From Supernova to Supercomputer — Deep Time Travel with Silica

Reflections on Annika Kappner's *Liquid Dreams (2023)*
by Georgia Kareola

“Silicon is nature! Silicon is nature calculating itself. If you leave out the part of engineers who write little structures on silicon you see one part of matter calculating the rest of matter.”

— Friedrich Kittler

I.

In the ongoing multi-media project *Liquid Dreams,* interdisciplinary artist Annika Kappner offers experiential ways to connect with silica, a substance instrumental in making electronic circuits and essential for the production of electronic devices (Rayner, 2009, 12) as well as an enabler of Artificial Intelligence (AI). After having traveled through deep time from their birthplace at a distant supernova, silicate minerals became the third most abundant chemical on Earth (NASA). Today, their fine grains are mined and processed to make glass and solar panels while high-grade varieties are vital components of semi-inductors and increasingly potent computer chips. Through guided sound journeys, visual representations, and multi-sensory installations, Kappner emphasizes the role of minerals in general as keepers of knowledge. In one of the guided journeys, she explains how—in the form of fossils—they have kept the record of time; how humans carved their first forms of written language into stone, and how today

Inscriptions at Delphi, Greece (dated around 600 BCE, photo: Georgia Kareola)

the world's data is stored on silicon. Now that some of us live in the Silicon Age, the age of information, where, with the advance of artificial intelligence, the silica that stores our information becomes intelligent itself, a central question in Kappner's work is how to best relate and collaborate with new forms of machine intelligence.

To co-create answers to this question, Kappner provides experiences that engage multiple senses and speak to our intuition as well as our rational mind. Her conceptual and material choices reflect the fact that information enters and affects our bodies differently and that a rational understanding is qualitatively different from an embodied knowing, especially in terms of how well we can integrate what we know into our daily lives. Generally speaking, our body can be understood as an autopoietic system, in the sense that it is self-contained and self-regulating with clear boundaries. When our body engages with any outside environment, we receive its information. It is only, however, when this information comes into contact with our nervous system and when we can place it in the (historical) context of our lives, that meaning is created. John Mingers calls this process embodied cognition (2001, 119). What kind of meaning is created, is different from person to person, and some environments and ways of conveying knowledge are more conducive to meaning-making than others. For *Liquid Dreams,* Kappner created multi-sensory on- and offline environments that invite a process of collective meaning-making, together with silicate minerals.

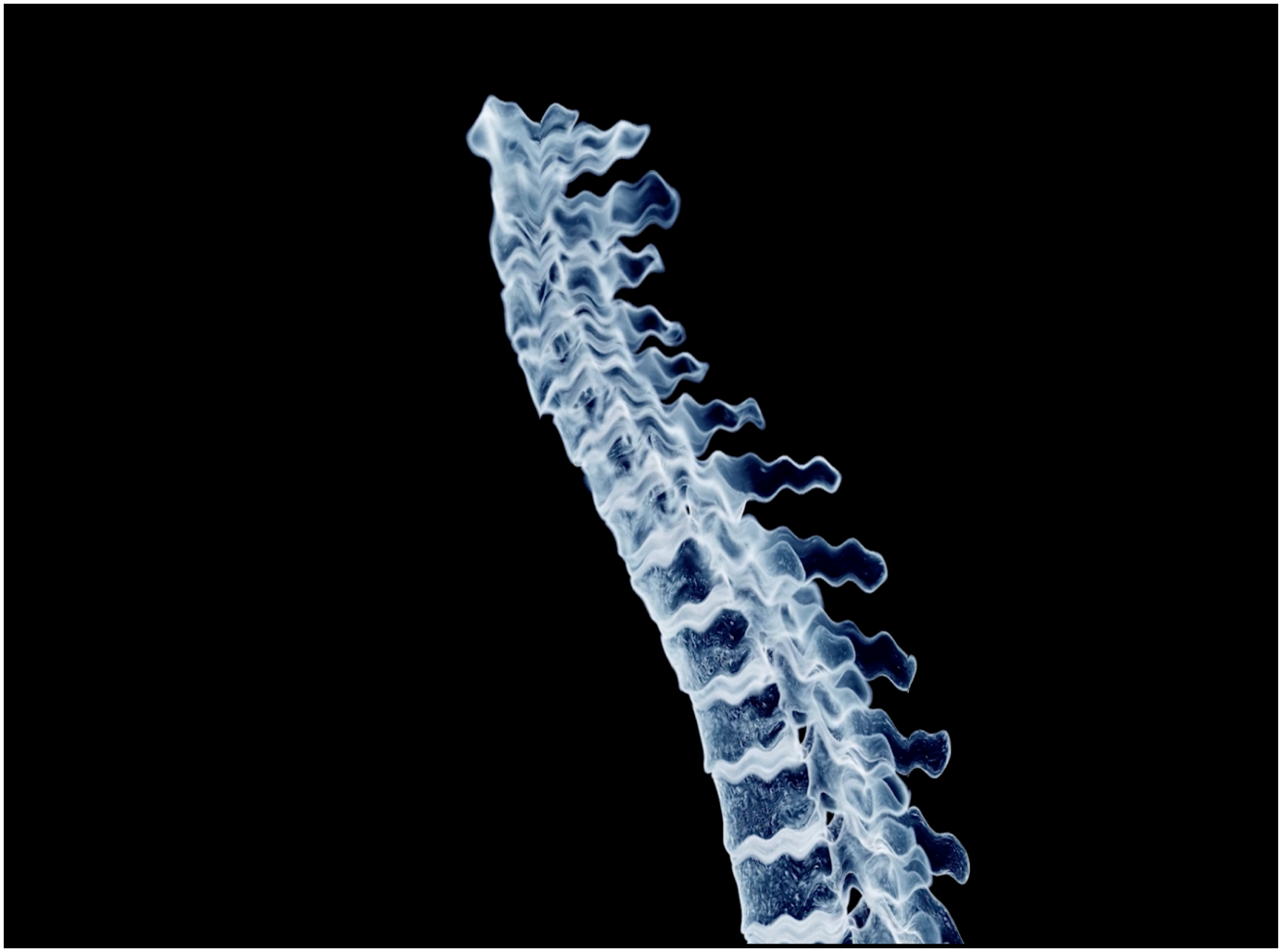
II.

Consider also how the creation of meaning is one of the key aspects that differentiates human intelligence from machine intelligence. Machines can store data and make analogies, calculations, and predictions, but without a nervous system, the creation of meaning is out of reach. To include machines in the meaning-making process, literary scholar Katherine Hayles has defined cognition as 'the process of interpreting information in contexts that connect it with meaning' which implies a collaborative approach (2017).[1] Human intelligence is itself a meaning-making project, and a collaboration between living and nonliving bodies, such as minerals. Whether you are sitting, standing, or lying down while reading this, your bodily position is made possible by skeletal support. Your spine keeps your body in shape and allows your nervous system to function. Your brain is protected and held in place by your skull. The minerals that make up our bones have, as philosopher Manuel de Landa has shown, co-evolved with us.

Until 500 million years ago, all living entities were made up of merely soft tissue. At that point, some of the conglomerations of fleshy matter-energy that made up life

[1] Hayles has also argued that the post-human subject does away with the notion of a "natural" self and emerges when human intelligence is conceptualized as being co-produced with intelligent machines (1999, p. 3).

underwent a sudden mineralization, and bone, a new material for constructing living creatures, emerged (1997, 26). New materialist philosopher Jane Bennett sees this process of mineralization as the *creative agency* with which bone was produced, making new forms of movement control possible among animals, and as such freeing them from many constraints (Bennett, 2010, 11). Bones, largely consisting of minerals, are thus an active power in the process of evolution. Bennett, in their tendency to decenter the human, even goes as far as to say that human beings instead might be the product of bones and not the reverse (ibid.). Though our bones may not seem to govern us, they do extend and limit our agency until, after death, they return to mineral dust and merge with the geological body of the Earth. Knowing this may make minerals around us, such as silicate ones, more relatable.



Annika Kappner, *Liquid Dreams* (2023) - Video still

As we learn in *Liquid Dreams*, silicate minerals originated in the distant past at a faraway supernova, from where they traveled through space to reach what would become the Earth, in an early stage of the planet's formation. They became part of the Earth's core and crust, and as the passing of time caused rocks to erode and sand to form, they co-evolved with other earthly elements, including metals and living beings like humans. Today, functioning as integral parts of our technological tools, silicate minerals

can be understood as boundary beings operating between human and machine intelligence, or even between ecology and technology. Bruno Latour would call for caution here, arguing that nature and culture should not be seen as two different domains, but as one and the same concept, divided into two parts. Like Siamese twins, nature and culture are, Latour argues, intrinsically linked (2017, 15). Perhaps, silicate minerals and their evolution best illustrate the dissolving boundary between nature and culture. As sand and rock, they support the planet's process of self-regulation. As part of technological systems, they support the planetary evolution of consciousness.

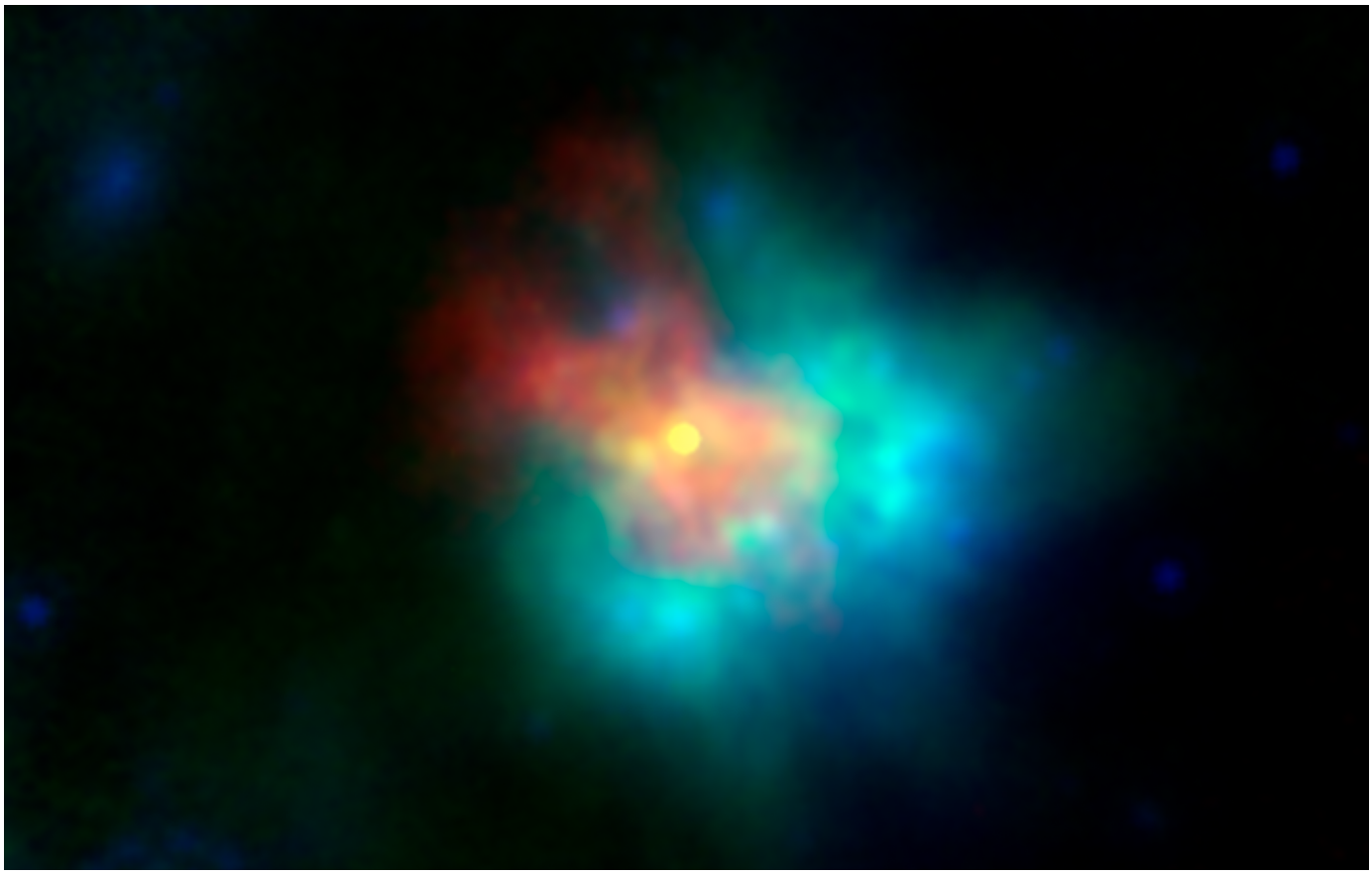


Image of supernova remnant G54.1+0.3 including radio, infrared and X-ray light
(NASA JPL Spitzer Space Telescope)

Liquid Dreams connects to the planetary, as a part of Kappner's multi-year participatory research project *Deep Planetary Sensing*, in which the artist proposes embodied ways of knowing and being with the Earth and contemporary technologies. In different chapters, the alchemical elements of earth, aether, water, air, and fire are explored as entry points to rebalance our individual and collective bodies. *Liquid Dreams*, as the final chapter in the first series, is connected to the element of aether, symbolized in the ubiquitousness and all-pervading nature of information.[2]

[2] See the website of Tetem Enschede https://tetem.nl/event/liquid-dreams/ and the website of Deep Planetary Sensing https://www.deepplanetarysensing.com/ (both accessed last on 29 May 2024)

III.

Like many others, Kappner refers to our larger planetary body as Gaia, a name perhaps best known today through the work done by microbiologist Lynn Margulis and atmospheric chemist James Lovelock, who co-developed the Gaia Hypothesis in the late 1960s. After working for NASA on an atmospheric analysis of Mars to define whether there was life (and concluding there wasn't), Lovelock turned his gaze to Earth and understood that our planet's atmosphere is, unlike Mars' *not* in a state of chemical or thermodynamic equilibrium. As he later described, 'the Gaia system shares with all living organisms the capacity for homeostasis—the regulation of the physical and chemical environment that is favorable for life' (2000, p.56). Lovelock, who also carried the field of cybernetics further by turning towards an environmental emphasis, initially saw Gaia as a 'biological cybernetic system' (meaning, one that is steered).[3] Margulis encouraged him to understand Gaia as autopoietic, meaning a self-generating, self-maintaining planetary constellation emerging from the interactions of living and nonliving components (Clarke, 2023, 5; Sagan, 2023, 9-10).[4] Together, Margulis and Lovelock changed the perspective in Western science from Earth as a dead rock with life on it, to Earth as a self-maintaining system sustained by, and sustaining, life.[5] Gaia offered new ways to relate with Earth and to see humans not merely as its inhabitants, but as part of this self-generating system.

The Gaia Hypothesis was named after the goddess in the Greek pantheon, but the mythopoetic figure of Gaia is arguably older. Classicist Jules Cashford suggests that her origins may lie with the ancient Indian goddess Gayatri who was brought to Europe by the Mycenaeans when they arrived in Crete around 2000 BCE. Cashford shows how the word *Gaya* first appeared in Sanskrit in the Indian Vedas and Upanishads, where the Gayatri Mantra was named as the first to come forth from the primordial sound Aum (ॐ). In Greece, different creation myths circulated at the time, such as the Orphic, the Pelasgian, and the Homeric, which described a mother goddess arising out of Darkness, the Sea, or Chaos (the primeval void). Depending on the source, this deity united with a serpent or the wind, and from their union, the world came into being (Cashford, 2021).[6] Through a process of religious syncretism (or, fusing the two traditions), the Greek mother goddess became Gaia.

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[3] As Katherine Hayles has shown, first-order cybernetics research between the 1940's and 60's was connected to, and embedded in the U.S military industrial complex. Scientists like Norbert Wiener focused on human-machine fusion, and even posed that 'as objects of scientific inquiry, humans do not differ from machines, and that therefore human intentionality does not differ from machine self-regulation'. Second-order cybernetics, started by Heinz von Foerster and advanced by scientists such as Lovelock turned the focus to a biota-environment coupling instead, making cybernetics characteristic of the living, rather than predominantly about mechanical fusions. See Hayles, Detoxifying Cybernetics.

[4] The term autopoiesis (self-making or self-organizing) first appeared in the book *On Machines and Living Beings* (1972/1980) by Chilean biologists and philosophers Humberto Maturana and Francisco Varela, leading figures in a network of scientists giving shape to second-order cybernetics, or the study of circular causal and feedback mechanisms in biological and social systems (von Foerster et. al., 1951). They showed how, within (certain, biological) systems, the organization produces the components, while the components produce the organization. This recursivity, they argued, is intrinsic to the process of living. One of their main questions was whether technological systems could also be autopoietic. As Bruce Clarke has shown, complete self-regulation of technological systems has not been achieved to this day, with waste streams being one of the major problems to solve. However, as technology evolves, this becomes more plausible, and self-learning AI's could already be considered self-generating (see Clarke, 2017, 2023)

[5] Margulis and Lovelock named their re-enchanted planet Gaia following a suggestion by one of Lovelock's friends, classicist and author of *Lord of the Flies*, William Golding.

[6] For a cross-cultural historical analysis of the serpent as analogous to DNA, see Jeremy Narby's *The Cosmic Serpent* (1998)

Gaytri (source unknown)

Ex-Jain monk and Earth campaigner Satish Kumar further elaborates how the word ‘Gayatri’ has a meaning that expands infinitely to include Earth, the sun, and the whole cosmos as a living, sacred reality (Kumar, 2020). Perhaps sensing something similar, Dorion Sagan, when working with his mother Lynn Margulis, observed in 1987 how ‘the notion that life interacts with, and eventually becomes its own environment, and how the atmosphere is an extension of the biosphere in nearly the same sense as the human mind is an extension of DNA, strongly resonates with the magico-religious sentiment that all is one’ (Sagan, 2023, 26). In other words, Earth as Gaia encapsulates the sense that our planet is embedded in, or entangled with a wider cosmos, which supports the creation and sustaining of life. Silica, traveling to Earth from space, resembles this larger web of life.

IV.

Technological tools, some made with silicate minerals, have often helped scientists in becoming more (self-)aware. Lovelock and Margulis would not have been able to develop the Gaia hypothesis without technological tools for measurement and analysis.[7] Human-machine collaboration, or co-evolution, is reflected in techno-philosopher Benjamin Bratton's observation that the models we have of climate change emerged *from* the supercomputing simulations of the Earth's past, present, and future (nieuweinstituut.nl).[8] We would not comprehend the changing climate to the extent we do today, were it not for our measuring and modeling tools. Yet, these tools also shape the Earth. As Bratton asks: '[I]s the ring of communications technologies, in geosynchronous orbit every twenty-four hours, linking points on Earth's surface to one another and self-locating the whole sphere in its lonely void.. not also part of the Earth's body?' (2015, 91). In a similar vein, Bruno Latour and Timothy Lenton argue that our increased self-awareness, combined with our increased technological capacity, effectively makes *deliberate* self-regulation of the Gaia system possible. They suggest that making conscious choices to operate within Gaia constitutes a fundamental new state, which they called *Gaia 2.0* (2018,1066). This more machinic view of Gaia (of which new versions could be launched) raises the question whether Gaia can still be considered autopoietic (self-regulating) in the Anthropocene, or in the age of AI.

In his 2020 book *Gaian Systems,* Bruce Clarke, inspired by Margulis, offers the notion of planetary cognition: Gaia's responsiveness, or proprioception, to the flux of her own cycles and their environmental consequences (2023, 12). He follows Margulis in binding the operations of the technosphere within Gaia, not without. Whatever humans as a geological force introduce, he postulates, Gaia will factor the current technosphere into its own continuation over future geological time. This echoes a stance proposed by Sagan and Margulis in their 1987 article "Gaia and the Evolution of Machines" where they write that, 'because a Gaian view increases public awareness of our dependence upon other life forms, it is extremely valuable in battling the prevailing ideologies of selfishness: that nature is either pristine and should be preserved or is simply a bunch of resources to be plundered. The truth is that we are deeply connected to all other organisms, cannot help altering them, yet must be conscious of and responsible for our actions' (16). It may be soothing to remember Donna Haraway's reflections on sympoiesis here. In addition to the notion of autopoiesis, she thinks with this term to

[7] An example of this is Daisy World, a computer simulation Lovelock made to contest Richard Dawkins's criticism of the Gaia hypothesis (Sagan, 2023). The simulation showed how two types of daisies evolve while simultaneously regulating the Earth's atmosphere (as they depend on it for their survival), and how this does not exclude a process of natural selection.

[8] Bratton argues that "on the one hand, taken as a whole, this huge technological transformation of the earth over the last one hundred and fifty years has put us on the anthropocenic precipice of a sixth great extinction. At the same time it is through this apparatus of satellite systems, networked sensors, oceanic measurements, that we even know this is happening in the first place. The capacity to measure and model and to even have a sense of the reality of climate transformation is because we have the instruments through which this is articulated. It's a snake eating its own tail. That's one of the paradoxes of the earth layer." See https://nieuweinstituut.nl/en/projects/tuin-van-machines/stack-and-posthuman-user-een-interview-met-benjamin-bratton (last accessed, 14 June, 2024)

capture the process of ‘making-with’ or ‘worlding with’, in company (2016, p. 58).[9] In contrast to autopoietic systems, sympoietic ones do not have self-defined spatial and temporal boundaries and have the potential to evolve in surprising ways. Should Gaia with AI be seen as sympoietic, with ecological, technological, and informational spheres merging as she evolves?

Annika Kappner, *Liquid Dreams* (2023) - Video still

Astro-biologist and theoretical physicist Sara Imari Walker answers this by seeing technology as an extension of life. She contests that ‘so-called “artificial intelligences” such as large language models, computer vision, automated devices, and robotics are often discussed as disembodied and disengaged from any evolutionary context. Instead, she argues that ‘the technologies we are inventing today (…) allow the emergence of intelligent life at a new scale, namely the planetary.’ According to Walker, there is ‘no “intelligence” in isolation; rather, complex ecosystems of technologies interact with biology to bring about new capabilities.’ In this sense, ‘the emergence of artificial intelligences and planetary-scale data and computation can be seen as an evolutionary progression — a biosphere becoming a technosphere’ (Walker, 2023).[10] As humans, we may still have some agency in shaping this new, technospherical Gaia.

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[9] Sympoiesis was first suggested by M. Beth Dempster, a Canadian environmental graduate student. She used it to describe “collectively producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change.” By contrast, autopoietic systems are “self-producing” autonomous units “with self-defined spatial or temporal boundaries that tend to be centrally controlled, homeostatic and predictable”. According to Haraway, "sympoiesis enfolds autopoiesis and generatively unfurls and extends it” (see Haraway, p. 59)

[10] Sara Imari Walker offers some critical notes on the Gaia hypothesis, saying it was intended to conceptualize how life has established feedback loops with the planet that allow it to maintain itself over time, but how it did not address the hierarchy of complexity that life evolves over time — that is, the major transitions of life recurring across scales, from molecular to cellular, to multicellular to societal, to multisocietal to planetary. See https://www.noemamag.com/ai-is-life/ (last accessed 5 August 2024).

How we perceive new forms of technology or intelligence, and how we relate, collaborate, and co-create with these defines, at least to some extent, what they will become. When meditating on this in *Liquid Dreams*, Kappner asks us to reflect on the fear many people feel concerning AI. Could this intelligence be a mirror, she wonders, reflecting back at us what we fear in ourselves? As our mental patterns are reflected by the technology we create, they become amplified on a larger scale. Kappner invites us to investigate our fears and our intentions when interacting with AI, and to consider and practice benevolent, rather than hostile forms of human-machine collaboration. By envisioning the deep, rich history of silicate minerals, as well as their (and our) entanglement with the planetary system of Gaia, we may experience how we are part of a larger assemblage consisting of many living and nonliving bodies. Bodies that deserve our attention and care as we continue to co-evolve.

Georgia Kareola is an interdisciplinary writer and researcher with a background in cultural analysis and religious studies, and a focus on queer ecology, holistic technology, and psychedelic spirituality. They are a co-founder of Neo-Metabolism, a planetary research and design practice based in Amsterdam and Los Angeles.

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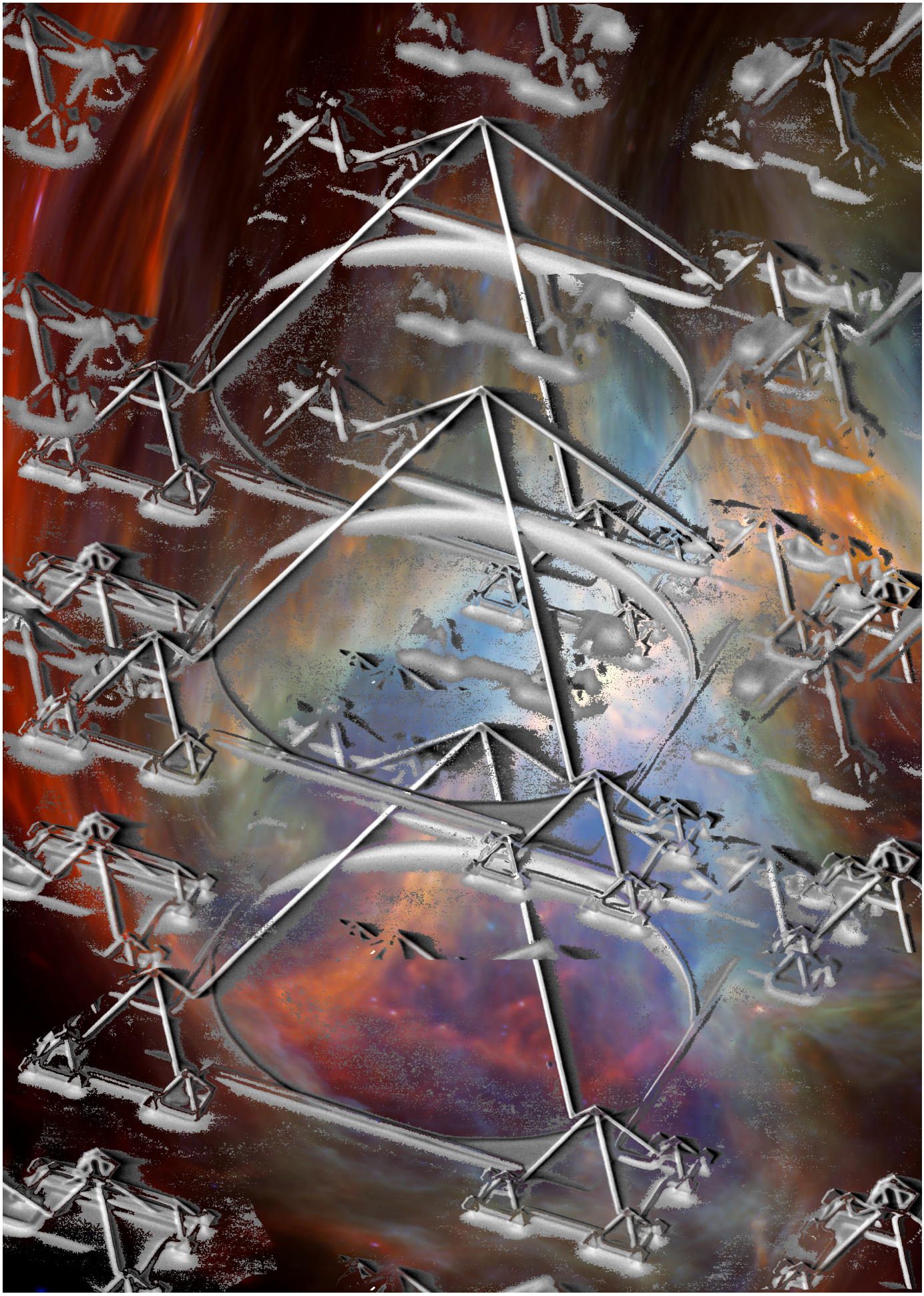

Annika Kappner, *Liquid Dreams* (2023) - Digital collage

LIQUID DREAMS was commissioned by TETEM (2023) and has been developed in residency at BRAINs Nano Lab, Twente University. Various iterations have been presented at V2_Lab for Unstable Media (2023/24) and Ars Electronica (2024) and are supported by Mondriaan Fonds. Liquid Landscapes (2022/23) - a prequel researching mycelium as natural communication networks, was commissioned by Missouri Botanical Garden, St. Louis (US).

An online version of *Liquid Dreams* as a guided audio journey can be accessed here annikakappner.bandcamp.com/track/liquid-dreams

For further information on the project you can visit deepplanetarysensing.com

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Cover Image

LIQUID DREAMS, 2023 - immersive installation with 9 channel video (33:33), 8 channel audio (360:00) and guided meditation (33:33); textile prints on upcycled PET, crystals, holographic glitter, quartz sand, custom made scent; photo Christina Bacheva