile men, trucks full of e-waste causing a fireball on the highway, laptops that blow up an office: it is always the lithium-ion batteries whose flammable materiality causes unforeseeable but not impossible episodes. The battery is the site of becoming: energy is released, forces afflict entities, things become possible or impossible. Collapse, destruction, in/finity reach anxiety, potentiality, virtuality: this is the core of the digital and its machines, its batteries.

OCCUPYING AND DEFECATING

The lithium-ion accumulator is a prime example that reveals how digitization, especially in the form of mobile computing, is based on wasting and reducing the world, contrary to the rhetoric of immateriality and freedom. Polluting the world, according to Michel Serres, is a form of re-colonization: "appropriation through pollution." It is an act of occupation, one that can be likened to a dog marking its territory by pissing on the roots of a tree.[159] This is, as Rob Nixon shows, "slow violence,"[160] or, as Marco Armiero says, "othering."[161] For while some get reach, others are deprived of it. This logic of ravaging and dispossessing is inherent in the history of capitalism, the *Wasteocene*.[162] Armiero's hypothesis is that "while wasting relationships are based on consuming and 'othering,' that is, on sorting out what and who is waste, commoning practices are based on repro-

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157 Richard Maxwell et al., "Introduction," in Richard Maxwell et al., eds., *Media and the Ecological Crisis* (New York and London: Routledge, 2014), p. xi.

158 This is the approach taken in Jan Müggenburg, ed., *Reichweitenangst. Batterien und Akkus als Medien des Digitalen Zeitalters* (Bielefeld: transcript, 2021).

159 Michel Serres, *Malfeasance: Appropriation Through Pollution*, trans. Anne-Marie Feenberg-Dibon (Stanford: Stanford University Press, 2010). The term re-colonization is not used here to refer to the era of colonialism. Rather, it is about the North–South power imbalance of wasting.

160 Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, Mass.: Harvard University Press, 2011).

161 Armiero, "FUMOGENI #2."

162 See footnote 5 and Nancy Fraser and Rahel Jaeggi, *Capitalism: A Conversation in Critical Theory*, ed. Brian Milstein (Cambridge: Polity Press, 2018).

ducing resources and communities."[163] And that's what technologies of care do, too.

If batteries and accumulators are media of digitalization, and the acute wasting by digitalization is another stage in the long history of colonization, violence, and othering, then batteries and accumulators, insofar as they provide the indispensable foundations for mobile and smart digitalization, are media of exploitation and colonization, of maximization and minimization of reach. This fact is normalized, repressed, or denied by rising consumption. Coupled with the business of caring for the environment or maintaining prosperity in the Global North, it is even turned into its green-labeled opposite. In the process, as the debate in the EU over coal and nuclear power plants shows, technologies of waste are declared technologies of care. Referring to the etymological meanings of *caring* as *griefing*, as well as *going along* and *accompanying*,[164] this chapter, "Going Along: WasteMachines," asks how this wasting, in which everyone is involved in some way, can be aesthetically witnessed; and how batteries can negotiate their ontology of violence in terms of a reach for all. One of the ways in which the naturalizations of this media/history of wasting can be brought into view and interrupted is by aesthetically examining the long chains or material-semiotic entanglements of the things at issue.[165] Central issues of this chapter then are the questions of what materials batteries are made of, where they come from, where they go, and what kind of garbage falls out in the process. Secondly, I deal with the question of what the aesthetic handling of these waste materials can open up. My stance on waste ties in with media ecology[166] as well as with the results of our research project *Times of Waste*.[167] In that project, we tracked the pathways and material transformations that smartphone waste undergoes. We realized the research project in an interdisciplinary team of six people and in collaboration with different project partners. One of these was Empa, a research institute at the ETH Swiss Federal Laboratories for Materials Science and Technology, that conducts audits in international e-waste recycling companies and prepares energy balances of battery recycling.[168]

Lithium-ion batteries have become indispensable in high-performance electronics because of their power output and have displaced other batteries such as the neodymium-containing nickel-metal hydride batteries. Batteries store and generate electricity based on electrochemical processes. Their cycles of charging and discharging are essentially based on three parts and the following elements, but specified differently depending on the type of battery: the stationary electrodes composed of copper, aluminum, graphite, cobalt and nickel; depending on whether they are charged or discharged, they are termed cathode (+) and anode (-). In addition, there is a separator made of carbon and the third element is the electrolyte made of lithium salts, in which the ions move freely. Accumulators are predestined to wear out by design, since their function, of enabling continuing charging cycles, inevitably results in reduced capacity and performance. This leads to an increasing demand for materials like the rare elements cobalt and lithium.[169]

To the extent that each battery has an outlet connected to an electricity distribution network that leads to a coal, nuclear or hydroelectric power plant, to a wind farm or to a solar cell, it would also make sense to think about the origin of the electricity. However, I am not pursuing this waste level in detail here. Just this: in Germany, 40% of electricity came from coal-fired power plants and 12% from nuclear power plants until 2016. With wind power, these figures have improved slightly since then. Nevertheless, almost half of electricity will still come from non-renewable sources in 2022

[163] Armiero, "FUMOGENI #2."

[164] See Chapter 1, pp. 7 sq.

[165] Ecological thinking following Timothy Morton and Karen Barad means thinking in long chains, it means thinking about where things come from and where they are going. Timothy Morton, *The Ecological Thought* (Cambridge, Mass.: Harvard University Press, 2010); Karen Barad, *Verschränkungen* (Berlin: Merve, 2015), pp. 184–185.

[166] Jussi Parikka, *A Geology of Media* (Minneapolis and London: University of Minnesota Press, 2015) and Kate Crawford and Vladan Joler, "Anatomy of an AI System: The Amazon Echo as an Anatomical Map of Human Labor, Data and Planetary Resources," September 7, 2018, https://anatomyof.ai (accessed August 15, 2022).

[167] See *Times of Waste*, https://www.objektbiografie.times-of-waste.ch/en/ (accessed July 3, 2023).

[168] Audits are quality controls of production processes, here of recycling processes. My thanks to the team of the Technology and Society Laboratory, Empa: https://www.empa.ch/web/s506 (accessed July 3, 2020).

[169] The prices of lithium and cobalt have increased five-fold on average over the last 20 years; speculation with raw materials, their conversion into mere values, into assets, is a lucrative business. But assets also have a material side and have to be stored somewhere, e. g. in a high-security outdoor storage facility at Zurich Airport, where the internationally active Schweizerische Metallhandels AG is hoarding critical metals such as cobalt in sealed barrels until they become more expensive.

and 2023.[170] In the course of the energy turnaround and the phase-out of nuclear power, Germany envisages that from 2025 40–45% and from 2030 65% of electricity generation should no longer be fossil-based.[171] To do so, Germany establishes, for example, "partnerships" with poorer countries who are transformed into geopolitical batteries to deliver "green power" to the north. So, the word "renewable" has a certain relativity. Also the rare earth element neodymium is now being used in modern wind turbines to make them lower-maintenance.[172] However, mining neodymium leaves behind radioactive sludge. Just for the electricity that each rechargeable battery continuously guzzles, one out of every two Teslas currently makes the fossil detour via coal, oil or gas, while one out of every five Teslas leaves behind radioactive waste as a result of the electricity produced by wind power.[173] The matter is further complicated if we add to this the fact that the range of an electric vehicle is on average 200 kilometers, but the battery of a Tesla is grossly oversized in response to range anxiety and can deliver about 650 kilometers. Additionally the gray energy[174] in a Tesla is so great that it takes a number of years until it becomes carbon-neutral. That excessive gray energy level is primarily because of the battery, which at the moment has an unknown number of charging cycles or kilometers, and how many years it will last, indeed whether it will even manage the 200,000–300,000 km mileage like a gasoline engine is unknown: the only conclusion is that a Tesla is a super-waste machine: in fact, cars—as particularly large and voracious mobile computers—are now among the biggest producers of e-waste. So while the small white Apple AirPods hide their ontology of wasting in an aestheticized minimalism, the two-ton black bolide twists it rhetorically into its opposite.

In short, mobile computers with their cells and batteries not only reconfigure the e-waste problem, but also appear friendly and cool. More and more devices are being miniaturized and interconnected by means of a battery-powered processor, potentially making everything digital. At the same time, the number of large devices is not decreasing. And the infrastructure behind them—their clouds and servers, is also constantly increasing. Miniaturization means that the enormous mountains of waste are no longer generated (only) after, but already before and during a device's use. This is because high-performance electronics, in which a large number of high-purity elements are combined in a very small space, consume raw materials at an unimaginable rate. Mining the raw materials for a smartphone generates more waste than it leaves behind at the end of its service life. The wasting caused by e-waste thus begins long before the product's use phase, which is also becoming shorter and shorter. The short use cycle is technically due to the permanently installed battery and economically due to the growth paradigm. Since it is now usually not possible to remove the battery from a device and replace it, the entire device has to be thrown away. The smaller it is, the more it will be disposed of in household waste—thus turning domestic waste into e-waste. And while until now poor countries in the Global South have been made the dumping ground for global e-waste[175] and at best have continued to use the obsolete devices, the first Chinese smartphone factories are already up and running on African soil. They are produced specifically for the African market. Africans are no longer just swallowing European and U.S. electronic waste, but are generating their own.

WASTING WITHOUT END

A machine is a technical object characterized by an "apparative logic" of "concatenations."[176] In this way, according

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170 See Fraunhofer ISE, "Nettostromerzeugung im ersten Halbjahr 2023," https://www.energy-charts.de/energy_pie_de.htm (accessed August 31, 2023).

171 See The Federal Government on Renewable Energies: "Das Zeitalter der erneuerbaren Energien," https://www.bundesregierung.de/breg-de/themen/energiewende/energie-erzeugen/erneuerbare-energien-317608 (accessed May 14, 2023).

172 See Jenny Lohse, "Environmental damage caused by neodymium in wind power," May 27, 2011, https://www.cleanenergy-project.de/umwelt/umweltschutz/seltene-erden-in-der-windkraft/ (accessed May 14, 2023).

173 I derived these figures on the origin of the electricity for the Tesla from the Fraunhofer Institute map cited in footnote 170 and the figures in Lohse (footnote 172).

174 The term "gray energy" refers to the energy consumed to produce a product. It is invisible and indirect and particularly high in the case of electronic devices, https://www.energiestiftung.ch/graue-energie.html (accessed July 3, 2020).

175 In 2015, 65% of the EU's e-waste was not disposed of correctly. The U.S. exports 85% of its e-waste and has never even ratified the Basel Convention that would prohibit that. Interpol/CWIT Project (2015), "Countering WEE Illegal Trade: Report Summary 2015," https://www.actu-environnement.com/media/pdf/news-25164-cwit-rapport-final.pdf (accessed July 12, 2023).

176 Georg Trogemann, "Synthese von Maschine und Biologie – Organische Maschinen und die Mechanisierung des Lebens," in *Synthesis: Zur Konjunktur eines philosophischen Begriffs in Wissenschaft und Technik*, ed. Gabriele Gramelsberger, Peter Bexte and Werner Kogge (Bielefeld: transcript, 2013) pp. 171–192, here p. 176.

to Félix Guattari, the machine can also include and machinate non-technical objects.[177] Machines, according to Guattari, are spatiotemporal assemblages that couple and decouple things, produce subjectification effects, and open or close possibilities for future machines. In the machine exists "something like a proto-subjectivity... there is a consistency function in the machine, a function of the relation to itself and to an alterity."[178] When I define the machines presented here—the AirPod and the Tesla along with their batteries—as waste-machines, I am claiming that they machinate everything that comes into contact with them, transforming it into waste and subjectivizing it according to the law of alterity or othering. Waste-machines mobilize a form of "ver–"—throwing, or better rejecting—that can be paradigmatically summarized by the symptomatic prefix ver– in German; in English this prefix does not exist in the same way, occurring in lexical rather than morphological forms. Thus "ver– words" in German are rendered as forget, repress, displace, deny, negate, reverse, relocate, waste or pollute in English. All these words point to the shallows of the psyche, of the society, to its failure in dealing with the waste. Ver– words show the other of the one, the other side of the fetish, the making of an abject, becoming an abject, the turning of the worldly world into inferiority, into shit. It is a symptom word that, like the Tesla, the AirPods or the Freudian slip, always says the opposite of what it does.[179]

In Swiss German there is no garbage, but only *Ab–Fall*, i.e. matter that has "fallen away" or "fallen off" (from the One), has become useless. Garbage threatens order and culture. That is why Mary Douglas speaks of "dirt" as "matter out of place," or Bertold Brecht of "dirt as matter in the wrong place."[180] Waste is extensive,

monstrous, alienating, feminine, queer.[181] The historian Bernd-Stefan Grewe defines "waste as matter" that is too firmly mixed.[182] It is matter that can no longer be broken down into valuable components (unlike the Earth's crust, in which the elements are distributed in such a way that they can be extracted). So mixing always means diminution: "downcycling"; what is mixed is unspecific, indifferent, worthless. Ultimately, waste is matter that does not disappear. There is always something that remains, based on the physical law that something cannot turn into nothing. Waste cannot be disposed of without a trace, because it always repeatedly "falls away/off" again.[183] Rather, disposing of waste means transforming it into smaller parts and relocating it spatially.[184] And recycling means extracting the little that is worthwhile. The large remainder remains or becomes waste. Because waste, says Myra Hird, "is anything but static and submissive: waste flows and mobilizes relations."[185] Waste, says Marco Armiero, is not an object but a "relation"; it is "wasting" based on "consuming and othering."[186] Waste is endless movement and transformation, endless mixing and shifting, endless becoming other, becoming remaining. "The remaining not only accrues—or falls "up"—it also stands out [...] The mere act of remaining always contains a form of resistance; it is testimony to an idiosyncrasy that does not merge into a clean distance between subject and object."[187] Or, to follow up on the previous considerations of ver–(throwing/rejecting), "Ver–" shows what is happening elsewhere. As in the case of the (Freudian) slip or the promise itself,[188] one must take the sound at its word in order to hear possible differences between what is said and meant, to hear the promise in the promising, to hear out the different futures and possibilities from the false. To put it another

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177 See Félix Guattari, "Über Maschinen," in Ästhetik und Maschinismus. Texte zu und von Félix Guattari, ed. Henning Schmidgen (Berlin: Merve, 1995) p. 118.

178 Ibid., p. 117.

179 On the artistic potential of displacement, see Chapter 2, pp. 19 sq.

180 Mary Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (London and New York: Routledge, 2002); Bertolt Brecht, *Flüchtlingsgespräche* (Frankfurt am Main: Suhrkamp, 2000), p. 12.

181 See Davies, "Toxic Progeny"; Elizabeth Grosz, *Volatile Bodies: Toward a Corporeal Feminism* (Bloomington and Indianapolis: Indiana University Press, 1994); Yvonne Volkart, *Fluid Subjects: Adaptation and Unruliness in Media Art* (Bielefeld: transcript, 2006).

182 *Times of Waste*, Workshop, Critical Media Lab/Institute of Experimental Design and Media Cultures, Hochschule für Gestaltung und Kunst FHNW Basel, October 15, 2015.

183 In Swiss German, *waste disposal* is coined "Abfall entsorgen" which means "taking waste's troubles away."

184 See Michael Lüchinger, head of the State Department for Environment and Waste Disposal, *Times of Waste,* Workshop, Critical Media Lab/Institute of Experimental Design and Media Cultures, Hochschule für Gestaltung und Kunst FHNW Basel, October 15, 2015.

185 Hird, "The Phenomenon of Waste World Making," p. 4.

186 Armiero, "FUMOGENI #2."

187 Lewe, Othold and Oxen, *Müll*, p. 9.

188 In German both meanings are the same verb: *versprechen*.

way, in the ambivalence and indifference of the mixed and discarded there are also chances, since what remains does not necessarily become superfluous nor disposable.

IN/FINITE MACHINES

Another definition of the machine could be that it wears out and becomes waste, waste that decays and evaporates but does not disappear—this in contrast to biological organisms that can heal and reproduce themselves. "The machine is the bearer of a finitude, it knows such a thing as birth and death," is "deadly to the outside, but also to itself," writes Félix Guattari.[189] As a device, the machine is finite, just as it is infinite as waste or as an accumulation of metals. *Times of Waste* interviewee Rainer Bunge of HSR Rapperswil put it this way: "It's very likely that a modern smartphone contains at least a few atoms of an arrowhead made in the Bronze Age."[190] Further, media theorists Jussi Parikka and Garnet Hertz claim "Computers are zombies."[191] Yes, but it could be added that they are revenants, but always in disfigured, "fallen off" or "fallen away" form. Jussi Parikka demands that we should conceive of media not as extensions of man, but, in a geological sense, as extensions of the Earth. "Technology is made of the raw materials of the earth" he quotes conceptual artist Robert Smithson.[192] Jean-Luc Nancy argues similarly when he says that "nature provides the raw material of technology."[193] In an unexpected way, our *Times of Waste* research also evolved in this direction, so that we defined the smartphone (the machine) as an assemblage of rocks, sediments and slags (fig. 22).

In short, the material side of the machine has acquired a completely new relevance through digitization. Contrary to cybernetic concepts that rely on the immateriality of information,[194] the exorbitantly increased demand for data-processing infrastructure and its monstrous waste shows that digitization is profoundly material: on the one hand, there is the immense demand for raw materials as its components as well as energy providers, and on the other hand, there is the acceleration and globalization that produces and seeks to satisfy enormous material needs. The current discussions about what is more devastating for the atmosphere, internet traffic or air traffic, show, in addition to the helplessness in the face of how to calculate such consumption and emission flows at all, that the increased mobility qua container shipping and air traffic and the associated quantity of transported goods must actually also be seen as a further, material effect of the internet.[195] And just as the steam engine used for coal mining simultaneously ensured the supply for its own voracity and generated new needs,[196] so too today the machines digging for raw materials satisfy their own hunger—and thus constantly create new needs. And waste.

RECYCLING

As part of *Times of Waste*, we created a sustainability scale of material use and generation for the smartphone. We came up with the following ranking:

1. Sufficiency and sharing models
2. Longevity of products
3. Use of second-hand products
4. Repair of defective equipment (difficult with smartphones)
5. Re-use of individual parts/component recycling
6. Various levels of material utilization (e.g., smelting metals) = classic recycling
7. Energy utilization (plastic, etc.)
8. Regulated landfilling
9. Illegal landfill

Material recycling ranks 6th on our list and is thus not rated as particularly sustainable. This is due to the high losses incurred by the material cycles, because the com-

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[189] Guattari, "Über Maschinen," p. 121.

[190] *Times of Waste* research group in telephone conversation with Rainer Bunge, Renewable Energies and Environmental Engineering, HSR Rapperswil, November 20, 2015.

[191] Jussi Parikka, *The Anthrobscene* (Minneapolis and London: University of Minnesota Press, 2015).

[192] Ibid., p. 5.

[193] Nancy, "Of Struction," p. 54.

[194] See Katherine N. Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999).

[195] Marcel Hänggi, "Circularity in the Sustainability Debate," lecture series at Lucerne University of Applied Sciences and Arts, October 23, 2019, http://www.mhaenggi.ch/ (accessed July 3, 2020); Crawford and Joler, "Anatomy of an AI System."

[196] See Hänggi, "Circularity in the Sustainability Debate."

Fig. 22: Installation view *Times of Waste—The Leftover*, Museum der Kulturen, Basel, 2017. The "smartphone" contains different granulats and slags from e-waste recycling.

position of a smartphone is so complex that only a few elements can be recycled in lengthy process chains. Although the smartphone is rightly dubbed an urban gold mine because, unlike "normal" electronic waste, it contains over 50 different elements, including gold, only around ten elements are ultimately recycled: these are primarily copper, gold, silver, palladium, platinum, indium and bismuth, as well as lithium, cobalt, nickel, aluminum and copper from the battery. For most elements, recycling is not financially viable. This is because it is cheaper to remove entire mountains of rock in countries with low environmental standards and child labor than to recycle them at high cost;[197] in addition, (probably for the same reasons) no industrially suitable process has yet been developed for certain substances, or the substances volatilize in the gold melt because they are unstable.[198]

The process chains for rechargeable batteries are smaller than those for smartphones, and the wear and tear caused by the permanent charging and discharging processes is greater. Therefore, if innovative processes are applied, batteries can be recycled more efficiently than smartphones. According to an ongoing study on the life cycle assessment of lithium-ion batteries by Empa, Duesenfeld-recycling by the company of the same name, which is based in Lower Saxony and focuses exclusively on recycling lithium-ion batteries, is one such innovative process.[199] In this process, the rechargeable batteries are mechanically and partly manually separated into their parts (cell shell and housing material; electrolyte; separator and foils; electrodes and other components), shredded and discharged. The electrolyte is then evaporated and recovered as condensate, and the other elements are separated from each other in stepwise hydrometal-

[197] *Times of Waste* Research Team, booklet *Times of Waste. The Leftover*, Museum der Kulturen Basel, April 23–September 24, 2017, https://times-of-waste.ch/wp-content/uploads/2018/06/ToW_Booklet_DE.pdf, https://times-of-waste.ch/wp-content/uploads/2020/01/TOW_Booklet_Berlin_136mmx210mm_EN_Prod_Web.pdf (accessed May 15, 2023).

[198] Rolf Widmer, Empa, on the occasion of the panel "Green Crimes," Haus der elektronischen Künste Basel HeK, November 15, 2017.

[199] Heinz Böni, Empa, telephone conversation with Yvonne Volkart, February 1, 2020.

lurgical processes and sorting. According to Duesenfeld, 85–90% of the lithium can be recovered in this way, as well as 55–75% of the entire battery cell. In conventional pyrometallurgical processes, on the other hand, which operate by melting down the metals, only 27% of the battery cell could be recycled. In addition, the conventional pyrometallurgical processes emit even more CO_2 because of the heating than if the batteries were manufactured from primary raw materials.[200]

The Belgian company Umicore specializes in the energy-intensive pyrometallurgical recycling of lithium-ion batteries. It is the largest in Europe and one of the few companies in the world that carries out battery recycling of hybrid and electric vehicles on a large scale. The company boasts a blast furnace capacity of 7000 tons of batteries per year, which is equivalent to about 250 million batteries from smartphones, two million from e-bikes or 35,000 from electric vehicles.[201] We came across this company as part of the *Times of Waste* research, as they also specialize in smelting precious metals from e-waste.[202] Part of its history is rooted in colonial times, associated with the mining company Union MiniŹre du Haut Katanga around 1906, when Belgium was mining copper in the Belgian Congo.[203] In 2001, the company broke away from mining to focus on precious metals refining and recycling. In 2019, it ranked seventh among the world's most sustainable companies, the same year it entered into a partnership with the ABB FIA Formula E Championship car series with the aim of recycling those batteries accrued during the races of the first and second seasons.[204] In the thermal process used by Umicore, the batteries are also first dismantled by hand before being melted together to form an alloy. Copper, cobalt and nickel are extracted from this using hydrometallurgical processes. The resulting slag is passed on to external partners for lithium recovery or directly to the civil engineering industry. The elements contained in the slag can be mobilized by acid rain and thus become potentially toxic, hence, building roads with such slag is prohibited in Switzerland, unlike in Germany or the Netherlands. Duesenfeld complains that this thermal process produces several types of highly toxic gases and fly ash, and their filter material is classified as hazardous material.[205] And hazardous material, as I know from our research, is temporarily stored in disused mines—I say temporarily stored because there is no final disposal for this type of waste.

Another recycling process using shock waves is being developed by the Fraunhofer Institute for Materials Recycling and Resource Strategy IWKS, but is not being used industrially. In short, the problem with current battery recycling, as with smartphone recycling, is that it is energy-intensive, generates new waste and is more expensive than using primary raw materials. In addition, pre-sorting is costly and requires human labor, which is expensive in the Global North. As long as the global economy rewards those who produce particularly large amounts of waste and passes the real costs on to those living geographically elsewhere, recycling (urban mining) will not be able to establish itself as the main source of raw materials despite stoked fears of raw material shortages, ecological considerations and innovative methods. A circular economy will not take hold until the real costs incurred are redistributed from the ground up in an equitable manner—and when leftovers are co-managed. As Lewe and her co-authors put it:

[200] http://duesenfeld.com (accessed May 15, 2023).

[201] Joachim Harder, "Battery recycling," *recovery* 5 (2020), https://www.recovery-worldwide.com/en/artikel/high-growth-rates-due-to-electromobility-3580404.html; Umicore, https://brs.umicore.com/en/, and Christian Hagelüken, "Recycling rare metals from waste electrical equipment," presentation July 5, 2018, https://www.esmfoundation.org/wp-content/uploads/2018/07/HSR_Zug_Hagelüken_2018-07.pdf (all accessed September 1, 2023).

[202] Ideally, discarded Swiss smartphones do not end up in the common electronic scrap, but go directly to Hoboken to the precious metal smelter.

[203] See Umicore, "History," https://www.umicore.de/en/about/history/ as well as the explanations on Wikipedia (German only): "From the beginning, copper mining was organized as a monopoly, as the mining company Union MiniŹre du Haut Katanga (UMHK), founded in 1906 and controlled by Belgian capital, singularly dominated the local raw material exploration and mining. It had been granted its mining rights until 1990, and these covered an area of over 20,000 square kilometers with all the copper deposits known at the time," trans. Peter Burleigh, "Copperbelt," Wikipedia, https://de.wikipedia.org/w/index.php?title=Copperbelt&oldid=198676825 (both accessed August 15, 2022).

[204] Umicore, "Umicore partners with ABB FIA Formula E Championship to implement battery recycling program," https://www.umicore.de/en/media/press-releases/umicore-geht-partnerschaft-mit-abb-fia-formel-e-championship-zur-umsetzung-eines-batterierecycling-programms-ein/ (accessed August 15, 2022).

[205] "Ecofriendly Recycling of Lithium-Ion Batteries," Duesenfeld, https://www.duesenfeld.com/recycling_en.html (accessed August 15, 2022).

universal, unreflective relabeling of waste as a commodity helps create a discourse that predominantly prevents effective waste prevention practices. A disconnect exists between the public perception of recycling as an unquestioned good deed and the hard fact that it is, after all, a process of "down-cycling" that precisely does not operate residually, that instead consumes energy and degrades material quality.[206]

"THIS IS COBALT. THE REST IS WASTE, WASTE, WASTE"

When we talk about batteries and their waste, we inevitably end up in both mining and the Global South, as mine sites are placed less where raw materials are particularly abundant and more where they may conveniently meet low environmental and social standards. Copper and cobalt are not only the main components of lithium-ion batteries, they often occur in the same ores. So we end up in Africa's copper belt, a region about 800 kilometers long and 250 kilometers wide between Zambia (Copperbelt Province) and the southeast of the Democratic Republic of Congo (DRC, formerly Katanga Province), where the Union MiniŹre du Haut Katanga (now Umicore) already operated its monopoly. The belt is the largest copper and cobalt mining area in the world, with more than one-tenth of global copper deposits located here. The DRC is also the world market leader in the extraction of cobalt, with a 60% share of production. Particularly strongly present in this domain is the Swiss-based commodities group Glencore with various subsidiaries, who have been criticized and legally prosecuted by various NGOs for environmentally damaging open-cast mining, human rights violations, tax avoidance, infrastructure development for their own interests and lack of investment in basic local services.[207] Also strongly represented are Chinese traders and companies that exploit legal loopholes in Congolese law to "infiltrate" illegalized small-scale mining into the region.[208] While researching *Times of Waste,* we met artist and filmmaker Daniel Kötter, who was working on his four-part documentary *Chinafrika.mobile*. He was dealing with the same smartphone issues as the *Times of Waste* team as part of the art and exhibition project *Chinafrika.underconstruction* (with Jochen Becker): resource extraction, production, reuse, recycling. His research led him to Kolwezi, the center of small-scale mining of cobalt and copper, where he provided traders and prospectors with a cell phone as a recording device. We agreed with Daniel Kötter that he would record some of his films also with regard to the interests of *Times of Waste*: he made them available to our project as raw material.[209]

In this 12-minute video excerpt (Part I of *Chinafrika.mobile*) (fig. 23), we are close to the rock, the people and their visions. Sometimes the image blurs, so close are we, so moving is it. To begin with, everything is just dark, rhythmic stone tapping is audible. A dancing light—a little later we make out a digger, in the narrow, makeshift shaft. He is a friend of Marcel Kapete, a trained teacher turned prospector who is filming while narrating in the off. As if in a lecture, he explains each of the steps. First he judders the wall, then he hacks out the sometimes dangerously soft rock, then he points to the cobalt: little black specks in grayish-white chunks: "This is cobalt, but all the rest is waste, waste, waste." He smashes up the chunks so he can cram the sack full and gloats, "Good product." Later, we see his colleague climbing out of the deep hole in the reddish-brown earth: many a man has fallen to his death here. "We only know what the whites tell us about the cobalt: 'This is made from cobalt...' I don't know where the cobalt goes and what they do with it. The great nations come to exploit here. But no idea what they will do with it." Marcel Kapete's words are a symptom of what Rob Nixon calls "slow violence"[210] and what especially characterizes the violence caused by digitalization: intertwined, global process chains affect people's lives and thoughts, exploiting them without them knowing the course of the entire chains or being able to profit from them. Kapete, who, like everyone else here, calls himself a "prospector" ("creuser"/"digger") and not a "miner," knows everything about the extraction

[206] Lewe, Othold and Oxen, *Müll*, p. 14–15.

[207] See Heks, "Vom Segen zum Fluch: Glencore und die Menschenrechte," https://www.heks.ch/glencore (accessed August 15, 2022).

[208] This formulation is used by journalist Jean-Jacques Kalonji in Daniel Kötter's video excerpt from *Chinafrika.mobile*. See a recent study on small-scale mining: Federal Institute for Geosciences and Natural Resources, "Mining Conditions and Trading Networks in Artisanal Copper-Cobalt Supply Chains in the Democratic Republic of Congo," https://www.bgr.bund.de/EN/Themen/Min_rohstoffe/Downloads/lieferketten_abbaubedingungen_artisanaler_Cu-Co-Sektor_DR_Kongo_en.pdf?__blob=publicationFile&v=3 (accessed August 15, 2022).

[209] Kötter in *Times of Waste*, https://objektbiografie.times-of-waste.ch/en/mining/#Kolwezi (accessed August 15, 2022).

[210] Nixon, *Slow Violence*.
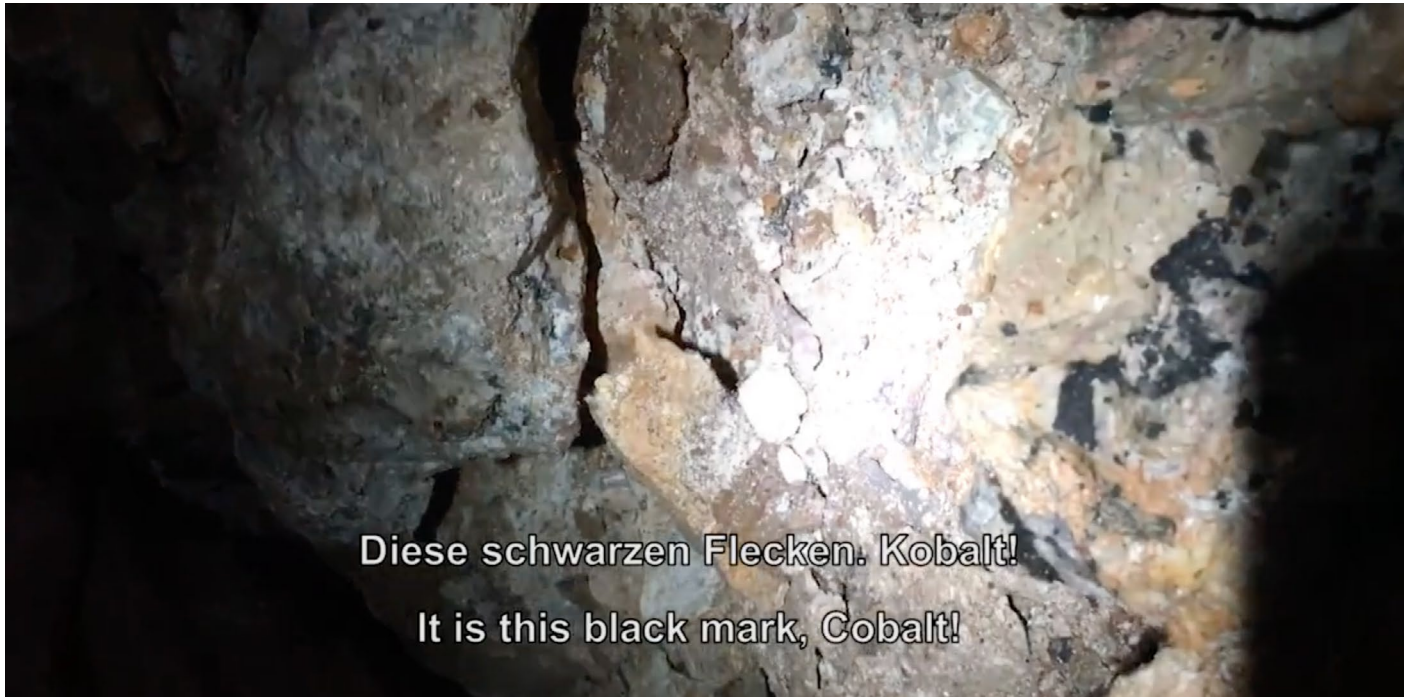
Fig. 23: *Times of Waste* and Daniel Kötter, *Chinafrika.mobil,* mining of Cobalt.

of the rock from the Earth's crust, but nothing about its role in the subsequent process and value chains (we, too, only found this out through research). He only knows the demand, the increasing consumption. His lack of knowledge is exemplary of exactly our technological and economic lack of knowledge and is put into a larger context in the film by the comments of the local journalist Jean-Jacques Kalonji: "Why does the Congo not participate in the process of producing mobile phones?" he asks, thereby bringing the perpetuation of colonialism to the point: mining and draining raw materials while at the same time wasting the land, without the people concerned benefiting from it. "Congo could also play a role in the field of electric cars..." With him, we walk to the edge of a huge open-pit mine where cobalt—or copper—is mined with large machines: instead of the narrow, cloth-covered holes and the people working there, we see roadways, ruts, and machinery—the usual torn-

up landscape worn away in circles with toxic tailings, wastewater lakes. Images that always look the same, no matter what commodity is involved and where on Earth we are. "We could end the war in East Congo, through implementing a battery factory there... To sell products instead of raw materials... All raw materials that are necessary are here in Congo. This isn't all too difficult. This is rather a question of commitment." The film ends with the roar of excavators removing earth and piling it up elsewhere. Whether a battery factory actually made things better is only questioned later, in subsequent parts of *Chinafrika.mobile.* However, the film clip here suggests that illegalized small-scale mining involved local people and provided them with a livelihood. Later, too, when scrap markets in Lagos are visited in the film, the impression matures that there are forces slumbering in small-scale entrepreneurship that do more than just ensure survival for those living there.

LITHIUM—THE WASTE OF THE MOTHER MOUNTAIN

Next landing site: Salar de Uyuni, a salt pan in the Bolivian highlands, where half of the global lithium deposits are stored, recently the site of lithium extraction. The video *We Power our Future with the Breastmilk of Volcanoes / Lithium Dreams* (2015–2018) (fig. 24) by the English artist group *Unknown Fields* presents the raw material lithium as both astronomical and physical waste: it is female and maternal fluids that mix and crystallize into a salt desert.[211] The footage, shot by a drone, provides abstract images, patterns, pools that change from toxic green to azure blue, an elegiac female voice speaking in broken English. She tells of the Big Bang that released those elements that are fought so hard for today, of the salt desert in the Andes that holds the coveted lithium, and the mountains that are sacred to her people. She tells the myth that seeks to understand the formation of this inconceivable plateau: it is the tears that the volcanic

mother wept for her lover when he left her, mixed with her breast milk that flowed out. It is the white waste of the giantess, transformed by a transnational factory into colored liquid, volatility and dirt.[212] In the video astronomical, geological, mythical and capitalist dimensions of time and space collide. The beauty of the images and the tranquility of the alien-sounding voice contrast with the colonialist violence of the excavation, which impresses strange patterns onto the Earth. This aesthetic collision underscores the disproportionate nature of resource extraction, which in a very short time will have destroyed the place where mythic dimensions and astronomical times have reigned. The coincidence of myth (the story of mother's milk and tears) and progress (in the form of lithium vaporization) and the incongruity and clash of their insertion in the title generate a desert-like mood of acute pain. In it, the ancient mourning of the mountain, its desolate weeping, is repeated with a variation: the loss of the mountain's beloved becomes the theft from a people who have other values and at the same time fewer rights. By linking geological deep time[213] with mythological time and the accelerated time of machines, the video reveals how different time scales can operate simultaneously in acute cinematic time. This strategy underlines the multiplicity of perspectives and actors and shows that, beyond the capitalist time of undermining, other temporalities apply.

The juxtaposition of the abject (in the form of dirt, wounds, and wasting) with beautiful visual abstractions allows the audience to experience nonlinear progress and loss of control on both a temporal and aesthetic level. A transversal flow of cyclical events and affective subjectivities is introduced: we see and hear cracks and fractures, we feel that something is going wrong, and we sense that "green" technology is not the next step in the progress story of technological innovation. Rather, it is a technological variant, another stage of loss and exploitation in times of wasting. The video involves us in a grief that is more-than-human, combining it with the paradoxical situation of simultaneous proximity and

211 See Unknown Fields, *We Power our future with the Breastmilk of Volcanoes*, http://www.unknownfieldsdivision.com/summer2015bolivia+atacama-lithiumdreams.html (accessed August 15, 2022).

212 The company is called Yacimientos de Litio Bolivianos (YLB) and is a state-owned enterprise founded by former President Evo Morales. There are partnerships with a Chinese company and a German consortium from Thuringia, which apparently also promised to comply with environmental standards; this type of state-organized extractivism is an example of the neoextractivism taking hold in Latin America.

213 The concept of geological time, which grasps the history of the Earth from a geological perspective, was supplemented by John McPhee in 1981 with the concept of *Deep Time* in order to get an understanding of the large periods of time involved. It has gained currency through the Anthropocene and media ecology discourse. See Archive for Media History, "Tiefenzeit und Mikrozeit," https://www.ikkm-weimar.de/publikationen/archiv-fur-mediengeschichte/cfp-tiefenzeit-und-mikrozeit/ (accessed July 3, 2020).

Fig. 24: Unknown Fields, *We Power our Future with the Breastmilk of Volcanoes / Lithium Dreams*, 2015–2018.

distance created by the bird's-eye view of the drone. The resulting affective aesthetic is strange and obscure, beyond conventional human perception.

We Power Our Future with the Breastmilk of Volcanoes / Lithium Dreams manifests that raw material production is waste production, and that the battery of a drone, the entire drone or a *Tesla* is always already waste. Another work within this transmedia project deals with the battery as a medium of "ver–throwing/rejecting." This involves a handcrafted glass battery. It contains an anode and cathode made of aluminum, nickel and graphite, immersed in a lithium brine electrolyte collected from the Salar de Uyuni.[214] This volcanic battery, according to the artists, produces a slow chemical reaction in the course of which it discharges drop by drop, like a weeping mountain. "If mourning is to be a passage to political action, reason and feeling have to be engaged together," writes Gene Ray.[215] That is what this film allows us to experience aesthetically. But the interesting thing is that people no longer play a role. Grief is an emotion felt by a mountain, while the images that go with it were shot with a drone, a surveillance and consumer technol-

ogy. Paradoxically, it is the drone that witnesses what is going on in this forgotten place of the world. It scans the plateau from above, revealing the acute situation of exploitation from a distance, but it is also part of it. The drone and its battery, like ourselves, are involved both in extractivism and in overcoming it.

THE BATTERY—A PLACE OF BECOMING

Batteries feed the flight of the drone and the recording function of the camera. The existence of the images we get to see in the video by *Unknown Fields* is based on the material whose exploitation they allow us to perceive. This makes it clear that we are deeply enmeshed in recolonization, even when we want to make things better and use drones to educate ourselves about the prevailing abuses. At the same time, it also becomes clear that if we know the materiality, routes and transformations of our technical objects, we could then develop other forms of subjectivation and alterity. Forms in which we do not simply react with crude bans, such as the Dodd-Frank

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[214] The battery was manufactured with the help of Eduardo Andreu Gonzalez and Donal Finegan, science consultants at Aimer Ltd. Battery.

[215] Gene Ray, "Writing the Ecocide-Genocide Knot: Indigenous Knowledge and Critical Theory in the Endgame," *documenta 14*, # 3, issue 8 (fall/winter 2016), p. 121.

Act does,[216] which operates blanket bans on the importation of raw materials from countries with conflicts, thereby creating much suffering, but also seek to take responsibility. In Switzerland, the "corporate responsibility initiative" failed to gain traction in the Corona 2020 crisis vote in a referendum that was delayed for years by pro-business parties. The initiative called for transnational corporations that have their tax domicile in Switzerland to be held liable in Switzerland for their actions abroad. Exploitation of people and their environment in the Global South should, according to the majority of Swiss in the referendum, be held to account, yet the initiative failed in the cantonal count.[217] Interestingly, the EU has introduced a similar corporate responsibility law in 2022. It remains to be seen whether legal disciplines and police procedures such as "Green Criminology,"[218]

which have become established in recent years, will prevail against the politics of re-colonization. We cannot easily escape digitalization and its economy of wasting, but we can witness and fight its current forms in the centuries-old history of exploitation—a struggle that is also a possible detriment to the financial prosperity of Western countries. As the WasteMachines teach, waste management that is not simply displacement and dislocation at the expense of others cannot be had for free. Artistic projects such as *Chinafrika.mobil, We Power our Future with the Breastmilk of Volcanoes / Lithium Dreams,* and Milo Rau's *Congo Tribunal,* mentioned in the introduction to this publication, can help make us willing to pay our share of the global cost—or to accept that we drive with a shorter range.

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[216] Global Witness, "US Conflict Mineral Laws," November 15, 2017, https://www.globalwitness.org/en/campaigns/conflict-minerals/dodd-frank-act-section-1502/ (accessed May 15, 2023).

[217] https://konzern-initiative.ch (accessed July 4, 2020).

[218] Since the definition of *Green Criminology* by Michael J. Lynch, the discussion has become more heated: activists call those who pollute the earth by producing and dumping hazardous equipment and materials, thus depriving others of their livelihoods, criminals who must be held legally accountable. See Nancy Frank and Michael J. Lynch, *Corporate Crime, Corporate Violence* (Albany NY: Harrow and Heston, 1992).

5

M-OTHERING: TENDING AND HEALING

What does it mean to allow oneself to inhabit that which is strange, nonintuitive, insensible—that which is remote from human comprehension or intelligibility—like phytoplankton, seeds, fungi, geological epochs, or multicelled organisms at the beginnings of time?[219]

Human beings can help heal the earth. The ruinousness of the Wasteocene must be interrupted by means of reproductive—generative, caring, healing—practices and transformed into something living, growing—a "Planthropocene."[220] This is how one could sum up the science fiction *Pumzi* (2009) by Kenyan artist Wanuri Kahiu (fig. 25). This short film is an outstanding example of decolonial maternal care that allows for fundamental alterity and includes other-than-humans. Caring for the Earth, wanting to heal it, is not as usual ridiculed as self-overestimating, nor criticized as a typically female role, but staged as something creaturely and even as a driving force for the decolonization of land, body and knowledge. I call the technology of caring to become one with others made possible in and through the film *becoming M-othering—literally enclosing, enclosing the other. Mothering as not othering*: it is reproductive and therefore "maternal," but lacks the attributions of that holistic, controlling or appropriating all-maternal that normally circulate. It is not altruistic, although it might give that impression at first. It is supra-individual, is political, and includes the other side of the generative—namely life-ending practices. While the film was widely and positively received internationally, it caused a good deal of controversy in my circles: many found it difficult to accept this epically staged maternity, a symptom that is not surprising given the difficulties the dominant culture has with maternity or developing other forms of it.

Pumzi is set in a dystopian technocratic control society of the future, the Maitu community in East Africa, after the Third World War: the great water war. It is

about the "MAITU (Mother) Seed," as the camera shot of a large seed and a dictionary insert at the beginning suggest; because in the language of the Kikuyu (the largest ethnic group in Kenya) Maitu is called "mother" and derives from the words "truth" and "our truth." So it is about letting grow, about breathing, because *Pumzi* means "breath" in Swahili, and about exchange; in short, about making the creaturely possible. Water has become scarce, so is constantly recycled from bodily excretions; even electricity has to be produced by physical effort. People live joylessly in a sealed-off techno-bunker, because, as a newspaper clipping from the past suggests, the planet has become a polluted desert as a result of the greenhouse effect. Slowly, the camera traces relics of organic life on Earth: skulls, insects, seeds—all sealed and stored in jars, the dead exhibits in a sterile-looking Virtual Natural Museum. And inside, asleep at her desk, the protagonist Asha. She dreams of water, of a tree, of laughter, of a "sensual" life. Later she will receive an anonymous package with soil. She no longer takes the mandatory prescribed pill to suppress dreams and, contrary to instructions to do so, she does not hand over the earth. As a technically experienced conservator, using her instruments, she is able to examine the composition of the soil sample herself: "no radioactivity detected," is the result. Maybe, despite what the government claims, not everything is contaminated after all. Now her senses are also awakened and she begins to trust the knowledge they impart to her: she touches and smells the earth, puts a seed from one of the museum exhibits into it, and falls into forbidden dream realms again. Every day she waters the soil and watches the plant grow. "The soil is alive," she tries to justify herself to her superiors; and, when side-lined, breaks out from the confining surveillance society. The world outside, a smoldering, extinct desert, is the landfill of the world inside. Guided by the tree of her dreams, now only a mirage, she sets out on a painstaking search for a suit-

219 Kathryn Yusoff, "Insensible worlds: postrelational ethics, indeterminacy and the (k)nots of relating," *Environment and Planning D: Society and Space*, vol. 13 (2013), pp. 208–226, here p. 225.

220 See Myers, "How to grow livable worlds," and the discussion in Chapter 3 of this publication, pp. 39 sq.

Fig. 25: Film still from Wanuri Kahiu, *Pumzi*, 2009.

able place to plant her Mother Seed. She gives it her last water and lies down dying, nourishing the plant with her death sweat. In the final image, a vertical zoom-out, a growing tree emerges from her body, which at the same time, through the receding camera, becomes a smaller and smaller dot in the vastness of the desert. At the very end, a rainforest and the title "Pumzi" are inserted: the techno-bunker embedded in the desert, on which the camera descends from the atmosphere above at the beginning of the film, becomes body, forest, breath. The protagonist's death is not the end, but post-subjective, post-human plant-becoming:

… by donating her body across species and metamorphosing into a human*tree, Asha and other in*animate actors create futureS for planet earth that overcome the culture-nature divide and position humans in mutual entangle-

ments (in terms of genes and conviviality) with other variants of organic life.[221]

Her body has, says Katrin Köppert in reference to Donna Haraway, "become compost… to give the world another chance."[222]

But Asha's becoming compost and tree is not only staged narratively and visually, but also structurally. The film itself behaves in a vegetal way and performs the cyclical dimensions of becoming and decaying—for example, with the zoom-out at the end inverting the zoom-in on the techno-bunker at the beginning of the film. Or that the tracking shot reverses the enlargement of the tree into a shrinkage until only circling dots can be seen in the yellow sand—seeds that, inconspicuous as they are, open everything up again. In this way, body *and* film combine to create an ecological event of breath-

221 Susan Arndt, "Human*Tree and the Un/Making of FutureS: A Posthumanist Reading of Wanuri Kahiu's *Pumzi*," in *Future Scenarios of Global Cooperation. Practices and Challenges*, Global Dialogues 14, ed. Nora Dahlhaus and Daniela Weißkopf (Duisburg: Käte Hamburger Kolleg/Centre for Global Cooperation Research [KHK/GCR21], 2017), doi: https://doi.org/10.14282/2198-0403-GD-14, pp. 127–137.

222 Kat Köppert, "Eine filmische Gegenerinnerung der ökolonialen Gegenwart," August 23, 2018, *zfm*, https://zfmedienwissenschaft.de/online/gender-blog/pumzi (accessed May 14, 2023).

ing and thriving, in which different times, spaces, beings and desires come together: Mythical images and recurring dreams of "nature" and joy—that is, what may be the past in the film, but still reality for the audience—a cyclical atmosphere of variation, return and surplus, as inherent in reproductive cycles. At one moment when the protagonist is in the desert, she winds a cloth around her head as protection against the scorching sun, having become a desert person; later, when she is lying down, the cloth becomes a blanket, shroud and tent (for the sapling). The techno-woman coming out of seclusion becomes environmental, life-giving mother, giving her life for her offspring, the "MAITU (Mother) Seed." The death of the individual, the mother, in favor of the reproduction of the species, the other, which already carries the possibility of becoming a mother. In this respect, Michael Marder has noted that the decision to die is a cognitive form of vegetal life. It is a form of vegetal decision-making in which the future good of the collective is placed above the present good of the individual.[223]

Such images with the death of the woman as a vision of the Planthropocene are also reminiscent of the many female figures in art and literature who die to ensure the survival of the artist and his work; and of the socially-sanctioned expectation of maternal self-sacrifice for family and nation. Possibly it was associations such as these that triggered discomfort with the film in my environment: those productions of caring until death, which were interpreted as one-dimensional. I always countered such criticisms by saying that despite the mythical dimensions with which maternal caring is presented here, there are many refractions: starting with the society of control, in which the economical use of water and energy takes place less as an ecological adaptation to an environment that has become desert than as the violent maintenance of an outdated technocratic *status quo*. The community itself, although it is called Maitu/Mother and seems to be essentially governed by Black women, is not simply good in the sense of a decolonial counter-narrative. Help for Asha, for example, comes from a subaltern White woman; but the hierarchies run more subtly than just

contrasts between Black and White. Furthermore, the images of Asha in the desert suggest the desert dweller adapted to the climate and perhaps even something like the "eternal Mother Africa" from whom the world's population descends. But they are also reminiscent of abandoned (climate) refugees from the Global South who perish in the Sahel because the borders to the Global North are sealed. And the final image does not simply show the green lung of the rainforest, but the sharp lettering "PUMZI" stenciled out of the black background asserts itself almost aggressively into the picture. It is these refractions that prevent any teleological pathos and stereotype. In this sense, the woman's becoming compost is not the—once again—allegorically gendered sacrifice for the survival of the Earth. Rather, in this decision to transform, "being-towards-death" is fulfilled, to follow Heidegger. On the one hand, this is creaturely, on the other hand, it is distributed unfairly in global economics: some have to die too early; others too late. While these facts are repressed in capitalism, *Pumzi* celebrates the art of dying as a joyful eco-event as well as a militant call for "The Universal Right to Breathe":[224] rejecting the disposal of the Black woman's body as a territory of economic, techno-scientific and sexualized violence while re-actualizing an excessive maternal love. This love is powerful and threatens the symbolic order. For it decides whether to bring forth life or not. And it shows that relationality and intimacy are not necessarily tied to sexuality.[225] Even Annie Sprinkle/Beth Stephens' lustful call for an Earth as "your lover, not mother," does not apply here, as it is, although in a trans-species way, committed to the dominant sexualization of relationships.[226] In this sense, M-othering becomes a rallying cry for decolonization in many directions.

CARING ECO-MASCULINITY

Just as Western audiences may struggle with the subtly fractured maternalism of *Pumzi*, it seems no coincidence that Technologies of M-othering as Tending and

[223] Michael Marder in conversation with Felipe Castelblanco, July 2022.

[224] This is also a reference to Achille Mbembe, "The Universal Right to Breathe," *Critical Inquiry,* Vol. 47, No. S2 (Winter 2021), https://www.journals.uchicago.edu/doi/full/10.1086/711437 (accessed May 14, 2023).

[225] In an interview with Kristin T. Schnider on the film *Rafiki,* Wanuri Kahiu points out that it is one-sided to always reduce the abundance of (love) relationships to sexuality. Kristin T. Schnider, "To fall in love is exceedingly African," *Aargauer Kulturmagazin,* December 2018/January 2019, pp. 24–29.

[226] Stephanie Theobald, "Nature is your lover, not your mother: meet ecosexual pioneer Annie Sprinkle," *The Guardian,* May 15, 2017, https://www.theguardian.com/lifeandstyle/2017/may/15/nature-ecosexual-annie-sprinkle-porn-star-queer (accessed May 14, 2023).

Healing are substantially developed among artists of postcolonial, indigenous, and queerfeminist critique.[227] Where the appropriation and annihilation of "maternal-generative" aspects is coupled with the erasure of reproductive modes of existence—enslavement, persecution of queer sexualities, or annihilation of subsistence and spirituality, Mother Seed, womb, vulva, feminine energy, or caring—reproductive behaviors are perceived not only as feminine stereotypes, but also as creaturely forces with the power to transform conditions. As such, they belong to all Earth-dwellers and, in a radical intertwining of culture, politics, spirituality, and economics, must be re-appropriated. In an interview with artist Oliver Ressler, ecofeminist Marie Mies tells of how women farmers in Bangladesh, who had lost not only their livelihood but also their respected position as custodians of the seeds due to the industrialized "Green Revolution," increasingly became victims of male violence. To escape their misery, they would then have killed themselves with those pesticides that the agro-industry sold them. Only small-holder movements initiated and organized by women were able to stop this spiral of violence. Mies and her colleague Veronika Bennholdt-Thomsen were also able to use numerous global examples to show how "good life," which reproduced itself in a subsistence economy, was deliberately turned into a waste machine, with the support of the World Bank.[228] In short, where violence and injustice are more massive and the losses more obvious, where compensatory prosperity does not turn a blind eye to the fact that the colonization of mothering aims at the colonization of "bare life," care technologies of mothering are found more frequently.

Next scenario: Lapland. A rising sun in front of a snowy white landscape: "At home," you hear a voice say in Finnish. A few images further on a dog on a snowmobile, accompanied by the voice: "Everyday routines. Exhausting. Arresting." Again and again these images of the dog on the machine, looking into the landscape. It is a herding dog, not enjoying the landscape, but being there, observing, working, resting. The 16-minute video meditation *Manifestations* (2017) by Leena Valkeapää tells about life with reindeer (fig. 26). It is also the life of

the artist, the partner of the Sami reindeer herder Oula A. Valkeapää. The video consists of a calmly timed sequence of photos with synchronously spoken text messages sent to her by Oula A. Valkeapää over the course of a year, from one winter to the next. The texts are poetic reflections, his own or those of his uncle, the Sami poet, activist and first secretary of the World Council of Indigenous Peoples, Nils-Aslak Valkeapää (1943–2001). Life is grueling, but also fun, and is defined by constant concern for the animals: "I look at my little ones from a distance. What are they up to? I try to understand. Interpret." The tenderness of his words, of his images, makes it clear that it is precisely in this, in this constant reference to his loved ones, that his fulfillment lies: "The reindeer seemed happy. So am I, too." This is Descartes' *cogito ergo sum* in the creaturely, world-connected, maternal version: I think that my cub is (happy), therefore I am (happy).

The vast landscape in white: As much as it shows itself to us as an empty, still image and touches the limits of humanity—"White. White."—it becomes clear that it is a territory inhabited by many living beings, who in turn want to observe, make contact or play. Hardly once does Oula A. Valkeapää speak as I, there is always a we, an encounter—with tracks in the snow, with young foxes, with water in summer, with dreams and songs. The world is a coming together of many, a constant opening towards what is, what is becoming. Words, pictures—made with the cell phone—meet the dog, the snowmobile. Reindeer, a tent, signs of nomadism. "Home," *oikos,* is outside, a zone of hundreds of kilometers, determined by the grazing routes of the animals and the climate—sometimes not used as pasture for years and yet indispensable for survival, as a reserve for bad times. The video only hints at the fact that this life in the subarctic zone of Finland, due to the unpredictability of climate heating and the destruction of fertile pastureland by forest and mining industries, is coming to an end. It takes a different approach: it evokes what is currently "manifesting" in Oula A. Valkeapää's environment—bare life—as mystery, miracle or simply everyday life. Because tomorrow it will be different. This is poetization, perhaps romanticization, but never transfiguration or nostalgia. Be-

[227] Johannes Paul Raether's actions as the world healing witch Protektorama, or Tabita Rezaire's aesthetic-spiritual yoga sessions for the self-healing of U.S. Black Womenx who had their wombs stolen, or for Africans buried in the Atlantic Ocean who died during the crossing into slavery are important examples. See Yvonne Volkart, "Postfuturistische Körper," *Kunstforum International*, Vol. 267 (2020), pp. 140–147, and Volkart, "Flowing, Flooding, Fibbing."

[228] Mies, "The Subsistence Perspective," as well as Maria Mies and Veronica Bennholdt-Thomsen, "Defending, Reclaiming and Reinventing the Commons," *Canadian Journal of Development Studies / Revue canadienne d'études du développement* 22:4 (2001), pp. 997–1023, https://doi.org/10.1080/02255189.2001.9669952 (accessed January 2, 2023).

Life opens up before me as a poem without words.

Fig. 26: Video still from Leena Valkeapää, *Manifestations*, 2017.

cause Oula A. Valkeapää and his household live, as Leena Valkeapää writes, "in the Anthropocene. There is no limit. Only hybridity."[229] This can be seen, for example, in the fact that not only is Leena and Oula A. Valkeapää's communication based on smartphones and messenger services, but the entire video is dependent on such technology or media. What appears in *Pumzi* as a visionary dream of a lost world, of a no-more, is witnessed in *Manifestations* as an always-yet, as a stubborn insistence of an aesthetically timed (video-mediated) time that stands still in seconds: the mode of existence of indigenous subsistence that was made impossible in the Wasteocene is still possible, says the beat of the images. It is a "good life" that gives pleasure, say the images and messages to his wife, to us. The "mother" of the animals, the keeper, is a narrator who remains invisible, speaking in an alien way, perceptible only through the forms of relationships he establishes. *Manifestations* thereby makes "manifest" a maternal caring eco-masculinity, a social being that defines itself as dependent on others and follows the decisions of its herd.

THE OTHER MOTHER OF THE PLANT

Pumzi and *Manifestations* counter the wear and tear of bodies and the colonization of knowledge in the Wasteocene with "time-honored" maternal practices of care, such as planting, herding, nurturing, and healing; at the same time, they use current technological infrastructures and so show themselves as deeply woven into these structures (and associated modes of wasting)—thus, at the level of narration, Asha uses data and computer-based analytic techniques to examine the earth and verify her feeling, while Oula uses smartphone and messenger services to communicate his impressions and care, from which he extracts a video meditation. But what does caring look like when it is exercised with methods that are unequally more tech-savvy? Taking Špela Petrič's project *Phytoteratology* (2016) as an example, the last part from the three-part series *Confronting Vegetal Otherness* (2015–2017), I discuss forms of maternal care in the context of Bio Art (fig. 27, 28).[230] This not only operates with biotechnological laboratory methods, but also suggests that it plays with and modi-

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[229] Leena Valkeapää in a conversation with the author, December 2019.

[230] Špela Petrič, "Confronting Vegetal Otherness: Phytoteratology," https://www.spelapetric.org/phytoteratology (accessed May 14, 2023).

Fig. 27: Špela Petrič, *Phytoteratology*, artists presentation at Het Glazenhuis, 2016

fies the matter of the living. For the artist, who holds a doctorate in biochemistry, the laboratory in art stands for the fact that the Earth has become a laboratory; it is from there that action must be taken; with laboratory art, or with what I called *labbing* earlier,[231] the prevailing mania for feasibility can be infiltrated and other relations between humans and other-than-humans can be established.[232] *Phytoteratology* (a neologism that means "plant monsterology") relies on the insistence of a maternal desire of bringing forth and caring for, and, as will be shown, recovering the rejected non-human other. In a strangely contradictory movement, this "monster" is both tenderly included and exposed to wearing laboratory techniques, or produced with them in the first place. "I wanted to mother a plant, a gentle green alien,"[233] is the artist's point of departure: a cross-species declara-

tion of motherhood that—as the titles *Confronting Vegetal Otherness* and *Phytoteratology* also say—seeks to open the audience to other forms of subjectivity, those in which people become aware of their own porosity and kinship with the plants in which they grow and become together. "Conspiracy with plants," Natasha Myers calls such forms.[234]

Modern subjectivity, according to Jacques Lacan (whom Petrič avowedly would reformulate), is constituted via gazes, mirroring, and the self-overestimation that goes along with it. It is, if we follow postcolonial feminist discourses, produced via "othering"[235]—a role that in the dominant culture is taken up by, among others, "the plant" as the foreign and, as a result of its supposed inability to move, the restricted and passive. The basis for Špela Petrič's artistic experiments is provided

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231 See Chapter 3.
232 Špela Petrič in a conversation with the author, April 2018.
233 Petrič, "Phytoteratology."
234 Myers, "How to grow livable worlds."
235 Gayatri Chakravorty Spivak, "The Rani of Sirmur: an essay in the reading of archives," *History and Theory* 24(3) (1985), pp. 247–272.

Fig. 28: Špela Petrič, *Phytoteratology*, 2016.

by recent research, which shows that, in addition to the fact that plants take care of us animals,[236] they have a decidedly rich sensorium, that they communicate, make decisions, are responsive and adaptive, and help shape environmental conditions. In short, plants are active in action and thus can be defined as intelligent and as subjects.[237] And so Špela Petrič's promise is to deliver a different arrangement: one in which plants and humans care for one another, or rather, in which we (humans) are not only subjectified by those beings we usually objectify, but in which human delusions of possibility would also be deconstructed. So how does the work live up to these claims?

Phytoteratology is an installation with a spoken performance in which the artist conveys her theoretical considerations. On display is a magically illuminated laboratory scenario with algae-like green plants in petri dishes, along with a video showing their laboratory "production" on the micro level as well as the artist's physical play with them: plants on the skin, in the belly button, on the nipple, the vulva—bodily encounters that counter the sterile environment.

For the project, Špela Petrič took tissue from the thale cress (*Arabidopsis thaliana*) and nourished it in a petri dish with steroids and hormones from her urine:

> Biotechnological protocols and science allow me to nurture the tissue into a myriad of plant embryos, conceived not in a seed but an artificial womb, the incubator... the molecules speaking to them of my presence, in response to which they alter their epigenetic patterns and grow a unique body morphology.[238]

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[236] See the discussion of plants as providers of ecosystem services in Chapter 3, pp. 47 sq.

[237] Petrič points to representatives such as Stefano Mancuso. I myself am investigating this discourse in the SNSF research project *Plants_Intelligence. Learning like a Plant* (2022–2025). On the subject status of plants, see Coccia, *The Life of Plants*; Michael Marder, *Plant-Thinking. A Philosophy of Vegetal Life* (New York: Columbia University Press, 2013).

[238] Petrič, "Phytoteratology."

Since the sprouts emerge and grow (only) as a result of the artist's steroids, they represented an amalgamation of woman and plant; they were "Monsters in Becoming,"[239] cross-species actors and acting subjects, alien *and* peculiar. This is subject theory in lab-art form: The biosemiotic exchange of female messengers with plant cells leads to a "trans★plant" becoming,[240] a M-othering that connects and separates plant (other) and woman/mother both inside the petri dish *(in vitro)* and outside *(in vivo)*. The artist imagines herself as (other-)mother of the plants, as mother of the monsters, trans-mother: "How to become the other mother of a plant?" she asks, in order to simultaneously reject the dominant fantasy of the über- and super-mother through a poetic-tender formulation.

Špela Petrič works with basic biotechnological techniques and post-materialist feminist theory. What she sets up in the petri dish, the "artificial womb, the incubator,"[241] are so-called callus cultures—cell multiplications and tissue overgrowths grown in industrial laboratories as the basis for invasive interventions, such as manipulation of DNA, as well as for the mass production of seedlings for the commodity market. That Petrič operates with the thale cress (*Arabidopsis thaliana*), a "weed," is no accident: as *the* model plant of biotechnology, it provides the biomass for all kinds of invasive or industrialized experiments. Thus, it is garbage in a double sense: as a weed and an experimental object, because the laboratory produces a particularly large amount of waste, remnants of cultivated beings that are no longer needed. Now the crux of Špela Petrič's work is that she does not invasively intervene in the biomass at all, as one might assume on the basis of her statements. She does not produce transgenic or cisgenic beings from it, nor does she obtain seedlings from it. She allows the beings just to be (art)—and herself uses rhetoric. Probably in molecular biology, in such a case where the gene is not changed and there are no verifiable control groups, no one would speak of "plant-human entities" as the

artist does.[242] Perhaps someone would follow Špela Petrič's reasoning and point out that plants have common ancestors in evolutionary history and are therefore particularly well able to integrate and mix human steroids into the plant organism. Perhaps something like this could also happen outside the laboratory; as, for example, when a woman relieves herself by the wayside and happens to fertilize the thale cress growing there with the hormonal messengers in her urine.

In other words, the molecular mixtures of human and plant, as they are staged and claimed here, do not only stop at the (ethical) boundary of the cell,[243] but could well happen in the laboratory as well as in the field; that is, everywhere where animal secretions mix with vegetal and where urine, steroids, hormones, drugs, pesticides, plasticizers, plastics and other toxic and non-toxic chemical residues with their known and unknown messengers from human and animal bodies mix with the soil and water and from which plants in turn get their nutrients. This makes it clear that the unholy mixtures of humans and plants that Špela Petrič plays with and speculates on are already happening—whether through "natural" processes, or through the equally natural reactions of released synthetic waste materials. At issue is "the barest of bare life,"[244] because life, broken down to its molecular being, re/acts, is beyond human control, and is thus always already monstrous.

The strategy of *Phytoteratology* is that the artist biotechnologically stages what she does— producing and propagating embryonic tissue, exchanging substances on a microscopic level, and allowing cell tissue to grow—and declares it to be a cross-species technology of maternal care: *Confronting Vegetal Otherness* enables, the scenario suggests, artificial interspecies encounters, interactions of mutual understanding, and molecular becoming-together.[245] (In addition to humans intelligently decoding the scenario, plant molecules would also recognize and absorb human messengers.) These encoun-

[239] Ibid.

[240] Ibid.

[241] Ibid.

[242] Ibid.

[243] The boundary of the cell is a contested site. Unlike GMO practices which intervene below the celluar level, organic breeding, for example, stops at the cell's boundary. See Florianne Koechlin and Monika Messmer, "Breeding as a Dialogue," *Rheinauer Theses on Organic Plant Breeding*, June 2011, http://www.blauen-institut.ch/s2_blue/tx_blu/tp/tpt/t_rheinau_dialogue.pdf (accessed September 1, 2023).

[244] Petrič, "Phytoteratology."

[245] See Alisa Kronberger, "Vom molekularen Werden-mit (-Vielen) in der Biokunst von Špela Petrič," *Artistic Practices as Cultural Inquiries*, issue 2, senseABILITIES– auf der Suche nach einem anderen Erzählen im Anthropozändiskurs #2 (2022), https://insert.art/ausgaben/senseabilities/vom-molekularen-werden-mit-vielen-in-der-biokunst-von-spela-petric/ (accessed December 23, 2022).

ters take place on a material as well as on an imaginary and speculative level—because they are not only molecular and intangible for humans, but the audience is also not enabled to verify the truth of this experiment. It can only reject the provided fantasy of becoming-together across species or accept it—and believe it. If one listens to the performance and sees the intimate images that show that it is possible to build physical and cross-species relationships of love even under laboratory conditions, one readily believes. For there is a biotechnologist-artist who abandons her distance, exchanges substances with the experiment and suspends the dominant subject-object hierarchy. Thus biotechnology becomes *M-othering*: including the possibilities of bringing forth/respecting/ accompanying the other, instead of, as one-dimensional *fathering* means, justifying one's own line:

> These tiny monsters, coming into being from an impossible love, with intense labor and a yearning of plant parenthood, emerge in a time of environmental, political and social crisis as beings of permeability, harbingers of affective agential intra-action. Making kin with plants, caring for us, hopeful monsters.[246]

Monstrous is what is mixed, what threatens the cultural dualistic order, what escapes control. Trained in the discourse of Haraway, Braidotti and others, the artist welcomes the monstrous because it is material effect and thus evidence of what happens, can happen: mixing, entropy, closure or opening. The delicate, peculiar little plants are monsters because they blur the boundaries of species. They are monsters because, in their presubjective becoming and, caused by the *in vitro* situation, their directionless growth, they know no above and below, no differentiation into leaf or stem. They tangle, clump, simply want to become. They are vulnerable, and "beautiful" in that. But are they really "submitted to my care, compassion, and commitment" as claimed?[247] Are they not rather children abandoned by their mother? Lost in the museum laboratory setting? Combine that with the fact that this type of tissue culture has no chance of surviving in the longer term. Without the addition of phytohormones, the creatures stop developing and die. Physical intimacies are also fatal for them: once taken out of the petri dish, they are not viable. Thus, covered with a white fungus that often sets in, they soon begin to ail, presenting a rather pitiful picture towards the end of the exhibition. If one takes this wasting away seriously, with simultaneous euphoric talk of love and care, then a failure is performed here. Its subtext could be: if one does not invest time in accompanying, caring and healing, then nothing can become in such a lab scenario... except garbage or at best compost. Totally dependent and vulnerable, the monsters need "the mother," at least until they are viable seedlings. For this, however, further biotechnological procedures would be added. It remains open whether such a treatment of the trans*plants is testimony to that typical carelessness, egocentricity and wasting that actually wants to be overcome. Or whether it is a form of self-care in which the m-other also embraces herself and stands by her unwillingness to pay the price of self-sacrifice. Or whether it is simply the unsentimental allowing of that irrevocable "being-towards-death" that escapes controllability— and connects plants and people.

In other words, in *Phytoteratology,* the non-fulfillment of the promise to deliver an arrangement in which biotechnology would become the technology of care, of mothering, takes place. Despite the possible becoming molecule of human and plant subjects, and the realization that humans are subjectified by plants, the setting reinstates a subject-object split that allows the artist to live on and the stunted trans*plants to end up in the trash. With goodwill we could say: the project is patchy M-othering instead of unrestricted mothering, fulfilling Petrič's claim that there are "many kinds of care,"[248] including the right not to care. Combine this with the fact that nothing is concealed: the failure to care, its contradictoriness and incompleteness are inherent in the experiment. The exuberant rhetoric paired with the obvious inconsistencies identifies the setting as speculative labbing: as a game with the agency of the other-than- or more-than-human. The assertion that we humans have always been/will always be plants and vice versa is, in a sense, awaiting its unfolding *in vivo*... Špela Petrič's M-othering is thus not only desire for reproduction and care. Rather, it is regaining and repairing their violently repressed kinship. That the recovery of repressed "nature" is accomplished via artificial, biotechnological laboratory processes that are typically in the service of the exploitation and victimization of organisms or "nature" is not only contradictory and unresolved in its broken-

[246] Petrič, "Phytoteratology."
[247] Ibid.
[248] Špela Petrič in conversation with the author 2018.

ness, but, like the unresolved nature of the project itself, can be read as a form of irony: an irony that does not seek to level the complexity and urgency of the situation with the sponginess of impotent laughter, but that seeks to endure it with skepticism and traverse it with humor. *Phytoteratology* can thus be interpreted as an ironic strategy of care: this seeks to resolve the desire for recreation of the discarded by means of techno-oriented meddling and repair, such as biotechnological tinkering and bio-hacking. By inscribing itself in the techniques of bringing forth life, it reiterates the urge for feasibility, but also breaks it: by using the laboratory to extract something new that is both speculative and ancient, the belief in the power of the laboratory and its compulsion to opti-

mize is called into question. More clearly than the media of photography, film, or video, and more clearly than the caring maternity in *Pumzi* and *Manifestations,* Špela Petrič's technologies of care derive from the "belly of the monster" (Donna Haraway); they are contaminated, corrupted, complicit—an ontology equally proper to modern subjectivity in the Wasteocene: what matters is only communicable with hyphen (M-othering), with slash (m/other), with irony or negation—as a human, I cannot not become a plant. There is no escape, says *Phytoteratology*, neither from the catastrophic of the situation nor from the grasp of "our" technologies, neither from maternal nor from vegetal desire.

6

EXCEEDING: TOWARD AN AESTHETICS OF ATTENTION

…how do we reinvent social practices that would give back to humanity—if it ever had it—a sense of responsibility, not only for its own survival, but equally for the future of all life on the planet, for animal and vegetable species, likewise for incorporeal species such as music, the arts, cinema, the relation with time, love and compassion for others, the feeling of fusion at the heart of the cosmos?[249]

My starting point was the assumption that in the selected artistic examples technology as well as the natural sciences and their methods play a central role in raising sensibility to more-than-human ecologies, but that ultimately it is the specific formations of the aesthetic that make us aware of them and promote care-led ways of constituting meaning and subjectivity. Following on from this, I argued that transversality would come about less through the use of innovative technologies and well-intentioned themes than through aesthetic experiences of co-existence, participation with more-than-human beings and the surplus evolving out of these processes. Meanwhile, I would not divide technology and aesthetics so much as emphasize their interplay with data from the natural world: aesthetic strategies in art always act material-based and media-technologically, at the same time transgressing the purely instrumental character of technology through the way they incorporate technical, sensory, and ethical moments. These transgressions trigger sensations, sensations that can create moments of attention and care. But nothing precedes the other. Rather, if we follow Guattari's eco-logic of intensities, they are simultaneous, generative, ethico-aesthetic processes between humans, technologies, and more-than-human actors.[250] They lead to forms of experience of transbecoming that, although singular, do not conform to conventional notions of human subjectivity. Thus, the media-techno-aesthetic strategies presented here contribute to the creation of a more-than-human aes-

thetic whose hallmarks are proximity and touch. This does not pretend to speak from the perspective of the other, but enables forms of participation in more-than-human worlds that we do not, or even need not, understand cognitively. This aesthetic is essentially produced through two distinct strategies: The first consists in the techno-medial, sensory (re)staging of the more-than-human world; it is grounded in visual and auditory media; different technologies try to enable a kind of genuine experience. The second strategy operates more through imaginary, speculative, or ironic techno-aesthetic methods; it plays with existing or narrated knowledge in an attempt to fill in the gaps where not everything is rendered sensorially graspable. Although both start from different approaches, there are overlaps; moreover, it is true for both that they are committed to a non-representative "eco-logic of intensities."

To conclude these reflections, I would like to bring into play another meaning of *to care*: *caring* is "exceeding," in the sense of going out, overshooting, becoming trans and collective. With this complex of meanings, I refer to the different meanings of *to care* discussed chapter by chapter, the node of which lies in opening oneself to an other. Another reference lies in Tim Ingold's definition of *attention*, an overarching conceptualization within which *care* is, in a sense, a specification. Ingold understands *attention* as the basis for a relational and immersive form of living, of leading a life:

Attention comes from *ad-tendere*, literally meaning to stretch (*tendere*) towards (*ad*). It is the stretch of life that I am after. We all know what this means, intuitively, when we strain to hear a distant sound. Though in a purely mechanical sense, the sound reaches our ears, which are firmly cemented in our heads, we have a feeling that it is we who reach out towards the source of sound, as if the entire body were itself an elastic ear that feels in its tension the effort of the stretch. We say we don't just hear but actively listen.[251]

[249] Guattari, *Chaosmosis*, pp. 119–120.
[250] Guattari, *Three Ecologies*, p. 44.
[251] Ingold, *Anthropology*, p. 21.

Becoming open to the forces of the world brings perception into the body, makes it a sensory organ, a technology of sensing. I have called this groping searching with reference to Myers, Lowenhaupt Tsing, Haraway, Martínez, Krzywoszynska, etc., *Antenne-Werden*—becoming-antennae—or technologies of care. Variations of artistic practices of becoming attentive, becoming environmental, developing the desire to *care,* thus, actively listening to other voices, forces, and seeking together with them *to repair* life on Earth. These considerations formed the background for my interpretations. In the course of the investigation it became more and more clear that technologies of care take a stance and are therefore also *Technopolitics of Care*:[252] ethical-aesthetic means of resistance and re-formatting of subjectivation in the Wasteocene, our age of the normalization of wasting. The technologies of care are, in a political sense, about reconnecting to the disconnected Earth, about reappropriating forcibly dispossessed worlds. Elsewhere I have called this *counterappropriation*.[253] It concerns feminized reproductive activities such as care-work and M-othering, as well as forms of subjectivation such as becoming and growing rather than merely economic growth, but also fundamentally the ability to pay attention to the material world. This counterappropriation is particularly virulent against the backdrop that attention today has been co-opted by the attention economy, which is all about calculating how much time one spends on a corporate media platform.

What *caring* repeatedly connects with *ad-tendere/attending* and also with *sensing* is thus the bodily movement of exposing oneself and opening oneself for and to others (not only other beings, but also other times, spaces, aesthetics, and so on). *Caring* in the sense of *exceeding* thus means: leaving the house, the site, the products offered. It means settling outside and—with Asha in *Pumzi* and Oula Valkeapää in *Manifestations* and their companion species—celebrating everyday rhythms and intensities as part of the cosmic. It means to connect and ally with the chaotic forces of the world: to conspire—even in the original sense of the word from "to breathe and blow together."[254] It means to leave one's ego behind, to let go; is loss of androcentric subjectivity with simultaneous becoming-intense, becoming-relational,

becoming-with-others; is overshooting, overflowing, becoming more. Growing, not in the extensive sense of becoming larger, but rather of becoming trans and collective. I will come back to this.

Using the example of diverse translation processes—from one language to another, from art to research and from science to art, from planetary world to art, from one reality to another, from one medium to another, one figuration to another, one word to another—I spoke of *dissemination* in the Derridean sense: things and meanings do not merge in their irreducible multiplicities and differences, they are multiplicative, generative, polyphonic, and full of residues.[255] This is overshooting of *sense* and subjectivity: concatenations of images, letters, cross-species modes of existence. Technology, with its instrumental as well as media-aesthetic possibilities, also comes into play: in all the projects discussed here, various technical control instruments and media not only play a central role in their function of observing, recording, data processing, generating, and mediating "natural objects" but also co-constitute them, so that the observed forces and entities of "nature" never appear mediated and mediable beyond their respective representational logics. At the same time, all the projects discussed here promote a closeness and intimacy with the recorded world: the instrumental character of each respective technology has shifted to an aesthetic of sensing and sensual co-feeling, a *becoming-antennae*—these are forms of machinic subjectivation in Guattari's sense. The technically sensing "I" or "we" is both part of the sensing technologies and part of the sensing, chaotically alien world of forces and intensities unfolding in the here and now—aesthetically structured immersion, touching and being touched.

The shift from instrumental sensing technologies to sensation-controlling technologies of care is accomplished by various aesthetic means. This includes the sensory and aesthetic effects of the respective media technologies, such as a flattening, abstracting, wide-angle camera in the drone, color-pattern generating thermal camera, point-resolving VR environment, shimmering sound snippets, drawing patterns of dancing mosquitoes via tracking software, flowing movements of microscopic worms and microorganisms as ocean-like soil, cooperative labbing with bacteria, insects or plants,

[252] Christoph Brunner, Grit Marti Lange and nate wessalowski, eds., *Technopolitics of Care* (Vienna: transversal texts, 2023).

[253] Volkart, "Flowing, Flooding, Fibbing."

[254] Oxford English Dictionary: https://www.oed.com/view/Entry/39777?redirectedFrom=conspire#eid (accessed March 10, 2023).

[255] See Chapter 2.

etc. This cursory summary of the primary sensory impressions of the various projects discussed makes it clear that the various technologies and their algorithmic optimizations produce certain representations of the natural world and that these appear technically conditioned in this way and not otherwise, but that only in the aesthetic interplay of observed "subjects" or data of the "natural" world with media, technology and artistic decisions can those impressions be evoked that give us an inkling of the other. Helpful in the discussion linking technical and aesthetic means for bringing forth a different aesthetic of witnessing is Alanna Thain's take on Raymond Ruyer's notion of *survoler*. This French verb means "to overfly," "to self-survey," and, following Ruyer, also "refers to the sensation of an "observation without distance."[256] By adopting this term, Thain characterizes the immersive aesthetic strategy of Lucien Castaing-Taylor and Véréna Parvel's film *Leviathan*.[257] Quoting Ruyer, she says that it is "sensation" "that gives us nonobjective experience of other beings."[258] Only through sensory feeling, which connects "observation *and* knowledge" (Ruyer), can we recognize the other:

> Sensation is a physical event in that the sensing organ is an instrument, in principle replaceable by an artificial instrument... Yes, sensation is an act of knowledge, and not of pure observation, in that it is an act of being already in the world, capable of seizing meaning (significations) and of having the sense of the other; a sense/feeling at least as primitive as the intuition of its own existence. Pure observation will never be knowledge, but only event, exchange of energy. Pure knowledge remains virtual, as it gives no details about the other. It is the combination of observation and knowledge through sensation, in other words of the primary organic auto-subjective conscience of the living being—and the physical events on the sensing organ—which permit a detailed knowledge of other beings.[259]

According to Ruyer and Thain, neither purely technological supervision nor purely theoretical knowledge trigger the sensations that lead us to the other. It takes "physical" touch—and, I would add, aesthetic touch—for sensation to happen.

As I have been able to show through various examples, aesthetic settings in which the participants enter into a shared time or fantasy provide the basic conditions for them to engage with each other.[260] Christoph Brunner, following Brian Massumi, speaks of an "ecology of relation." This refers to an aesthetically timed temporality in the now that touches those present on an affective level and calls them in their physicality and relationship to others in the space, as a multiplicity of pre-individual entities in the making. They have a particularly real impact on other worlds in Bio Art, which operates with the agency of non-human beings, such as the mosquitoes in *Insect Songs*, the bacteria in *Introduction to Posthuman Aesthetics*, the smells in *One Tree ID*, and the plants in *Phytoteratology*; but they can also unfold in more image- and audio-based installations, namely whenever different worlds or axes come together —for example, the audience and generative sound in *Perimeter Pfynwald*, or breathing with a tree *qua* thermal camera in *Dendromacy*. Central to the unfolding of ecologies of relation are physical and affective feedback loops. These promote not so much an exchange of information as an excess of meaning and a sense of active participation. They engage and create participation, even when the information is not understood and misses the mark, or different desires are articulated. For example, the mosquitoes in *Insect Songs* did not join in the cello playing and did not sing during their time slot at the music festival in Bern 2021. Perhaps they did not feel like it, perhaps they were distraught by the loud laboratory building in which they were kept by the organizers against the artists' advice. Only by investing time, patience and care for the common event by the involved people did the mosquitoes finally start singing. Although this clearly showed that resonances, surpluses, only arise in their own temporality, in the singular transgression, the exceeding of the given framing, the organizers apologized to the audience for the "failure" of the event.

Another strategy to aesthetically trigger mindfulness and/or care as going out from the familiar is to insist on commonalities across species where the dominant culture sees none: "Afterall, the trees are breathing," for example, in *Atmospheric Forest*. This sentence triggered

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256 Alanna Thain, "A Bird's Eye View of *Leviathan*," *Visual Anthropology Review* 31, no. 1 (Spring 2015), pp. 41–48, here p. 42.

257 Ibid.

258 Ibid.

259 Raymond Ruyer, translated and quoted by Thain, ibid.

260 On the importance of shared times, see Brunner, "Affective Politics of Timing"; Puig de la Bellacasa, "Making time for soil"; Ingold, *Anthropology*, p. 27: "To care for others then, we must allow them into our presence so that we, in turn, can be present to them."

fierce resistance at a symposium; it was found to be an example of anthropocentric thinking that presumes to speak from the perspective of the tree and thereby once again only reflects the human perspective. Instead of talking about breathing, one should talk about photosynthesis. Such criticisms seem symptomatic of the uncertainty that such projects cause. Why should the word "breathing"—exchanging air—be reserved only for human and non-human animals? Science, for example, uses the term "breathing" in the case of soil that consumes oxygen and produce CO_2, or with plants at night when they do not photosynthesize and similarly consume oxygen, a fact of which few people are aware, since trees are represented almost exclusively as oxygen factories. Is science therefore anthropocentric? I myself only learned about this through Terike Haapoja's installation *Inhale - Exhale* (2008–2013): in it, a sensor measures the CO_2 production of composting leaves in a display case. Its lid lifts at regular intervals to supply fresh oxygen to the process inside. Soil respiration becomes an aesthetic experience here, where, among other things, the air is shared between "plant" and "audience." Indeed, breathing—*conspirare*—is a good example of the fundamental happening of the cross-species, collective co-composing of the world, that is, of the atmospheric, even cosmic becoming-together that is always already taking place, in which we participate whether we want to or not; and that reappropriating and recalling such shared actions helps to turn "othering into togethering."[261]

After all, the trees and we are breathing. Inhale-Exhale. We are in this together. In order for such thinking to take hold in its excessive, non-sentimental *sensing,* it needs an aesthetics of desubjectification as well as resubjectification: by this I mean strategies of interchangeability and substitution of the human—as the seat of intelligence, agency and ethics—by non-human forces and beings, which in turn claim subjectivity status. Desubjectivization, the loss of humanness happens, for example, through strategies of *becoming-antenna* or through "observation without distance"; it takes place as becoming part of the technicality and materiality of the world. This consists in the world's basic structure of animate/inanimate living beings, molecules, atoms, particles, energies, in which all Earth inhabitants are arranged on the same

"primitive"[262] structure. The loss of individuality, however, also means a gain in collective subjectivation; this is what I mean, among other things, when I say resubjectivation. I refer here to Guattari, who calls for "a nascent subjectivity" alongside "a constantly mutating socius" and "an environment in the process of being reinvented" to remedy the crisis.[263] In our context, this means, for example, that non-human beings also have affects, such as the weeping mountain in the myth in *Lithium Dreams*, and that they seek resonances or play just like mosquitoes.

In addition to the techno-media strategies linking science and art discussed here, as a priority, mythical, cosmic, and spiritual figurations are increasingly coming into play, as *Lithium Dreams* suggests. Current eco-art is increasingly becoming a site where the desire for decolonization, healing, and belonging to the more-than-human is sought to be realized through performative rituals or collaborations with indigenous peoples. Artist and yoga teacher Tabita Rezaire, for example, who has long been healing traumatized African women's bodies through transgressive videos, extends mindfulness practices and spiritual healing to the exploited and devastated Earth with the founding of AMAKABA 2021 (fig. 29). Ursula Biemann's collaboration with the Inga Nation in Colombia is dedicated to blending modern and oppressed forms that incorporate a cosmic perspective—she calls it *Devenir Universidad*. Cornelia Sollfrank, one of the initiators of the cyberfeminist Old Boys Network in the mid-1990s, holds workshops on collective breath training. She has written a manifesto propagating collective breathing as a radical act of self-care in times of massless (self-)exploitation. With *Le massacre du printemps,* Mathilde Rosier has rewritten Igor Stravinsky's paganistic-archaic ballet into a video ritual set on the Gulf of Naples: in it, young women are no longer sacrificed to the earth, as in Stravinsky's work (fig. 30). Rather, water and soil that have been sacrificed to and polluted by agro-industry are healed by means of dancing plant-human beings. At the same time, this work creates links with practices of miracle healing in the Christian cult of Mary. In this way, Rosier traces repressed possibilities of becoming other-together also in the heart of colonialist European history.

The turn of these artists towards the ritualistic, the religious-spiritual and (self-)repairing and their inclusion

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[261] Ingold, *Anthropology*, p. 26.

[262] Ruyer, quoted by Thain, "A Bird's Eye View," p. 42.

[263] "We need new social and aesthetic practices, new practices of the self in relation to the other, to the foreign, the strange." Guattari, *Three Ecologies*, p. 68.

Fig. 29: Video still from *Amakaba—A vision for collective healing*, 2021.

of human beings for ecological, more-than-human concerns seems to me to be exemplary of the now forming Aesthetics of Attention, because they all have always had a great affinity for technology in their works and apply methods of desubjectification and mechanization or algorithmization in different ways. This leads to the conclusion that it is precisely where desubjectivization takes place that resubjectivizations of carers become possible:

> How truly sublime the notion that it is the inhuman—that which commonly gets associated with humanity's inhumanity as a lack of compassion—that may be the very condition of possibility of feeling the suffering of the other, of literally being in touch with the other, of feeling the exchange of e-motion in the binding obligations of entanglements. That is, perhaps what we must face in thinking responsibility and justice is the existence of the inhuman as threaded through and lived through us, as enabling us, and every being/becoming, to reach out to the insensible otherness that we might otherwise never touch. The indeterminacy at the heart of being calls out to us to respond. Living compassionately, sharing in the suffering of the other, does not require anything like complete understanding (and might, in fact, necessitate the disruption of this very

yearning). Rather, living compassionately requires recognizing and facing our responsibility to the infinitude of the other, welcoming the stranger whose very existence is the possibility of touching and being touched, who gifts us with both the ability to respond and the longing for justice-to-come.[264]

The radicality of Barad's approach to caring, as well as the works discussed here, is not so much that care is felt because of psychological empathy/concern, but that we are called to care because of our material and techno-aesthetic entanglements. Techno-eco-feminist projects do not represent care, but *create care*, in their bracketing of the meanings of *trouble, concern, solicitude, and surplus: in their ethics and aesthetics of relationality and uncertainty.* Caring comes into effect although—or precisely because—it no longer ties itself only to individual heroic subjects changing the world with their deeds. Rather, it works through disruptive settings, feedback loops, desire, touch, and enclosure (of the alien).

But although care is generative and contagious, it does not happen and collectivize itself. "...care practices deserve the possibility of practical experimentations... [they] must be collectivized by training ourselves to or-

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[264] Barad, "On Touching," p. 10.

Fig. 30: Video still from Mathilde Rosier, *Le massacre du printemps*, 2020.

ganize: who cares for the caregivers?" is how participants in the Institute of Radical Imagination IRI put it in a nutshell.[265] IRI is an alliance of artists and activists from Southern Europe who work for the establishment of care and the ecologization of society through the Internet, in-situ meetings, workshops and performances. They do this, for example, by celebrating festivals for caregivers in public places. They celebrate gratitude and exuberance and—together with the audience—anticipate a future that has not yet arrived in this form. They generate surplus where in reality there is lack. Thereby they open, in a political sense, for the indeterminate, the im/possible, and as Isabelle Stengers says, for "joy," as "a mode of existence":[266]

Joy, Spinoza writes, is that which translates an increase in the power of acting [...] Joy, one could say, is the signature of the event *par excellence,* the production of discovery of a new degree of freedom, conferring a supplementary dimension on life, thereby modifying the relations between dimensions that are already inhabited—the joy of the first step, even if it is uneasy. And joy also has an epidemic potential.[267]

Joy, and related to it, what I call surplus, happens in pre-subjective, non-rational encounters of mutual attention: where things are not understood, and information is lacking, unforeseen connections and intensities are produced. They unfold where something doesn't have to be or mean anything, where it is "only" aesthetic play, experiment, event—while radically naming the dominant,

[265] Institute of Radical Imagination, workbook in the context of "On the Precipice of Time. Practices of Insurgent Imagination. The Zapatista Forum," Madrid 2021, https://instituteofradicalimagination.org/about/ (accessed March 17, 2023).
[266] Stengers, *In Catastrophic Times,* p. 155.
[267] Ibid., p. 156.

techno-capitalist dispositifs. Comparable to what I call surplus, excess, exceeding, Christoph Brunner speaks of "amplification" or, citing Isabelle Stengers, of "an emergent situation 'in the name of that which emerges'":

> From pure relationality to an ecology of relation, an amplification takes place which selects out of the manyness of potential lines several without disregarding the others. This process is politically relevant because an ecology does not mark an already closed system but gives forces the potential to actively attune to an emergent situation "in the name of that which emerges."[268]

What grips and intervenes in the projects discussed here, what creates meaning and surplus, is the contact-enabling handling of control technologies with simultaneous celebration of their power to generate machinic images/sounds/objects of mere "nature" that we cannot understand—and thus cannot directly use. (Whose infrastructures, however, are very likely to data and exploit us). Supported by the increased attention to the whole context of extractivism we are thrust into, we can/must/ want to let them stand in their strangeness and otherness. This is care as excess: intensification of forces of becoming foreign and different. It is dislocations of meaning that shake the reign of normalization. Forms of poetry and opacity that claim your "right to be incomprehensible, first and foremost for yourself."[269] "And I will claim for me and for you and for all, the right to opaqueness, and to *opacité*. You can be what you are and I don't need to understand that, or to reduce you to a transparency, to live with you or love you or accept you."[270] Technologies of Care intensify and singularize collective forces that we do not (need to) understand. Forces that, if we follow thermodynamics, never run dry, but transform, transmute. And so Technologies of Care become Technopolitics of Care. *Singing until the mosquitoes sing or not sing along, even if the time has passed and the majority of the audience has left the hall.* Technologies of Care are not offered as solutions in times of climate emergency, because as art practices they transcend their purpose-oriented instrumentalization. In times of "disturbance based ecologies,"[271] their mode of insistence may at best inspire imitation. They are neither harmonious nor do they proclaim hope. Rather, they create care—actionable touches of the strange—and trust where only skepticism and gloom seem appropriate.

268 Brunner, "Affective Politics of Timing," p. 254.
269 Edouard Glissant, quoted in German by Anette Hug, "Edouard Glissant. Denker der All-Welt," *WoZ*, September 29, 2022, https://www.woz.ch/2239/edouard-glissant/edouard-glissant-denker-der-all-welt/%21KVRJGCGZJ6XT (accessed January 29, 2023).
270 "From the Archives: Édouard Glissant and Derek Walcott in Conversation about the Epic," *Poets House*, October 15, 2018, https://poetshouse.org/from-the-archive-edouard-glissant-derek-walcott-in-conversation/ (accessed January 29, 2023).
271 Lowenhaupt Tsing, *The Mushroom at the End of the World*, p. 5.

ACKNOWLEDGEMENTS

PUBLICATION HISTORIES

LIST OF ILLUSTRATIONS

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