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A Mountain of Words Unspoken

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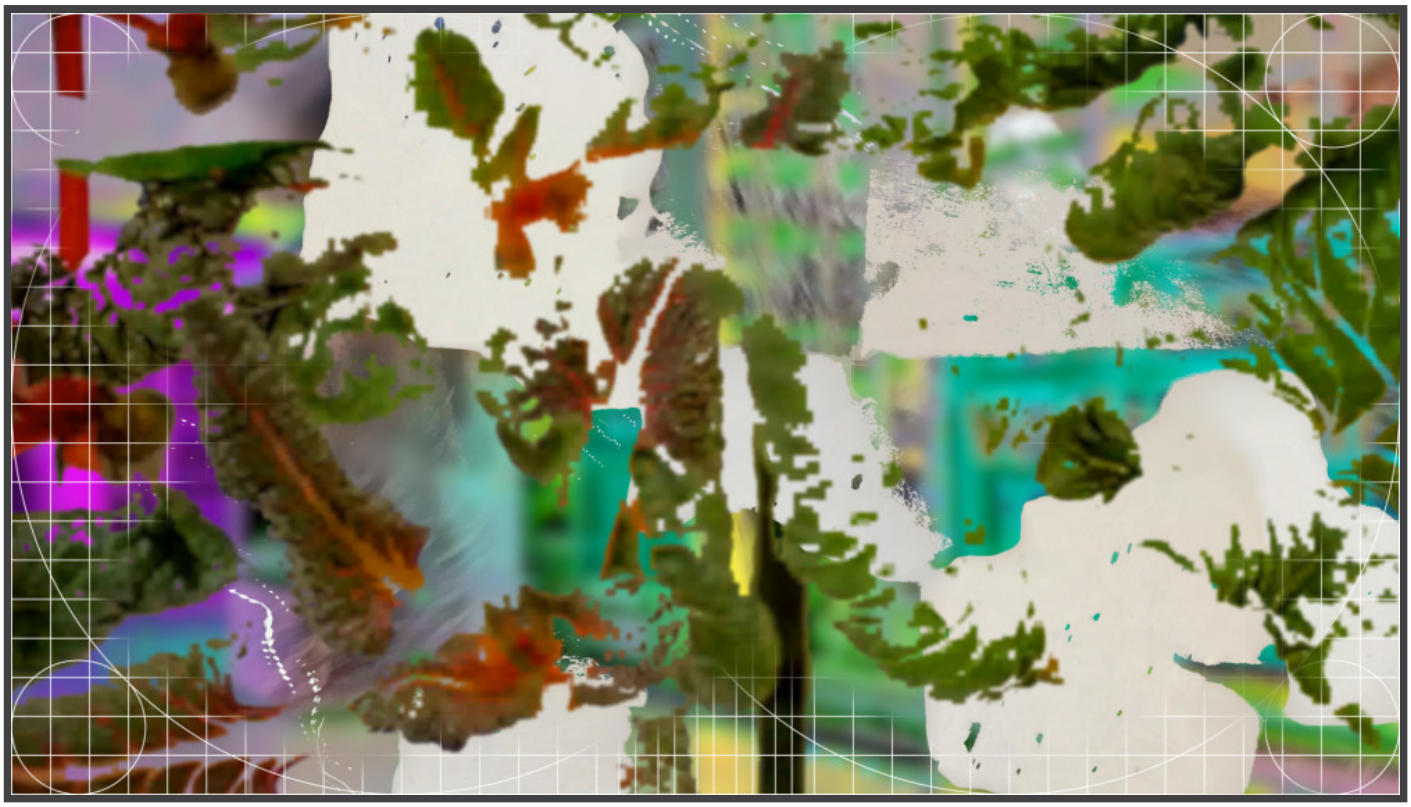
How to write a design history that navigates in between material and body politics? By trying to find articulations in a mountain of words unspoken this project explores translations of disciplinary literacies between scientific and artistic/design practices. An ambivalent endeavor that challenges perspectives on crystalline matter.



Lilo Viehweg, kitchen experiment, home-grown Rochelle salt crystal on industrially sintered ceramic crystal, 2021

A Mountain of Words

Deep into the mountain of unspoken words I go.

Looking for footnotes.

I carry one word in my backpack.

Bringing it back to where it never came from yet always belonged to.

In my PhD project *Situated Knowledges of Complex Matter*,[1] I am unfolding a design history of a small electronic component of crystalline matter. So-called «piezoelectric materials,» which are also referred to as «smart materials»[2] or «technological materials,»[3]

depending on the discipline in which they are described. The design history of these materials is ambivalently positioned in disciplinary demarcation. Designed in the field of materials science today, the small electronic component is used as a mass-produced commodity within maker cultures at the intersection of art and design education for tinkering processes, i.e. the making of little machines and learnings about creating with electronics. This situatedness in between (at least two, if not many more) seemingly different readings of design raises the question of what hi/story we are telling here. Beyond the linearity of a history of science or a history of maker cultures, I am interested in exploring their ambivalent interdependencies. Looking into the accessible material also raises the question of where design history begins and where it ends. In a mountain, in a laboratory, in an online shop, in our bodies? Does design end in an archive or in a landfill? What is unspoken and what needs to be said? A challenge in dealing with complexities between different disciplinary literacies, which also calls for the use of a different vocabulary in writing about this material design history.

Multiple Delineations of Design Histories

The question of coming up with a vocabulary for writing a design history is entangled with the question of disciplinary literacy. This means it is closely interwoven with the question of how design is made and how the process of making is represented, i.e. what words are used depending on the particular lenses. While the term «design» is defined differently in different disciplines,[4] the respective positioning of the historiographer changes accordingly. In my case, I am investigating a design history that operates in a multitude of peripheries between design in material science and design in maker cultures read from the perspective of material and body politics. With this, I do not only have to understand the respective literacies of the disciplines involved in the design process of the material, but also to find words for my particular positioning as historiographer. This raises the question of a delineation of the field of design history. In my case, I am referring to a particular field in design history which is always closely linked to design in contexts of art school education and in ambivalence to the attributed roles of the profession.

The discipline of the history of design in 20th-century European art school environments was mainly told from an art-historical perspective that dealt with objects and masters, thus perpetuating a history of singularity and continuity of Eurocentric modernist design.[5] Design was (and in many cases still is) read from a perspective of progressive linearity, instead of understanding it as a field of a multitude of cultural frictions. As the perspective on design has changed from objects to global cultures, processes, and infrastructures, the way in which design history is written has changed accordingly: away from an approach that analyzes how something is from the outside (e.g. iconic, cemented, or continual) and towards the description of how things are in the making (e.g. troubled, lively, or ambivalent). Design historians such as Alexandra Midal seek to fundamentally relocate the role of design history within the framework of social-cultural negotiations.[6] Such demarcations go hand in hand with a liberation not only from one-sided perspectives on design, but also from historiography. Writing a design history beyond progress changes the structure of a reading from linearities of timelines to a plurality of voices, as highlighted, for example, in the intersectional design histories of «design struggles» gathered by Claudia Mareis and Nina Paim.[7] In such fields of design historiography, endings and beginnings do no longer refer to a linear understanding of time, but are found in the demarcation of heterogeneous knowledge cultures and, thus, shiftings of design attributions. This also questions what voices are represented in which ways and forms and how to deal with literacies in which words are

unspoken?

Design Histories Unspoken

My research begins with the ambivalent demarcation of design in between science and maker cultures with the ceramic sensor, which you can see in the picture above. Following the path along both possible disciplinary frameworks of this design history (science / maker cultures), one encounters mountains and mountains of data on materials design in an immense scientific industry of applied materials science in academic databanks on the one hand, and crafting with electronics in countless YouTube videos and posts in maker culture forums on the other.[8] Both understandings of design are connected through the word piezoelectricity, but like a passing of the baton, the former discipline is credited with designing materials, while the latter is using the designed materials for designing machines. This could also be understood as an «assembly line of knowledge production» in which materials are assembled in global industries and disciplinary approaches are assembled accordingly.[9] This perspective on disciplinary exchange creates specific hierarchies in knowledge production, as it entails different perspectives on social entanglements with design. The design processes in scientific laboratories are interwoven with the politics of material procurement, global raw material supply chains, and participation in material policymaking. However, these aspects are rarely addressed in the tinkering practices of maker cultures in museums, maker labs, and art schools, which work with the products of the materials science industries.

To challenge such hierarchies and to access the scientific research, I turn this process around and start working with piezoelectric crystals in my kitchen, in museums, and in art schools myself and with others. The intention is not to make new sensors but to try to find other material literacies as an additional analytical lens; crafting words, structures of texts, layouts of representation while growing, cutting, sandpapering crystals simultaneously. Finding words for things unspoken.

The production of a ceramic sensor is an elaborate process that requires specialized scientific equipment, access to materials, knowledge of crystal growth physics, and a specific vocabulary to describe the apparatus. Clearly, this is not comparable to kitchen experiments—at least not if the goal is to replicate scientific design. Instead, I focus on selected steps from the complex production process in the scientific design history of the sensor—such as crystal growth—and look at them through different lenses of reading material processes.

In parallel, I read into the histories around the term piezoelectricity. For this reciprocal reading of describing material processes and histories I am trying to find words that go beyond the respective disciplinary demarcations, yet always in relation to the word piezoelectricity. A brief look at the history of the term itself explains its ontological limitations and why it is necessary to find words beyond it.

The scientific term piezoelectricity describes an energy conversion from mechanical to electrical energy and vice versa. When a piezoelectric crystal is nudged, it generates electricity, and when current is applied, the crystal begins to vibrate at certain frequencies. Piezoelectric materials can be found everywhere. In their industrially manufactured form of, say, cut quartz plates or sintered ceramics they come in various shapes and sizes and are used in multiple technologies that we use every day—smart phones, computers, watches, measuring instruments, and lighters. Piezoelectricity makes, for example, clocks tick or

implemented in sonar technologies and ultrasound devices it generates images of human and more-than-human bodies.

In 1880 the brothers Jacques and Pierre Curie came up with the word piezoelectricity in a laboratory experiment with precut tourmaline crystal prisms manufactured by a laboratory instrument supplier.[10] Focusing on the physics of crystal atoms, they derived the term from Ancient Greek in which «piezo» stands for «pressure.»[11] However, the natural phenomenon existed before it was named. Piezoelectric crystals can be found in mountains, soils, and seas as well as human and animal bodies. Salt, sugar, and a variety of other minerals show this material effect connected to intricate processes. For example, that we are able to feel touch is due to the piezoelectric effect in calcium crystal ions in our cells.[12] Our bodies are full of piezoelectric crystals. Thus, underlying the linguistic reference is a relationship level of fine electric vibrations that connects us all. However, the term itself is reductive in that it only describes the correlation between pressure and electricity in specifically cut crystal plates. The historical account of the Curie brothers' research—i.e. the dominant representation of their crystal experiments based on published scientific papers—is framed in the literacy of physics. It uses geometric and mathematical descriptions of atomic processes that omit any interactions beyond the atomic scale.

Whether the Curie brothers also thought about mountains and feelings in their laboratory experiment with the crystal prism remains an open question. However, to this day the dominant narrative in connection with the word piezoelectricity in materials science perpetuates this disconnected perspective on nature.[13] In this reduction lies a mountain of unspoken words as well as the silence of interdependencies between words, mountains and bodies.

The few accounts that do exist in the history of science to date draw from what is accessible in the codified data of scientific papers and archived documents.[14] The Curie brothers' published findings made piezoelectric minerals measurable and calculable, which led to the theorization of piezoelectricity in 1895 and subsequently to the invention of sonar in 1915 and the birth of mass-production of oscillators during World War II.[15] The main narrative told in the accounts of the history of science focuses on the collectives of scientists and engineers in charge of the development. Historians of the field draw attention to general gaps in the historiography beyond this.[16] But more than that, this history leaves out issues on material and body politics in knowledge production.[17] The impact and involvement of other than the dominant scientific knowledges and literacies of representation only appear, if at all, in minimal side notes. In this way, the majority of the current historiography perpetuates the violent notions of a design bound to extraction, mass-production, toxicities, (neo-)colonialism, and military industries[18] 150 years of neglected and silenced narratives of those equally involved in the design process; unspoken histories of the early beginnings of maker cultures in the 1920s; of the role of hands-on work by miners in Brazil and manufacturing workers in military industries; of hierarchies between different scientific design systems at the end of the Cold War in East and West Germany; of the ecological impact of extraction and toxic waste of lead-based ceramics; of ethics in medical research; and of today's movements in feminist hardware. This kind of exclusive historiography is based on the one hand on the available data—meaning the data that has been generated, collected, archived, and delivered—and on the other on how this history has been written depending on the disciplinary epistemologies.[19] This also raises the question: Who writes the design history of piezoelectric materials?

Writing Design Histories Otherwise

Existing feminist accounts in Science and Technology Studies, such as research done by Karen Barad and Lisa Yin Han, show how body politics are intertwined with the application of piezoelectric materials.[20] By examining the effects of physics and machines on human and more-than-human bodies, they bring out critical politics around the violent implications of products of engineering in the field—sonar and ultrasound devices. While drawing connections to those modes of analyzing piezoelectric materials, my approach in design historiography not only describes how things are, but also reveals how other realities have always already existed beyond dominant narratives of scientific innovation. A look into the history of production processes through the lens of body and material politics reveals more ambivalent perspectives underlaying the stories of objects, masters and violent effects.

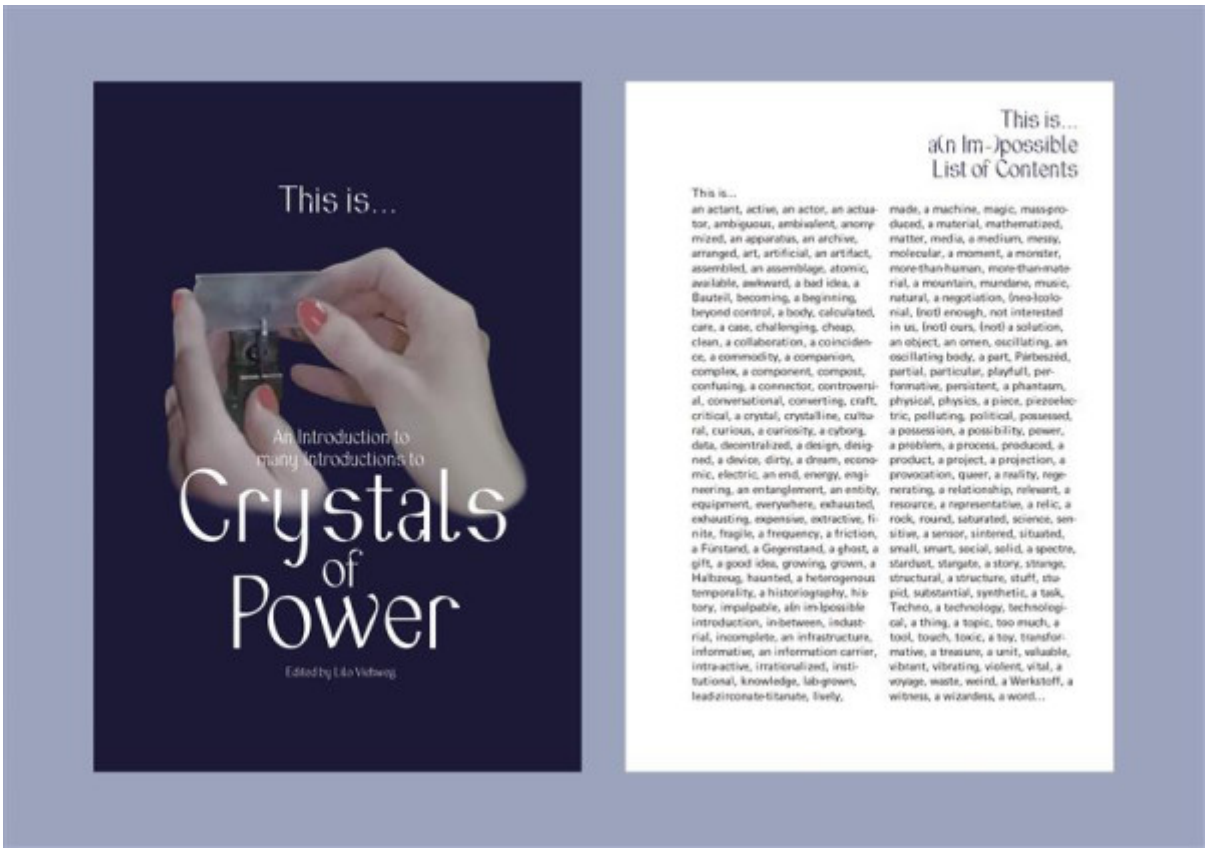
To this end, I am re-reading the archival material, investigating where words on materials in relations to bodies can be found, while also testing boundaries in accessing knowledges that were never archived in the first place. Representation is political. However, while both—writing otherwise in intersectional feminist accounts within humanities and cultural studies and making in artistic and design research—are discussed intensively, the writing of a design history in between the two is a lesser explored field. This touches on current engagements with design history methodology that develop so-called «counter histories»[21] and «critical fabulations»[22] which cycle back into physical artifacts. However, in my methodology of design history writing I do not imagine new material relationships but investigate the dynamics in between different knowledge cultures and the hierarchies of knowledge production in relation to those very imaginaries. It is a design history of what Marilyn Strathern calls «awkward relations»[23]—a mode of reading that challenges seemingly opposing paradigms in knowledge production. In my case this means a mediation that overcomes the binary of design history focusing on either production or implication/consumption—not only by writing about others, but also by questioning representation in history.[24]

In testing disciplinary boundaries of writing design history between science, design/artistic research, and new materialist lenses it is not always clear where one begins and the other ends. Exploring this challenges universalist readings of design and the linearity of history of endless growth and technological innovation. While crossing disciplinary boundaries in my research, it becomes a challenge to draw new boundaries. Thus, I am taking a two-pronged approach—on the one hand, I am looking for histories of material and body politics yet to be told; on the other hand, I ask how historiography changes through other forms of writing on the subject and in relation to the people who work(ed) with piezoelectric materials (including me). To this end, I am looking for words that are, like the term piezoelectricity itself, linked to different disciplinary readings. At the same time, I expand the narrowness of concepts by finding words that can hold multiple meanings in knowledge and material production. One example is the notion of ‹Complex Matter› in the working title of my PhD project, which refers to the historical field of crystallography in the late 19th century called «arranged complex matter».[25] At the same time, it refers to the idea that the history of piezoelectric materials told through the lens of material and body politics is a matter of complexity on a different scale. While the former is limited to the description of atomic arrangements on a micro-level, the latter connects the question of what humans do with crystals navigating between micro and macro lenses.

One decisive mode of building the archive of awkward relations of piezoelectric histories is exploring different ways of reading material. I am looking for words that connect disciplinary readings of the relationship between material and body politics, between epistemologies of design and humanities, anthropology and cultural studies writing. I am looking for words that could describe processes in crafting materials and structures by thinking temporalities beyond

hyperlocal perspectives. In a conference paper entitled «Cutting, Grinding, Dissolving and Growing Disciplinary Borders in the Assembly Line of Knowledge Production», for example, I explored how micro-acts in hands-on work with crystals could be also understood as processes of thinking temporal relationships simultaneously.[26] In the paper, a production step from the history of the electronic component was read through lenses of embodied experience—a critical exercise in manufacturing as well as in historiography beyond linear forms of techno-materialization in design. For example, by physically cutting a ceramic sensor I was cutting through the assembly line of global manufacturing that intends to proceed from mountain, to laboratory, to manufacturer, to online shop, to maker lab, to machine, to landfill. By cutting it, I intended to see how it was made, skipped the step of use and function and sent it straight to the archive—a very toxic endeavor, I am afraid, since the worst thing I could have done to the lead-based piece was to break open its surface structure and release the dust.

In another text, «Untouched Design Histories of a Crystalline Modernity,» I explore words that could be read as both sensory perception (feeling) and perspectives of critical analysis.[27] In it, the notion of «touch» is understood as both a physical act and a perspective in reading history.



This is… An Introduction to many Introductions to Crystals of Power, Lilo Viehweg (ed.) for Crafting Futures Lab, Ars Electronica University of the Arts Linz 2024

Furthermore, the book *This is… An Introduction to many Introductions to Crystals of Power* (an ongoing project) gathers different introductions to piezoelectric materials I came across, developed or presented in the past eight years since I heard and read the word «piezoelectricity» for the very first time.[28] The phrase «Crystals of Power,» which I develop there, plays with the notion of power in physics as both energy conversion and power through access to knowledge. In the book, I engage in a conversation with those introductions by others, collaborators and fellow crystal researchers of recent years, while also reading piezoelectricity through both materials science and new materialist lenses—actants, ghosts,

Werkstoff, object, subject, thing power, Halbzeug, smart material, technological materiality, bodies… The aim is to develop critical pedagogies in collective writing in between different disciplinary approaches. «Crystals of Power» in this sense is not seen as a solidifying definition that replaces piezoelectricity or scientific knowledge, but as an ongoing process of testing, practicing, un-tooling, (un-)crystallizing modes between words and materials—a challenge to the hierarchies of knowledge production. Such exercises in writing design historiography question the limits of design history and design knowledge through the limits of both representation and literacy.

[1] Lilo Viehweg, *Situated Knowledges of Complex Matter*, PhD project, Make/Sense PhD-Program, Basel Academy of Art and Design and Linz University of Arts, since 2021, https://makesensephd.ch/#/project?id=15 [https://makesensephd.ch/#/project?id=15].

[2] Murat Bengisu and Marinella Ferrara, *Materials that Move: Smart Materials, Intelligent Design*, New York and Berlin: Springer, 2018.

[3] Susanne Küchler, «Technological Materiality: Beyond the Dualist Paradigm,» in: *Theory, Culture & Society*, 25 (1), January 2008, pp. 101–120.

[4] Cf. Claudia Mareis, *Theorien des Designs zur Einführung*, Hamburg: Junius, 2014, p. 16.

[5] Alexandra Midal, *Design by Accident. For a New History of Design*, New York: SternbergPress, 2019, p. 22.

[6] Ibid., p. 48.

[7] Cf. Claudia Mareis and Nina Paim (eds.), *Design Struggles. Intersecting Histories, Pedagogies, and Perspectives*, Amsterdam: Valiz, 2021, pp. 11–22.

[8] The Primus database of the library system of Humboldt University Berlin collects around 130,000 peer-reviewed papers under the keyword «piezoelectricity.» A Google search returns some 25 million entries.

[9] Lilo Viehweg, «Untouched Histories of a Crystalline Modernity,» in: *Leida*, 5, *Stubborn Compromises in Production*, Faculty of Design, Estonian Academy of Arts, 2024, https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity [https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity].

[10] Cf. Marie Curie, *Pierre Curie*, Garden City, NY: Dover, 1963, p. 17; Shaul Katzir, *The Beginnings of Piezoelectricity. A Study in Mundane Physics*, Dordrecht: Springer, 2006.

[11] Wikipedia contributors, «Piezoelectricity – Etymology,» in: *Wikipedia*, https://en.wikipedia.org/wiki/Piezoelectricity#Etymology [https://en.wikipedia.org/wiki/Piezoelectricity#Etymology].

[12] Nobel Prize Organization, «The Nobel Prize in Physiology or Medicine 2021,» https://www.nobelprize.org/prizes/medicine/2021/summary/ [https://www.nobelprize.org/prizes/medicine/2021/summary/].

[13] Katzir 2006, p. 2.

[14] Cf. Viehweg 2024, https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity [https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity].

[15] Cf. Katzir 2006, p. 11.

[16] Cf. Ainissa Ramirez, *The Alchemy of Us. How Humans and Matter Transform One Another*, Cambridge, MA: MIT Press, 2020, p. 211; Katzir 2006, p. 2.

[17] Cf. Viehweg 2024, https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity [https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity].

[18] Ibid.

[19] Ibid.

[20] Karen Barad, «Getting Real: Technoscientific Practices and the Materialization of Reality,» in: *A Journal of Feminist Cultural Studies*, 10 (2), 1998; Lisa Yin Han, «Percepicates of the Deep Sea: Seismic Surveys and Sonic Saturation,» in: Melody Jue and Rafico Ruiz (eds.), *Saturation. An Elemental Politics*, Durham, NC: Duke University Press, 2021, pp. 223–242.

[21] James Auger and Julian Hanna, «Counterfactual and Alternative Histories as Design Practice,» in: *Temes de Disseny*, 2023, pp. 20–39.

[22] Daniela K. Rosner, *Critical Fabulations. Reworking the Methods and Margins of Design*, Cambridge, MA: MIT Press, 2018.

[23] Marilyn Strathern, «An Awkward Relationship: The Case of Feminism and Anthropology,» in: *Signs*, 12, 1987, pp. 276–292.

[24] Grace Lees-Maffei, «The Written Object. Design Journalism, Consumption, and Literature since 1945,» in: Anne Massey (ed.), *A Companion to Contemporary Design since 1945*, Chichester: John Wiley & Sons, 2019, pp. 299–325.

[25] Cf. Katzir 2006, p. 4.

[26] Lilo Viehweg, «Cutting, Grinding, Dissolving and Growing Disciplinary Borders in the Assembly Line of Knowledge Production,» in: Victoria Kelley, Jessica Kelly, Anne Massey, Cat Rossi, Kim Trogal (eds.), *Border Control: Excursion, Incursion and Exclusion. Book of Abstracts*, Design History Society, University for the Creative Arts Canterbury, 2024.

[27] Viehweg 2024, https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity [https://leida.artun.ee/en/issues/stubborn-compromises-in-production/untouched-design-histories-of-a-crystalline-modernity].

[28] Crafting Futures Lab, «First Edition at Ars Electronica 2024,» https://craftingfutures.net/category/projects,research,practice,teaching,explorations,publications/ [https://craftingfutures.net/category/projects,research,practice,teaching,explorations,publications/] .

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Lilo Viehweg is a researcher, curator, and mediator with a background in Industrial Design and Cultural Studies. In her work, she investigates critical historiographies of material-based design processes, the hierarchies of knowledge production, and the related socio-political conditions of design.