SYNTHETIC BECOMING

Malin Ah-King and Eva Hayward, Aliens in Green, Adham Faramawy, Feminist Technoscience Governance Collaboratory, Annabel Guérédrat, Rian Ciela Hammond and Krystal Tsosie, Franziska Klaas and Susanne Bauer, Marne Lucas, Mary Maggic, OBOT, Byron Rich, Mariana Rios Sandoval and the Rosæ Canine Collective, Lenka Veselá, Ker Wallwork

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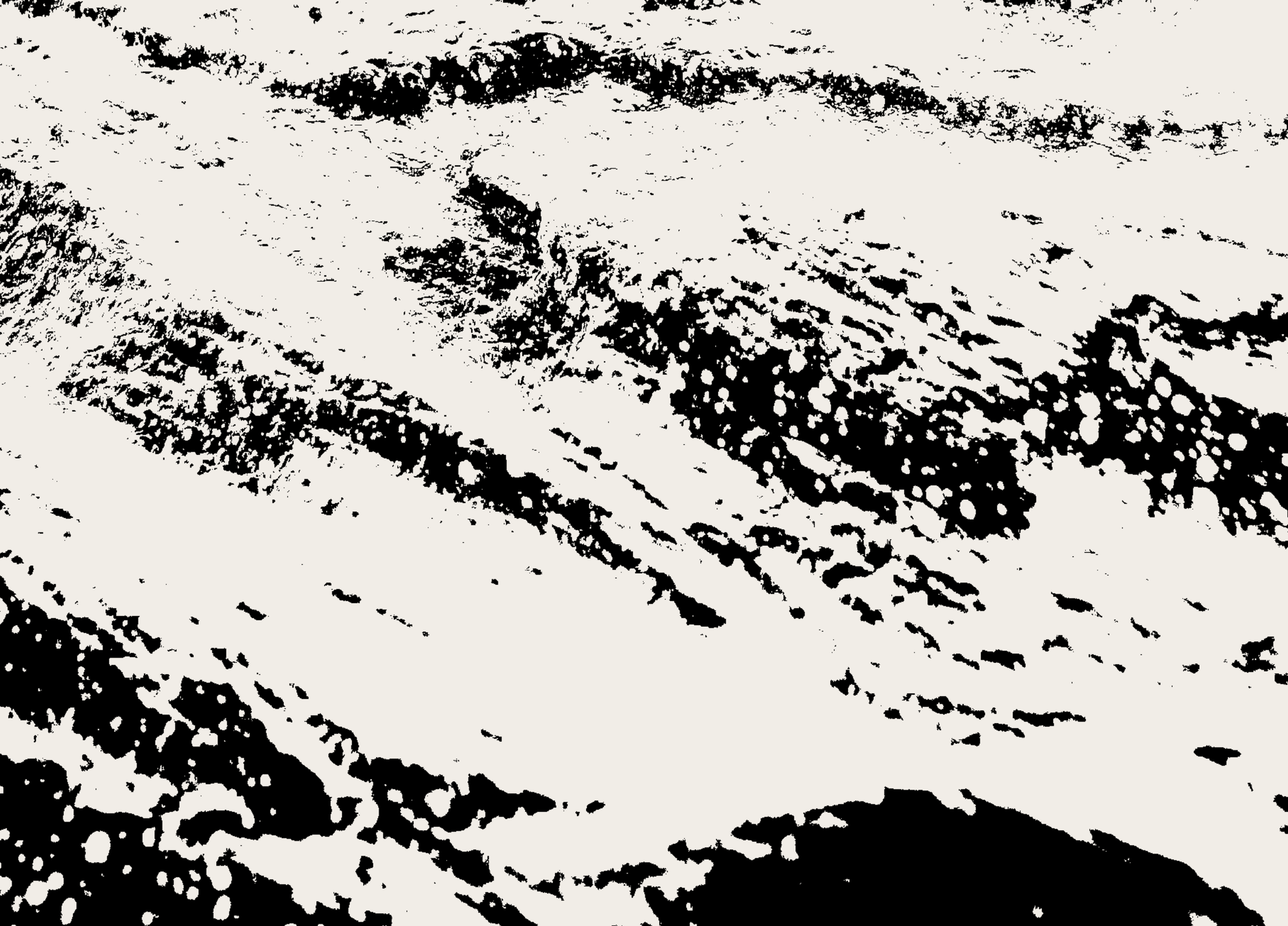


Preface & Acknowledgments

The book you are holding in your hands tells different stories about entanglements with hormones and hormone-mimicking chemicals. It is a collection of essays, poetic interventions, and critical provocations brought to you by a group of artists, activists, and feminist techno-science scholars and practitioners united by a shared belief that we are not autonomous, self-contained, and self-governing individuals but porous and malleable, open to change and reconfiguration. A critical examination of the effects of industrial, pharmaceutical, and more-than-human production of hormonally active molecules shifts our attention to our non-innocent chemical relations and at times traumatic and harmful, even deadly, entanglements with them. Studying these effects necessitates our engagement with issues of consent, complicity, and violence attached to the consumerism and extractivism implicit in the production, use, and disposal of hormonally active substances. There is no way out: the ubiquity of anthropogenic chemicals—be them pharmaceutical hormones or industrially manufactured substances with endocrine disrupting properties—leaves us with no option but to live our lives with and against them. This book seeks to facilitate this process of learning to live well in a world that also includes these chemicals.

Like our bodies, books are entities that exist owing to multiple influences, processes, and agencies. Including acknowledgments in books is an important reminder that it is because of a multitude of actors (rather than just listed "authors") that books come into existence. With over thirty people authoring this collective monograph, acknowledging and expressing gratitude to all those who have supported us as we kept working towards the completion of this book becomes a challenging task. Responding to this challenge, this acknowledgement breaks with the tradition of writing an exhaustive list of all our partners, lovers, parents, children, friends, colleagues, supervisors, teachers, students, academic departments, institutions, and funding bodies (as important and indispensable as their support is for us and our book) and instead acknowledges the contribution of a particular entity without which this book—quite literally—would not be possible: the paper it is printed on.

You wouldn't be able to hold our book in your hands if it wasn't for this 100 percent post-consumer recycled paper. The decision to use paper made of waste collected from recycling programs stems from our commitment to take our material relations seriously. Using recycled paper, rather than paper made of virgin fibers, reduces greenhouse gas emissions and protects natural resources—saving not only trees but also energy and water needed for manufacturing. However, the commitment to use recycled paper comes with several challenges—economic, practical, and aesthetic—and entangles us, producers of this book, and you, dear reader, in a set of relations worthy of attention.

Despite being produced from waste, recycled paper is more expensive than new paper from virgin fibers. This is because of the extra steps needed to create recycled material compared to manufacturing a new product. Additional processes include paper collection and recovery, sorting, removal of adhesives, staples, and other things that may be attached to the paper, pulping, and de-inking. Another consideration of concern is that paper fibers degrade when they are recycled, losing their strength and length. As a result, paper created from reused fibers is less durable and weaker. In addition, it is not as soft as paper from virgin fibers, with lower absorbency rates and worse color retention. Since the characteristics of recycled paper depend on the properties of the waste paper used for its production, recycled papers differ greatly not only by type, but even from batch to batch, presenting the design process with multiple challenges. Because of the varying paper qualities and white tones, no standard exists for recycled paper and color-binding proofs are therefore not possible. Moreover, some studies suggest that recycled paper might be less hygienic compared to paper from virgin fibers.[1] This is owing to the starches used as binding ingredients, which may serve as a breeding ground for bacteria and germs. Last, but not least—and of particular significance to this book—recycled paper contains increased amounts of endocrine disrupting chemicals. Although recycled paper requires less bleach and other potentially harmful chemicals than virgin fiber paper, it can contain ink residue and other contaminants. Ink, adhesives, and other substances, such as those used for surface treatment of paper and board packaging, are detached from the fibers' surface during the repulping process. Studies indicate that small amounts of chemicals of concern, including endocrine disrupting chemicals, such as polyfluorinated compounds, bisphenols, or phthalates, can still be detected in paper made from recycled materials.[2] From the perspective of environmental health, the recycling of paper is desirable; however, recycled paper containing potentially harmful chemicals may pose a health hazard to humans.

1
See, for example, Ulf Granhall, Allana Welsh, Ingela Noredal Throbäck, Karin Hjort, Mikael Hansson, and Sara Hallin, "Bacterial Community Diversity in Paper Mills Processing Recycled Paper," *Journal of Industrial Microbiology and Biotechnology* 37.10 (October 2010): 1061–69,

The decision to print on a more expensive, yet weaker, less reliable, and potentially toxic recycled paper is a commitment that is not separate from, but instead bound within this book and the ideas explored in it—a material choice to acknowledge dependencies, vulnerabilities, and sensitivities of contemporary life extending beyond our individual selves. Inspired by multispecies feminist theorist Donna Haraway's proposal for more-than-human sympoietic action nurturing common well-being and survival on a damaged planet, our making-with recycled paper marks the commitment of this book to "stay with the trouble" by affirming and embracing impure, inconsistent, weak, and damaged forms of being in/with the Anthropocene.[3]

2
See, for example, Anne Marie Vinggaard and Anna Kjerstine Rosenmai, "Paper and Board Food Packaging Contains Endocrine Active Chemicals," *DTU* (18 March 2015), food.dtu.dk/english/News/2015/03/Paper-and-board-food-packaging-contains-endocrine-active-chemicals; Greta Stieger, "Toxic Chemicals in Recycled Paper and Board: Danish Researchers Detect Chemicals of Concern in Food Packaging Made from Recycled Paper and Board; Push for EU-Wide Regulation of Paper and Board Food Contact Materials," *Food Packaging Forum* (26 October 2015), foodpackagingforum.org/news/toxic-chemicals-in-recycled-paper-and-board; and, David Pérez-Palacios, Miguel Ángel Fernández-Recio, Cristina Moreta, and María Teresa Tena, "Determination of Bisphenol-Type Endocrine Disrupting Compounds in Food-Contact Recycled-Paper Materials by Focused Ultrasonic Solid-Liquid Extraction and Ultra Performance Liquid Chromatography-High Resolution Mass Spectrometry," *Talanta* 99 (September 2012): 167–74.

3
Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham and London: Duke University Press, 2016).

Introduction

The word "synthetic" comes from the ancient Greek συνθετικός [synthetikós]—meaning relating to or involving synthesis. Synthesis is a composed word, combining *syn-*, meaning "together with," "along with," or "jointly," and *-tithenai*, meaning "to put," "to place." In accord with this original meaning, synthetic things are things composed of multiple parts, combining these parts to form a new, connected whole. Synthetic things involve composing, combining, joining, and togetherness.

The guiding idea of this book is that we are synthetic. We contend that nothing in this world is a standalone thing. We are composite entities, mixtures in which the stuff of the world comes together to form what we understand to be ourselves.[1]

The stuff of the world that this book concerns ranges from bodily produced hormones to synthetically manufactured compounds, called endocrine disrupting chemicals, which have the ability to interfere with the biosynthesis, metabolism, and various functions of the former. Hormones examined here are synthesized in and released from endocrine cells of animals (including humans), synthesized within the bodies of plants and fungi (called phytohormones and mycohormones), or in laboratories and at industrial sites. In this regard, the notion of the synthetic points us to more than the compositional nature of things—it simultaneously refers to the processes of biochemical and chemical syntheses by which hormones and endocrine disrupting compounds emerge. In chemistry, synthesis has a specific meaning referring to the assembling and production of chemicals. Chemical synthesis is the creation of chemical compounds by reaction from simpler materials—a complicated undertaking involving human actors, chemical agents, reactions, catalysts, protocols, and methods by which new, more complex molecules are constructed.[2] In that sense, we understand the synthetic as a concept that cuts across scales as it ties together the molecular with bodies and body politics, global economies, and environmental concerns. Our claim that we are synthetic also acknowledges the ever-increasing amounts of synthetically manufactured molecules entering and co-constituting our bodies, lives, and environments.

Synthetic Becoming investigates combined and interactive effects of industrially synthesized endocrine disrupting chemicals, pharmaceutical hormones, and hormones biosynthesized in the bodies of human and nonhuman organisms. Effects of hormonally active molecules produced across all these sites are bound with conditions and relations in which they occur and must be considered not only as part of broader molecular networks but also as part of scientific, social, and cultural practices that involve them. It is through these practices that we understand some hormonal molecules to be either "natural" or "synthetic," or either "good" hormonal medicines or "bad" endocrine disruptors. Building on the conceptualizations of materialism feminisms, new materialism, and posthumanism, we challenge simplistic binaries pertaining to hormonally active agents and attend to the different and unexpected ways in which their biochemical and sociopolitical effects converge, combine, and collide.

The very way we come to know hormones emerges within a particular situatedness and from certain infrastructures of knowledge. Hormones are not fixed objectifiable entities but carry social and cultural ideas. Hormones are "chemical messengers" that circulate through the bloodstream and inform functions of organs and tissues.[3] Hormones have wide-ranging effects on our bodies, including effects on blood sugar, lipid metabolism, bone density, growth and development, fat distribution, cardiovascular function, sleep, mood, cognition, and stress levels. Notwithstanding these effects, it is their transformation of sexual development and reproduction that most occupies scientists' attention, especially when it comes to endocrine disrupting compounds. Gender studies scholar Celia Roberts coined the term "messengers of sex" to critically analyze how hormones as bio-social agents act to produce sexed bodies and behaviors.[4] Drawing on her analysis, we interrogate signals—chemical and cultural—transmitted and communicated within planetary-wide infrastructures of hormones and hormone-disrupting chemicals. With the focus on involuntary exposure to industrially manufactured endocrine disrupting chemicals (as opposed to exposure to naturally occurring hormones or voluntary experimentation with hormonally active substances of all types), we examine the capacity of these compounds to interfere with not only endocrine systems but also normative gender orders. As evolutionary biologist Malin Ah-King and gender researcher Eva Hayward point out in their essay in this book, "endocrine disruption is a toxic, expressive, and politically problematic form of corporal-environmental interaction that unravels sex determination." To shed some light on what this unravelling entails is one of the primary goals of our collective investigation.

The figuration of synthetic becoming emphasizes that we are not only synthetic but also constantly being synthesized. It marks the open-endedness of our synthetic nature—

1
For the notion of "the stuff of the world" informed by material feminisms, see Stacy Alaimo, *Exposed: Environmental Politics and Pleasures in Posthuman Times* (Minneapolis: University of Minnesota Press, 2016).

2
See the definition of chemical synthesis by Oxford University researchers at chem.ox.ac.uk/synthesis.

3
Ernest H. Starling, "The Croonian Lectures. I. On the chemical correlation of the functions of the body," *Lancet* 166.4276 (August 1905): 423–25.

4
Celia Roberts, *Messengers of Sex: Hormones, Biomedicine and Feminism* (Cambridge: Cambridge University Press, 2007).

the incessant emergence and re-emergence through the processes of synthesis. Synthesis—understood as an undertaking whereby simpler elements come together and interact with each other, giving rise to a higher order of emergence, greater than a mere sum of its parts—is linked to complexity. With the notion of becoming, we underscore this link between synthesis and complexity, characterizing the action of components interacting in multiple situated ways, yielding nonlinearity, randomness, collective dynamics, and emergence. Following material feminist, new materialist, and posthumanist lines of thought, we understand becoming to be a counter-causal process. Becoming, particularly as discussed by feminist theorist Karen Barad, signifies the mutual co-constitution of entangled material and social phenomena coming into being out of different possibilities occurring at each moment.[5] It follows that cause and effect, as well as other distinctions such as "nature" and "culture," or "natural" and "synthetic," do not exhibit clear boundaries, but only become determinate and meaningful in the dynamic and open-ended processes of becoming.

Becoming is a particularly helpful concept to grasp the indeterminacy of how substances unfold performatively and relationally—beyond the dualisms of "natural" and "synthetic," "pure" and "polluted," or "healthy" and "damaged." In the book, we paint various scenes in which hormonally active substances unfold and emerge relationally and differentially, exploring these hormonal landscapes as sites of indeterminacy and becoming—ditching purity politics for the sake of interrogating the possibilities of resilience, chemical kinships, queer survival, and resurgent life, which asserts and continues nonetheless.[6] We embrace impure and contaminated forms of life, affirming their capacity to recompose and become something else, and search for new, unpredictable, and surprising ways of living well with the "bad" kin. We "stay with the trouble," learning how to make-with the chemicals with the potential for harm and build resilience through encounters with toxicity, contamination, and impurity. Synthetic becoming, we point out, is a symbiosis—living together—a sympoietic becoming.[7]

To designate hormonal landscapes as sites of indeterminacy and becoming is not to gloss over the ongoing violence connected to profitable chemicals being produced, used, and dumped into the environment, nor is it meant to relativize these effects. Rather, it is an appeal to shift our gaze from the brokenness and suffering of the victims of pollution to the accountability of perpetrators of violence; it is a call to suspend damage-centered research in favor of investigating the interactions, power relations, and modes

5
Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007).

6
On the concept of "chemical kinship," see Angeliki Balayannis and Emma Garnett, "Chemical Kinship: Interdisciplinary Experiments with Pollution," *Catalyst: Feminism, Theory,* Technoscience, 6.1 (2020): 1–10; on the notion of "alterlife" – a figuration of chemical exposure indexing life in its already altered state, which is also life open to further alterations – see Michelle Murphy, "Alterlife and Decolonial Chemical Relations," *Cultural Anthropology* 32.4 (2017): 494–500; and, Michelle Murphy, "Against Population, Towards Alterlife," in *Making Kin Not Population*, eds. Adele E. Clarke and Donna J. Haraway (Chicago: Prickly Paradigm Press, 2018), 101–23.

7
Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham and London: Duke University Press, 2016).

8
For the notion of "damage-centered research," see Eve Tuck, "Suspending Damage: A Letter to Communities," *Harvard Educational Review* 79.3 (2009): 40928.

9
Reena Shadaan and Michelle Murphy, "Endocrine-Disrupting Chemicals (EDCs) as Industrial and Settler Colonial Structures: Towards a Decolonial Feminist Approach," *Catalyst: Feminism, Theory, Technoscience* 6.1 (Spring 2020): 1–36. See also: Max Liboiron, *Pollution is Colonialism* (Durham: Duke University Press, 2021).

of governance that structure and sustain chemical violence.[8] As environmental justice researchers Reena Shadaan and Michelle Murphy argue, the problematics of industrially manufactured endocrine disruptors extend to the structures of settler colonialism and racial capitalism associated with oil extraction and refining, as well as industrial emissions to air and releases of water pollutants.[9] Following their argument that exposure to endocrine disrupting chemicals is materially a form of colonial environmental violence, we seek to contribute to a systemic analysis of the interactions and power relations that structure and sustain this violence in order to dismantle the regimes of extraction and exploitation pertaining not only to endocrine disrupting chemicals, but also to pharmaceutical hormones. In particular, the contributions in this book by artist Annabel Guérédrat, and by artist and biologist Rian Ciela Hammond and Indigenous geneticist and bioethicist Krystal Tsosie, address hormones and hormone-disrupting chemicals through the lens of colonialism, proposing artistic and scientific strategies for decolonizing these uncaring, colonial relations.

With the ubiquity of anthropogenic endocrine disruptors in the environment—and the abundance of prescription and over-the-counter hormonal drugs (as well as those available to buy online)—who are we becoming? How do synthetic hormones and hormone-disrupting compounds affect us and how do we interact with them? How can we live well with endocrine disrupting chemicals despite their potential to cause harm? In what follows, we seek answers to these questions in a collection of critical but hopeful stories about these peculiar agents. These stories can be read in any order. Common threads run through them, and we invite you, dear reader, to explore and link our storylines in any way you choose, navigating the labyrinth of stories according to your own path. We encourage you to examine the connections among stories and to weave them together in different ways to synthesize a complex web of thoughts, ideas, characters, plots, conflicts, mysteries, and revelations.

The synthesis of form and content has been a key principle guiding our thinking about how to articulate our research. Each contribution, written from within a particular situatedness, takes a different form, telling its story using different means. Altogether, the book presents fourteen contributions by a collective of more than thirty artists, activists, and humanities and social sciences researchers combining aesthetic and discursive strategies of storytelling. To facilitate the non-linear experience of traversing the book and interacting with its different styles and approaches to research (and) storytelling, each contribution is preceded by a brief

introduction acquainting the reader with the author(s), key ideas explored in the story, and how it could be read. In addition to the contributions of individually and collaboratively working researchers, a collectively written glossary of terms is included to (p)revisit the pivotal conceptual ideas driving the book. The glossary, we hope, can serve as a baseline for further exploration of thoughts and ideas examined in the book, continuing and expanding our work.

The book is a peer-reviewed collective monograph insisting that our interventions at the intersection of art, activism, and feminist technoscience indeed count as research. Extending the notion of the synthetic to also include epistemic concerns, we make use of the synthetic methodologies, combining different approaches to researching and different ways of articulating research concerns, advocating for their importance for studying the hidden, slow-moving, and emerging realities of our becoming with hormones and endocrine disrupting chemicals. Our experimental engagements look for the different ways of knowing and being with these chemical agents. Ultimately, in this way, the synthetic adheres not only to our research topic but also to ethical and epistemic considerations of our work. Karen Barad's conception of "ethico-onto-epistem-ology" captures this spirit of our book, in which everything comes together in an entangled way—our research concerns, ethics, and politics, as well as epistemic claims. None of them can be separated from each other.[10] They co-emerge and co-exist. As we do, too. Finally, we hope you enjoy the book and its myriad components as we attempt to rethink and reshape the ways by which we are becoming synthetic.

10
Barad, *Meeting the Universe Halfway.*

TOXIC SEXES

MALIN AH-KING
an evolutionary biologist and feminist science scholar engaged—from an "insider-outsider" position—in investigating how and why evolutionary biologists produce the knowledge about sex that they do, as well as what knowledge is ignored, delayed, or not produced

● Stockholm, Sweden

EVA HAYWARD
an anti-disciplinary scholar with training in the history of science, film and art history, and psychoanalytic semiotics, attending to the persistence of sexuality and aesthetics in the structuring of knowledge, subjectivity, and power

● Utrecht, Netherlands and New Mexico, USA

How can we understand the processes of endocrine disruption beyond common normative assumptions of sex and sexuality?

What cultural nerves are triggered by the mutations of sexed biologies associated with artificially produced hormones?

How can we discuss the effects of endocrine disruptors seriously, without retelling heteronormative understandings of sexed biologies?

Engaging in debates about sex changes in animals as a consequence of environmental endocrine pollution, this essay uses a dynamic model of sex to show how hormones and their environmental disruption can be understood as part of an ongoing process of sexing. The deleterious effects of material culture—the objects we encircle ourselves with, the food we eat, the water we drink, the medicines we take, the hygienic products we use—become part of the process of sexing. Side-stepping the now entrenched debates about the socially or biologically constructed nature of sex, sex might be better understood as a dynamic emergence with environment, habitat, and ecosystem, and made toxically so within the context of pollution. Combining feminist and queer studies of sex, gender, and sexuality with a critical but engaged approach to biology, this essay claims toxicity as one of the current conditions of sex in the contemporary moment. The intent is to broaden our understanding of humans' and animals' shared vulnerability and explore potential sites for coming to terms with the environmental catastrophe that we are already living in.

Toxic Sexes: Perverting Pollution and Queering Hormone Disruption

INTRODUCTION

Endocrine disruption, as attended to in this essay, is a toxic, expressive, and politically problematic form of corporal-environmental interaction that unravels sex determination; "endocrine disruptive compounds" (EDCs) prompt unruly thresholds of sexual emergence and modes of morphological upheaval. "Toxic sex," this paper's title, is not a root-bound forecast—disaster does not await us—rather, it is a reminder that we are already living in ruination. Toxic sex foregrounds sex as an ongoing process influenced by endocrine disruptive chemicals, describing our shared vulnerability to one another; our bodies are open to the planet.

Guided by Stacy Alaimo,[1] Celia Roberts,[2] Donna Haraway,[3] Bailey Kier,[4] and other feminists focused on environmental issues and multispecies ethics, this essay: 1) traces some popular discourses about the effects of endocrine disruption through the normative assumptions of sex and sexuality; 2) suggests a broadened understanding of pollution-induced sexual change through a dynamic model of "reactive sex;"[5] and, 3) proffers an approach toward an ecological resilience that reframes the toxicity without reasserting a politics of purity. What follows is more descriptive than definitive, more entanglement than disentangled resolution. Moreover, while this paper unrests oversimplified assumptions about sex and sexual difference by "staying with the trouble"[6] of pollution, it also demonstrates the overwhelming need for critical apprehension of anthropogenic forces and their viral consequences on planet Earth.

EMERGING PERSPECTIVES

The Scientific Committee on Problems in the Environment (SCOPE) and the International Union of Pure and Applied Chemistry (IUPAC) have been diligently investigating the impact of endocrine active substances, which are known to alter reproduction and sexual morphology in organisms. The new SCOPE-IUPAC report says that endocrine disruption can be expected in all animals in which hormones initiate physical change, including humans. Although the importance of low-dose exposure to endocrine disruptors for increasing human disease worldwide is contested—

1
Stacy Alaimo, *Bodily Natures: Science, Environment, and Material Self* (Bloomington: Indiana University Press, 2010).

2
Celia Roberts, *Messengers of Sex: Hormones, Biomedicine and Feminism* (Cambridge: Cambridge University Press, 2007).

3
Donna J. Haraway, "Awash in Urine: DES and Premarin® in Multispecies Response-ability," *Women's Studies Quarterly*, 40.1/2 (Spring/Summer 2012): 301–16.

4
Bailey Kier, "Interdependent Ecological Transsex: Notes on Re/production, 'Transgender' Fish, and the Management of Populations, Species, and Resources," *Women & Performance: A Journal of Feminist Theory*, 20.3 (2011): 299–319.

5
Malin Ah-King and Sören Nylin, "Sex in an Evolutionary Perspective: Just Another Reaction Norm," *Evolutionary Biology*, 37.4 (November 2010): 234–46.

6
Haraway, "Awash in Urine."

e.g., claims of the connection between endocrine pollution and increased infertility[7]—and some researchers even claim that the evidence is scarce, nevertheless, references to the large body of studies on disrupted animals are mounting.[8]

Among the agents culpable of endocrine disruption in ecosystems are: artificially produced hormones (steroids), which have been widely used as contraceptives for the last fifty years;[9] steroids are found in other treatments such as anti-inflammatory hormone cortisol (hydro-cortisone) used as an active ingredient in organ transplant anti-rejection drugs as well as asthma inhalers; estradiol and Premarin® are prescribed to medicate menopause symptoms, provide birth control, and other hormonal replacement therapies; androgens are made use of for muscle enhancement by athletes and during androgen deficiency. Other medicines, such as Paracetamol, a very common pain-relieving medicine, also have endocrine disrupting effects,[10] as do many artificially produced chemicals, such as Bisphenol A (BPA), which is found in plastic bottles and containers, dental materials, paper receipts and food tins. Numerous studies claim that BPA elevates rates of breast and prostate cancer, decreases sperm count, and causes reproductive problems that include early puberty as well as other neurological difficulties.[11] Other agents are found in softeners in plastics, flame-retardants in clothing, electronic devices, synthetic fragrances, cleaning products, and phthalates in cosmetics. Further complicating issues of toxicity, researchers also warn about the cocktail effect—the combined impact of multiple chemicals may add up to worse effects than each substance on its own.

With regard to environmental pollution, problematically, these artificially produced hormones have a longer degrading time than more naturally occurring hormones. Sewage works are not built to filter drugs and other endocrine disruptors from waste water.[12] Consequently, these substances pass through water systems and end up back in our environments.[13] A Danish study showed that estrogen leak into aquatic environments from farming manure distributed in the soil, and water analysis revealed the spread of this hormone pollution.[14] Furthermore, twenty-three different kinds of medications were found in a perch caught in the Fyriså, central Uppsala, Sweden.[15] In the U.S., "A U.S. Geological Survey on 140 waterways in 30 states tracked 95 different pollutants, with some surprising results: 74% of the samples contained insect repellents; 48% contained antibiotics; 40% contained reproductive hormones (e.g., birth control pill estrogen and progestin); 32% contained other prescription drugs; and 27% had chemicals used for fragrances."[16]

7
See Monica Lind and Lars Lind, "Circulating Levels of Bisphenol A and Phthalates are Related to Carotid Atherosclerosis in the Elderly," *Atherosclerosis* 218.1 (September 2011): 207–13.

8
Ernie Hood, "Are EDCs Blurring Issues of Gender?" *Environmental Health Perspectives* 113.10 (October 2005): 670–77.

9
Nancy Langston, *Toxic Bodies and the Legacy of DES* (New Haven: Yale University Press, 2010).

10
David Møbjerg Kristensen, Ulla Hass, Laurianne Lesné, Grete Lottrup, Pernille Rosenskjold Jacobsen, Christèle Desdoits-Lethimonier, Julie Boberg, Jørgen Holm Petersen, Jorma Toppari, Tina Kold Jensen, Søren Brunak, Niels E. Skakkebæk, Christine Nellemann, Katarina M. Main, Bernard Jégou, and Henrik Leffers, "Intrauterine Exposure to Mild Analgesics is a Risk Factor for Development of Male Reproductive Disorders in Human and Rat," *Human Reproduction* 26.1 (November 2010): 235–44.

11
Hiroyuki Okada, Takatoshi Tokunaga, Xiaohui Liu, Sayaka Takayanagi, Ayami Matsushima, and Yasuyuki Shimohigashi, "Direct Evidence Revealing Structural Elements Essential for the High Binding Ability of Bisphenol A to Human Estrogen-Related Receptor-," *Environmental Health Perspectives* 116.1 (January 2008): 32–38.

12
"Report: Avloppsreningsverkens förmåga att ta hand om läkemedelsrester och andra farliga ämnen," *Naturvårdsverke* (February 2008); naturvardsverket.se/Documents/publikationer/620-5794-7.pdf; Sandra Steingraber, *Living Downstream: An Ecologist's Personal Investigation of Cancer and the Environment* (New York: Da Capo Press, 2010).

13
Steingraber, *Living Downstream*.

14
Jeanne Kjaer, Preben Olsen, Kamilla Bach, Heidi C. Barlebo, Fleming Ingerslev, Martin Hansen, and Bent Halling-Sørensen, "Leaching of Estrogenic Hormones from Manure-Treated Structured Soils," *Environmental Science and Technology* 41.11 (June 2007): 3911–917.

15
Jerker Fick, Richard H. Lindberg, Lennart Kaj, and Eva Brorström-Lundén, "Report: Results from the Swedish National Screening Programme 2010: Sub-Report: Pharmaceuticals," IVL: Swedish Environmental Research Institute (December 2011), ivl.se/download/18.694ca0617a1de98f473943/1628417294174/FULLTEXT01.pdf.

16
Elizabeth Lee Vliet, *It's My Ovaries, Stupid* (New York: Scribner, 2003).

17
Lori Ann Thrupp, "Sterilization of Workers from Pesticide Exposure: The Causes and Consequences of DBCP-induced Damage in Costa Rica and Beyond," *International Journal of Health Services* 21.4 (1991): 731–57; William Henriques, Russel D. Jeffers, Thomas E. Lacher Jr., and

Although endocrine disrupting pollution affects the whole world, it is relevant to ask which human populations are most exposed and where? Reports notify of banana plantation workers that become sterile, have increased cancer risk, or die from poisoning.[17] Premature breast development in children may be due to exposure to agricultural pesticides.[18] Thrupp analyzed the causes for sterilization of banana plantation workers in Costa Rica and concluded that the determinants were "dominance of short-term profit motives, and the control over information and technology by the manufacturers (who concealed early toxicological research evidence of the reproductive hazards) and by the managers of the banana producer companies."[19] The working classes in developing countries are experiencing greater exposure to weed killers, insecticides, industrial chemicals, and medications, which are banned in neighboring countries. While insecticides, such as DDT, are banned in many industrial countries, their use is continued in developing countries, and they are spread through the atmosphere. As such, endocrine disruptors disturb multiple boundaries: of sexes, generations, races, geographies, nation-states, and species.[20]

This increasing threat of toxicity has, for good reason, prompted media attention. Many news outlets are reporting these frightening endocrine tales from our backyards. In an effort to gain ratings and readership by covering these issues, the media has gaslighted a Frankenstein metamorphosis that threatens sex and sexuality. Rather than addressing the many other health risks associated with toxic exposure, the most sensational and polemical issues stand in for debate and critical response. This raises questions: why is sex more central than cancer, autoimmune disease, and even death? What cultural nerves (many of which are globalized), are triggered? And, for those of us with feminist concerns, how do we reorient the debate away from essentialism, sexism, and heteronormativity?

POLLUTION PANIC

Issuing a transex panic—and here, transex takes up Myra Hird's articulation of "trans" as a biological emergence, a becoming multiple[21]—*National Geographic* published a spate of articles with titles such as "Female Fish Develop 'Testes' in Gulf Dead Zone,"[22] "Sex-Changing Chemicals Found in Potomac River,"[23] and "Animals' Sexual Changes Linked to Waste, Chemicals,"[24] all of which champion the connection between pollution and the undermining of sexual differences.[25] In an effort to raise awareness about the dangers of pollution, these write-ups rely on sensational titles that

sound more like science fiction accounts of "gonadal deformities" and "sex mutations" than serious attention to environmental issues.[26]

The panic spread across species boundaries. Even more politically progressive organizations, such as Greenpeace, have warned against the effects of commonly used chemicals in "the feminization of young boys and the masculinization of girls."[27] Books from environmentalists are entitled *Our Stolen Future: Are We Threatening our Fertility, Intelligence, and Survival?*,[28] *The Feminization of Nature: Our Future at Risk*,[29] and *Our Toxic World.*[30] Barbara Seaman, in a book called *The Greatest Experiment Ever Performed on Women: Exploding the Estrogen Myth,* writes: "Nobody can be sure whether environmental estrogens lie behind the quadrupling of infertility rates since 1965; if the sea of estrogens in which we live explains the fact that sperm counts are half of what they were in 1940; and if, like intersex fish and mutant frogs, male humans might begin to morph into women."[31]

Furthermore, environmental reports also suggest a connection between endocrine-disruptors and gender identity and sexuality.[32]

The Swedish Society for Nature Conservation (Svenska Naturskyddsföreningen) has recently highlighted the issue in a campaign called "Save the man!"[33] The aim is to draw attention to the connection between endocrine disruptors and declining sperm counts, increased number of genital malformation, postponed puberty, diabetes, and obesity in humans. These calls for response reveal a central importance given to "male" bodies, and a lack of concern for women's health problems. What is unveiled here is a preoccupation with the vulnerability of masculinity, maleness, and manhood—those precious commodities of any patriarchal system. It is not to say that there isn't a reason for action, but again, "Save the man!" occludes many more environmental and health challenges. The Swedish Society for Nature Conservation campaign book states, "phthalates seem to have a special liking for very young boys' genitals."[34] Hence, human sex, particularly male sex, is described as under siege, endangered, and threatened.

It is true that organisms are responding to pollution in their environments.[35] Polar bears, alligators, frogs, mollusks, fish, and birds: hormone-altering pollutants have affected more than 200 animal species around the world. The World Wildlife Fund (WWF) has reviewed reports showing interrupted sexual development, thyroid system disorders, inability to breed, reduced immune response, and

Ronald J. Kendall, "Agrochemical Use on Banana Plantations in Latin America: Perspectives on Ecological Risk," *Environmental Toxicology and Chemistry* 16.1 (January 1997): 91–99.

18
Samim Ozen, Sukran Darcan, Petek Bayindir, Ercument Karasulu, Damla Goksen Simsek, and Tahir Gurler, "Effects of Pesticides Used in Agriculture on the Development of Precocious Puberty," *Environmental Monitoring and Assessment* 184.7 (July 2012): 4223–232.

19
Thrupp, "Sterilization of Workers from Pesticide Exposure."

20
Roberts, *Messengers of Sex*.

21
Myra J. Hird, "Animal Transex," *Australian Feminist Studies* 21.49 (August 2006): 35–50.

22
Ker Than, "Female Fish Develop 'Testes' in Gulf Dead Zone," *National Geographic News* (31 May 2011), nationalgeographic.com/animals/article/110531-female-fish-sex-testes-gulf-dead-zone-freshwater-environment.

23
Amitabh Avasthi, "Sex-Changing Chemicals Found in Potomac River," *National Geographic News* (22 January 2007), news.nationalgeographic.com/news/2007/01/070122-sex-change [no longer available online].

24
James Owen, "Animals' Sexual Changes Linked to Waste, Chemicals," *National Geographic News* (1 March 2004); news.nationalgeographic.com/news/2004/03/0301_040301_genderbender [no longer available online].

25
Eva Hayward, "When Fish and Frogs Change Gender," *Independent Weekly* (3 August 2011), indyweek.com/news/fish-frogs-change-gender.

26
Giovanna Di Chiro, "Polluted politics? Confronting Toxic Discourse, Sex Panic and Eco-Normativity," in *Queer Ecologies, Sex, Nature, Politics, Desire*, eds. Catriona Mortimer-Sandilands and Bruce Erickson (Bloomington: Indiana University Press, 2010), 199–230.

27
During recent years, many environmentalist NGOs have campaigned against sex-changing pollution. This raises important questions about the sexual politics of environmental movements: how is sexual normativity the basis of preservation and protection? This question requires thorough investigation.

28
Theo Colborn, Dianne Dumanoski, and John Peterson Meyers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story* (London: Little, Brown and Company, 1996).

29
Deborah Cadbury, *The Feminization of Nature: Our Future at Risk* (London: Penguin, 1998).

30
Doris Rapp, *Our Toxic World: A Wake Up Call* (Environmental Research Foundation, 2003).

31
Barbara Seaman, *The Greatest Experiment Ever Performed on Women: Exploding the Estrogen Myth* (New York: Hyperion, 2003), 222.

abnormal mating and parenting behavior in wild animals. Recent media reports call out, variously, "Researcher: Pesticide 'Castrates' Male Frogs"[36] and "Birth-control pills poison everyone?"[37] and scientific reports raise alarm about estrogen pollution.[38] In a review of endocrine-disrupting effects, WWF states that, "The effects on female dog whelk [a predatory sea snail] are striking, as they become masculinized and grow penises."[39] Commenting on the findings of the effect of birth-control pills on trout producing "intersex" fish with both male and female features, university biologist John Woodling says that it is "the first thing that I've seen as a scientist that really scared me."[40] But again, very little attention is given to how various organisms are experiencing increased rates of disease, cancer, or loss of habitat. This returns us to the earlier problem of hyper-focusing sexual anxiety around ambiguity, variability, and changeability.

What follows is our effort to provide an alternative framework that unsettles dated assumptions about sex and its transformation, while providing a less apocalyptic mode of interpreting environmental change. It is not that we are promoting pollution, but rather offering ways for coming to terms with the real conditions of everyday life. Rather than reinvesting in purity politics—the hope of some environmental movements—we wonder how resilience and healing can occur in the context of transnational capitalism and its monstrously under-regulated dumping and pumping of various byproducts into air, water, and earth. Instead of taking up the position of a purity idealist—the world is doomed unless we clean it all up—we offer a more pragmatic and practical theorization for understanding the organisms we are becoming and the changing nature of the ecosystems to which we belong.

REACTIVE SEXING

Across manufactured landscapes, and through chemically polluted oceans, endocrine disruption presents a challenge to how we conceptualize sex. Following the knots in this issue, we turn to a model of sex that emphasizes sex as a dynamic process in which organisms have more or less "open potentials" of sex, sex related characteristics, and behavior.[41] Instead of thinking of sex as a nature-given dichotomy, or essentially discrete characteristic, sex is better understood as a responsive potential, changing over an individual's lifetime, in interaction with environmental factors, as well as over evolutionary time.

Many species have environmental sex determination, in which temperature, pH, or social environment (dominance hierarchies, sex ratio of group, sex of potential partner) influence an individual's sex, and sex determination mechanisms have changed between genetic and environmental sex determination multiple times during evolution.[42] Furthermore, there are many species that sex change regularly as part of their life histories, such as shrimps, ringed worms, echinoderms, mollusks, and some fish.[43] Sex change may be induced at a certain body size or age, or in response to social conditions. The timing of the sex change often appears to be an adaptive response to an individual's social and ecological environment.[44] Genes for sexual characteristics are carried by both sexes, regulated by hormones, and, therefore, characteristics of both sexes are within the "potential" of most individuals; which is to say that sex changing, intersexuality, and expressing characteristics of both sexes is, for many organisms, a latent aspect of their species potential.

Potential: to become. Capacity: directed toward an elsewhere, an unknown future (even if that future is unbecoming). Latin: *potentialis*, from *potentia* "power," from *potens*—"being able." Potential is an expressive unit, force, or excitation through which organisms, bodies, and environments become themselves and more. Organisms are creative responses, improvisations with and through their capacity to become with their environments (but always through the refrain of their sensoria—their ability to sense and perceive their environments and those that inhabit it).[45] Sex potential is just that, an opening out, responsiveness that is ontologically more dynamic than static. While some organisms have a narrow regular range of sex possibilities—their potential is more delimited—the effects of endocrine disruption provide a reworking of even these limits. In other words, while some species of fish more easily shift from female to male as an environmental response to pollution, others, such as polar bears, shift with more trouble. And yet, hormonal disruption assures changes across the borders of sexes.

Considering that all animal life shares an evolutionary past, many of us also share hormonal vulnerabilities. Hormone levels change over an individual's lifetime and are affected by lifestyle (stress, physical activity), and exogenous hormones.[46] Even natural plant substances like phytoestrogens interact with endocrine systems of various animals.[47] Our material culture—as expressed by the objects we encircle ourselves with, the food we eat, the water we drink, the hormones we (and our food industries) dump into our surroundings, the air we breathe, the perfumes, soaps, shampoos and lotions we use, and how we utilize our bodies—

32
Hood, "Are EDCs Blurring Issues of Gender?," and Colborn et al., *Our Stolen Future*.

33
Naturskyddsforeningen, "Save the Man—Environmental Toxins Influence Fertility and Development [Rädda mannen—miljögifter påverkar fertilitet och utveckling]," *Naturskyddsföreningen.se* (31 May 2011), naturskyddsforeningen.se/artiklar/radda-mannen.

34
Anna Froster, Magnus Hedenmark, and Roger Olsson, *Den flamsäkra katten: om kemikaliesamhället, hälsan och miljön* (Svenska Naturskyddsföreningen, 2012).

35
Theo Colborn, Frederick vom Saal, and Ana Soto, "Developmental Effects of Endocrine Disrupting Chemicals in Wildlife and Humans," *Environmental Health Perspectives* 101.5 (November 1993): 469–489; Langston, *Toxic Bodies and the Legacy of DES*.

36
"Researcher: Pesticide 'Castrates' Male Frogs," NPR: *All Things Considered* (7 March 2010), npr.org/templates/story/story.php?storyId=124422894.

37
"Birth-Control Pills Poison Everyone?" *WND: America's Independent New Network* (12 July 2007), wnd.com/2007/07/42520.

38
Colborn et al., "Developmental Effects of Endocrine Disrupting Chemicals in Wildlife and Humans;" Kjaer et al., "Leaching of Estrogenic Hormones from Manure-Treated Structured Soils;" Angéline Bertin, Pedro A. Inostroza, and Renato A. Quiñones, "Estrogen Pollution in a Highly Productive Ecosystem Off Central-South Chile," *Marine Pollution Bulletin* 62.7 (July 2011): 1530–537.

39
World Wildlife Fund, "Endocrine Disrupting Chemicals: Position Statement," *WWF Global* (January 2000), wwf.eu/?4034/Endocrine-Disrupting-Chemicals-Position-Statement-2000.

40
Quoted in "Birth-Control Pills Poison Everyone?"

41
Ah-King and Nylin, "Sex in an Evolutionary Perspective."

42
Judith E. Mank, Daniel Promislow, and John C. Avise, "Evolution of Alternative Sex-Determining Mechanisms in Teleost Fishes," *Biological Journal of the Linnean Society* 87.1 (January 2006): 83–93; Ah-King and Nylin, "Sex in an Evolutionary Perspective."

43
Philip L. Munday, Peter M. Buston, and Robert R. Warner, "Diversity and Flexibility of Sexchange Strategies in Animals," *Trends in Ecology & Evolution* 21.2 (2006): 89–95.

44
Munday et al., "Diversity and Flexibility of Sexchange Strategies in Animals."

45
Eva Hayward, "Fingery-Eyes: Impressions of Cup Corals," *Cultural Anthropology* 25.4 (November 2010): 577–99.

46
Roberts, *Messengers of Sex*.

becomes part of the process of sexing. Hence, meshing our discussion of hormone disruption with Ah-King and Nylin's ontological view of sex as a dynamic process proffers an interpretation of sex that enfolds toxification into the provocations of sexing. In this way, emerging transsex characteristics and "symptoms" can be understood as potentials rather than iterations of sexual difference. In this approach, we resonate with Bailey Kier's perspective on "shared interdependent transsex," by which he attends to the ecologically constitutive nature of bodies: he refers to "bodies" as constant processes, relations, adaptations, and metabolisms, engaged in varying degrees of re/productive and economic relations with multiple other "'bodies,' substances, and things."[48] In alliance with our project here, Kier's entanglement works to decenter normative assumptions about embodiment, futurity, and nature.

Human sex is responsive rather than recalcitrant to the bumptious forces of bioindustrial-chemical advances. Toxified and polluted: sexual assignments are reshaped and morphological specificity is undone.[49] Sexual differentiations are still at play, but their familiar parameters and orderings become ambiguous and uncanny; alterity between the sexes, however previously imagined, is unanchored. Already, sexual life as we know it is dissolving; through the unwilled transformation of toxicity and biochemical materiality, the call-and-response formation of bodies and their relations has re-dynamized corporeality. In this way, the supremacy bestowed to sexual difference—its ontological force[50]—is out-paced not only by social or political movements, but also by metabolizing pollutants, xenotransplanting toxicants, and intravenous banes.

RESILIENCE POTENTIALS

At the beginning of the twenty-first century, we are swamped globally by endocrine disruptors that unsettle and disarrange environments—the milieus and territories through which species emerge with one another. Species "become with"[51] in principle: become with habitats, resources, associations, and involvements. In this way, endocrine disruption is an unavoidable co-presence in the liveliness of organisms. It remains crucial to politically resist the continued leaching, dumping, and producing agents of hormonal disruption, but equally important is taking stock of the conditions of the present. We live within unruly effluvia and wayward discharges that promise to affect sexual, cognitive, and corporeal existence. For now, we are in over our heads, but questions remain: Can we engender environmental responsibility with-

out invoking anxiety that our most intimate reproductive environments have been infiltrated by an industrial world? How do we begin to think freshly and innovatively about environmentally induced sex and body changes without reinscribing gendered biases, sexual fears, and old prejudices? How can we discuss the effects of endocrine disruptors seriously, without retelling heteronormative understandings of sexed biologies?

As Ah-King and Nylin demonstrate, seeing sex as a reaction norm, a potential, opens up for new ways of perceiving environmental sex change as a part of a developmental process, whether it occurs in species that regularly sex change or those that don't. That hormones are a part of our sexing process throughout life means that there is potential for arbitration and regeneration. There is no need for sex panics. Seeing sexing as an ongoing process also means that there is potential for healing and restoring. Some stages in organismal development are more vulnerable than others; some incur irreversible changes in physiology. Others are short-term and reversible. We know that the endocrine disrupting substances in plastic softeners are discharged from the body relatively quickly, while substances like DDT and PCB may be stored in fat tissue for decades. The DES (Diethylstilbestrol, a synthetic estrogen) prescribed to pregnant mothers still affects descendants after three generations. Temporality is part of organisms' sex potentials. That is to say: sex is longitudinal and ongoing; time (within a toxic context) is part of sexing, part of its unfolding (potential) nature.

Reinvigorating the promise of transgender and queer politics: sexual difference, an engine of difference, is wrenched and retooled by toxicity and pollution, propagating variability rather than difference as usual. Neither utopic nor dystopic, toxic sex opens the realization that bodies are lively and rejoinders to environments and changing ecosystems, even when those same engines of change provide exposure to carcinogens, neurotoxins, asthmagens, and mutagens. "Seeing the beauty in the wounds and taking responsibility to care for the world as it is" is what we aim for here.[52]

For instance, in the Potomac River (mid-Atlantic United States), chemicals from industrial and residential sources have caused male bass to produce eggs that can be fertilized by their former gender mates. Changes in the reproductive cycle of fish can decimate populations, but as shown by these bass, evolutionary change may also bring futures other than extinction. These perspectives open the realization that bodies are lively and practical responses to environments and changing ecosystems.[53]

47
Herman Adlercreutz, "Phyto-Oestrogens and Cancer," *Lancet Oncology* 3.6 (June 2002): 364–73.

48
Kier, "Interdependent Ecological Transsex: Notes on Re/production, 'Transgender' Fish, and the Management of Populations, Species, and Resources."

49
Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham: Duke University Press, 2012).

50
The history of medical research on hormones, endocrinology, is permeated by conceptions of natural binomial sex differences and the naturalness of heterosexuality. See Nelly Oudshoorn, *Beyond the Natural Body: An Archaeology of Sex Hormones* (New York: Routledge, 1994); Anne Fausto-Sterling, *Sexing the Body: Gender Politics and the Construction of Sexuality* (New York: Basic Books, 2000); and, Roberts, *Messengers of Sex*. These hetero-normative conceptions of the relationships between sex and hormones are carried on in discussions of endocrine disruption today.

51
Donna J. Haraway troubles Deleuze and Guattari's now famous articulation of "becoming animal," with an attention to the phenomenology of prepositions. Proffering "becoming with," Haraway brings into focus Deleuze and Guattari's attention to intensity and multiplicity, while attending to the material conditions of contact, encounter, and immediacy. The preposition "with," here, is an ethical domain; meetings are built through obligations, indebtedness, and responsibility. Haraway writes, "We are all responsible to and for shaping conditions for multispecies flourishing in the face of terrible histories." "Becoming with," then, is a threshold of emergence that attends to ways in which the expressiveness of encounters envelops bodies, exchanging elements and particles of one another such that the members of the involvement become more and different. See Donna J. Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008).

52
Catriona Mortimer-Sandilands, "Unnatural Passions? Notes Towards a Queer Ecology," *Invisible Culture: An Electronic Journal for Visual Culture 9* (2005), hdl.handle.net/1802/3756.

53
Kier, "Interdependent Ecological Transsex: Notes on Re/production, 'Transgender' Fish, and the Management of Populations, Species, and Resources;" Di Chiro, "Polluted politics?"

54
Navjot S. Sodhi, Rhett Butler, William F. Laurance, and Luke Gibson, "Conservation Successes at Micro-, Meso- and Macroscales," *Trends in Ecology and Evolution* 26.11 (November 2011): 585–94.

There are also examples of how deleterious effects can be reversed, like the re-establishment of the population of bald eagles after its decline due to exposure to DDT, an endocrine-disruptive chemical.[54]

We—human and nonhuman—are living in a time of intensified exposure to toxicity where life requires reinvention (if it can), or risks disease and extinction. Things can get worse, and probably will, but life is already dire for many. We are entwined through our descent (and, possibly, our extinction), but also through our coexistence among shared environments. Nonhumans and humans are vulnerable, but also exuberant, adaptable, resilient and constantly changing in interaction with environments. We are living in environmental catastrophe, certainly some organisms will survive; humans may not.

In an effort to critique the medial focus on threats to "natural" and normative sex and sexuality, this essay developed a critical perspective for understanding environmentally induced sex changes, and encouraged a counter-discourse to rethink purity and "chemical free" ideals so as to simultaneously comprehend threats, resilience, and potentials. Embodiment, which includes sex, is a process of becoming with these altered environments. Whatever futures await us, we are the future organisms that we are becoming.

RIAN CIELA HAMMOND
an artist and biologist creating media-expansive artworks that invite people to examine the interactions between technology, power, and ways of knowing and being a body

● Munsee Lenape Territory (Jersey City), New Jersey, USA

KRYSTAL TSOSIE
an Indigenous geneticist and bioethicist advocating for Indigenous genomic data sovereignty

co-founder of the Native BioData Consortium—the first nonprofit research institute led by Indigenous scientists and tribal members in the United States ensuring that advances in genetics and health research benefit all Indigenous people

● Diné/Navajo Nation, Arizona, USA

REFUSAL AND AUTONOMY WITHIN COLONIALLY MEDIATED MOLECULAR RELATIONS

What does an anti-colonial science look like?

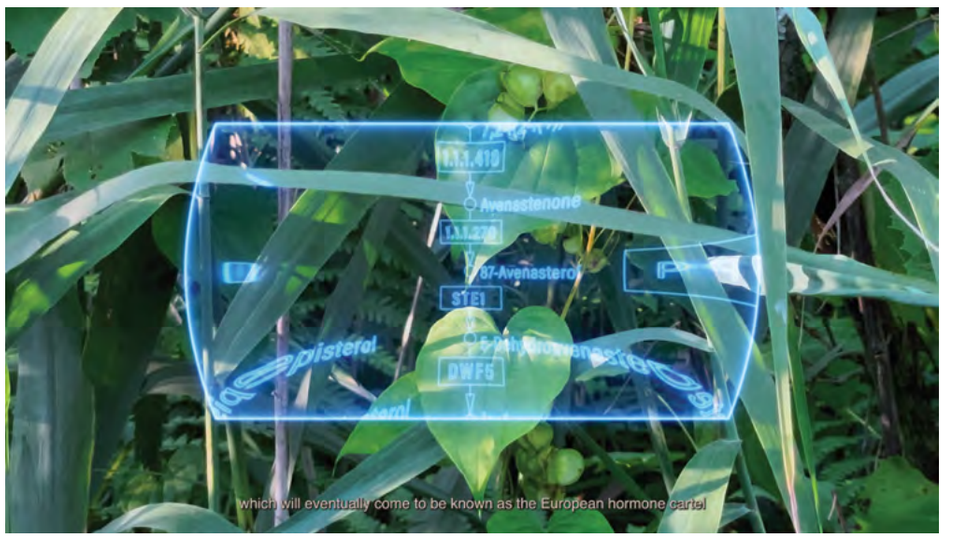
What does bio-colonialism mean historically and presently in the ongoingness of settler colonialism?

This contribution begins with the script, screenshots, and visuals from Rian Ciela Hammond's recent short film *Root Picker*—a queer nature documentary centered around wild yams who were historically the main feedstock globally for the production of steroid hormone pharmaceuticals. Through this ecological, historical excavation, hormones are understood as colonial artifacts—microbeings colonized by binary gender ideology and some of the first "natural substances" to be patented, opening the door for the patenting of genes, cells, microbes, and plants. The script of *Root Picker* is followed by Hammond's conversation with Dr. Krystal Tsosie. Together they discuss what bio-colonialism is and does historically and presently in the ongoingness of settler colonialism, what an anti-colonial science looks like, how biomolecules can be decolonized, and why "open source science" can serve as a tool of oppression, deepening pre-existing global intracommunal disparities and aiding extractive practices like bio-commercialism or bio-colonialism.

Refusal and Autonomy within Colonially-Mediated Molecular Relations: Root Picker in Conversation with Geneticist and Bioethicist Dr. Krystal Tsosie

ROOT PICKER
A SHORT FILM BY RIAN CIELA HAMMOND TRANSING
ECOLOGIES OF HORMONEBIOTECHNOLOGIES

(Fig. 01)
Rian Ciela Hammond, *Root Picker*, 2021, video still, HD video, color, sound.
All images courtesy of the author.



1. **EXT. Shots of wild yam in the swamp**

Narrator 1 Gabriella Cordoba Vivas

This yam is a blessing. This yam is a queer shapeshifting guide for moving through transformations and births. These yams teach lessons about what types of severing and violence are hidden with the words progress and technological advancement, and this yam teaches us also about the power of refusal. This yam and I are tied up in some strange entanglement. Their molecular gifts sit, extracted, transformed by fermentation with soil fungus, encapsulated in a warm bubble of castor oil embedded deep in the muscle of my thigh.

In the 1930s, with the discovery of steroid hormones, the world was ignited with desire for scientific promises of life extension, heightened sexual prowess, the elimination of queer, transgender, and intersex people who were seen as polluting imperfections, and the maintenance of colonized populations through the application of birth control. Hormones had set historic precedent in court cases that overturned previous rulings that "natural substances" could not be privately owned. With the isolation, classification, and synthesis of steroid hormones, courts began ruling on the side of European pharmaceutical and chemical companies which would eventually come to be known as the European hormone cartel. The patenting of steroid hormones opened the door for the patenting of genes, cells, microbes, plants and animals. After World War II, the United States government seized European laboratories and patents based on US soil, and in an attempt to dominate the global hormone market, the US congress funded expeditions to colonized territories in Africa, Asia, North America, and Latin America.

A family of wild yams with many names, Barbasco, Caparazon de Tortuga, Cabeza de Negro, who were used by many Indigenous peoples to ease birth pains, assist abortions, and catch river fish, were found to have the highest levels of the molecules needed for producing hormone pharmaceuticals. The yams containing these molecules in abundance were collected and shipped to Federal Experiment Stations in Puerto Rico, Florida, Georgia, Maryland, and New Jersey. On these occupied lands, as well as on plantations of the Firestone Company, US Sugar Company, and Merck and Company, Barbasco was replanted, and mono-cropped using industrial agricultural techniques. They grew in these new environments, but the levels of steroid molecules in their bodies plummeted. Rejecting

the displacement from their ecological home, and the commercialization of their molecular gifts, the yams refused to produce the desired steroids. After years of failed efforts, US researchers were unable to reproduce the molecular abundance of those yams they had stolen. The richness of the yams was not something unique to their individual bodies, but something more distributed and networked through the land. Something about their relationship with a particular soil, enmeshed in the vibrant web of lives that they had grown alongside, was essential to the gifts they offered.

2. **ANIMATED VIEW OF WILD YAM 3D SCANS, YOU ARE SMALL AMONGST THEIR ROOT SYSTEMS, MOVING SLOWLY THROUGH THEIR TANGLES AS THEY SHAKE AND VIBRATE.**

Narrator 2 - Silent [animated captions]

Search: How to refuse gender assignment?

Search: How to be perceived beyond the visuality of my body?

Search: How to honor that I can be multiple seemingly contradictory things at once?

Search: Trans as refusal to be fixed.

3. **EXT. Shots of the mud with yam/body animation overlayed**

Narrator 1 Gabriella Cordoba Vivas

The mud of the wetlands where these yams' watery bodies grow is densely populated with bacteria and fungi. Hundreds of thousands of microbes, among the muck and the roots, fermenting and transforming molecular forms. In industrial processes for production of hormone pharmaceuticals, scientists take advantage of the talents of these wetland fungi, like Cunninghamella Elegans, a filamentous fungi isolated from wetland mud who's able to transform the diosgenin produced by the yam into progesterone and androgenic steroids identical to those produced in our bodies. There is an inherent queerness to these molecules trafficked within and between bodies of all sexes across species lines. Slippery, oily, lipid steroids, slipping through the membranes of our bodies, organs, and cells.

As I began to learn from the yam, and the community that they chose in

(Figs. 02–03)
Pages from the script of *Root Picker*, 2021, HD video, color, sound.

this transformative muck, I came to see that my disidentification with binary gender ideology, was really a disidentification with the colonial classifications that our bodies are tangled up in. The notions of Human-ness that mythologize us as separate and above the messiness of the ecologies we spring from… that we are brought to life by.

My femininity is dirty and tangled and rooty.
It is impure, unclean, tarnished, covered with soil and micro-communities.
If I am not a woman, it is because my womanhood is incomplete, not in some anatomical sense, but in being broken open by the fact that femininity, whatever that is supposed to be, can not hold me, can not contain me.

My body can not fit in a binary.

4. **ANIMATED VIEW OF WILD YAM 3D SCANS, YOU ARE SMALL AMONGST THEIR ROOT SYSTEMS, MOVING SLOWLY THROUGH THEIR TANGLES AS THEY SHAKE AND VIBRATE.**

Narrator 2 - Silent [animated captions]

Search: How is the patent system Colonial Infrastructure?

Search: How is binary gender Colonial Infrastructure?

EXT. Following wild yam in the Great Swamp ~ steroid hormone biosynthesis pathway interface animation overlayed on the footage

Narrator 1 Gabriella Cordoba Vivas

Mapping a landscape is a way to create a digital copy of it's form... a kind of virtual avatar for fleshy, earthy, watery bodies. To map is to reduce, divide a being into segments, carve away the parts not cared for, in order to quantify what is valuable and desired. To map sex, to map gender, to map land, to map genomes, to map resources, to map space. The creation of this copy renders a being, open to capture within systems of extraction and control.

Today's Colonial expansion has multiplied from the outward expansion and theft of land into a project of infinitely increasing screen resolution. It is a tunneling deeper and deeper into occupied ecologies, mapping the most intimate spaces of the flesh. The territory is the cell, the molecule, the genome, the atomic. The transformation, the metabolism,

the mutation.

It is our relationships and desires in their most fine grained fleshy embodiments: the micro molecular choreographies across and within cellular bodies whose movements we experience as a feeling, a desire, a gender, an appearance.

5. **ANIMATED VIEW OF WILD YAM 3D SCANS, YOU ARE SMALL AMONGST THEIR ROOT SYSTEMS, MOVING SLOWLY THROUGH THEIR TANGLES AS THEY SHAKE AND VIBRATE.**

Narrator 2 - Silent [animated captions]

Search: How to glitch maps to show possibilities for a world otherwise.

Search: How to become illegibly un-essentialized?

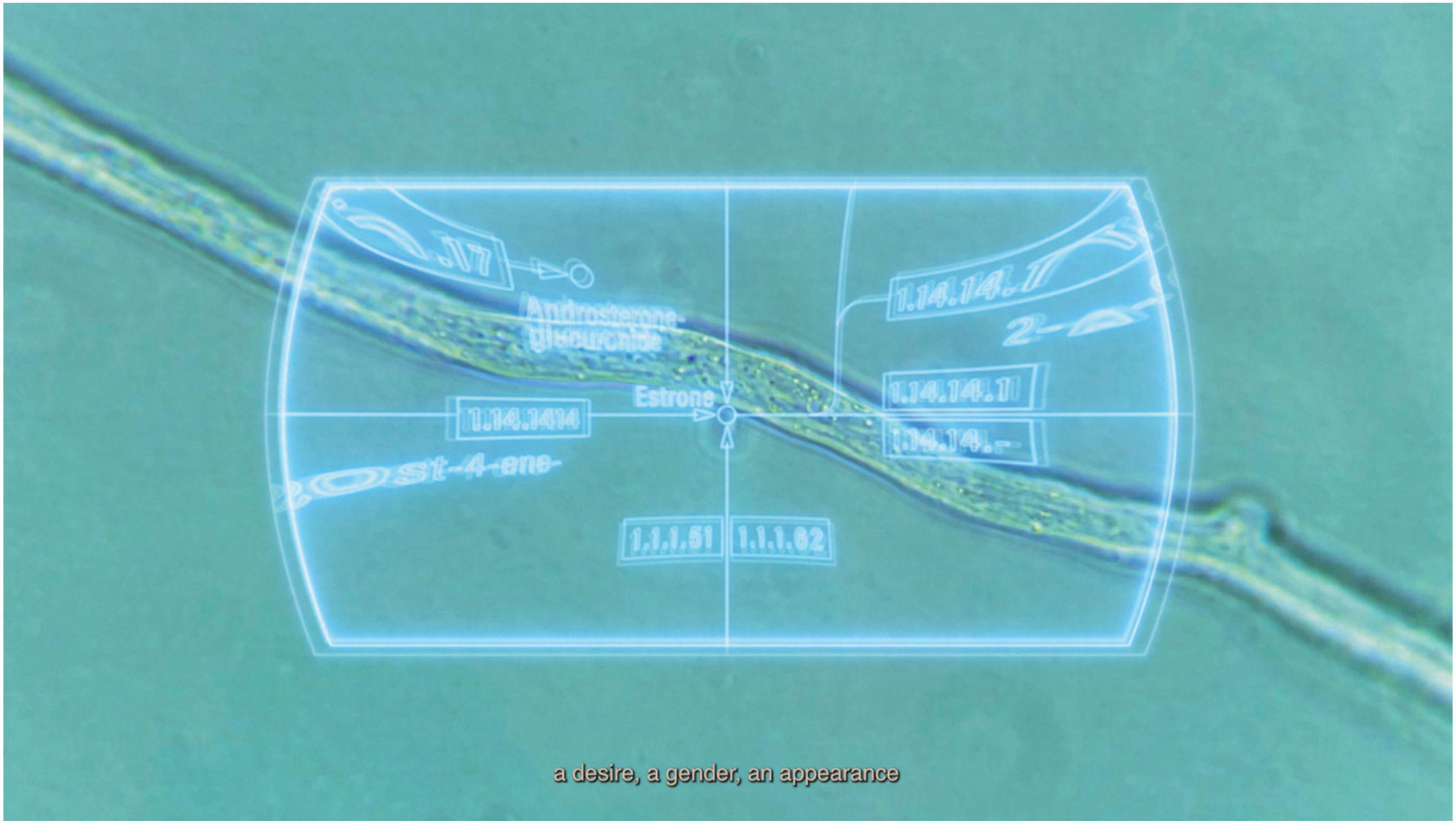
Search: How to hold my unrenderable, incalculable, incomparably vast expanses?

Search: How to fold into our watery, oceanic bodies?

(Figs. 04–05)
Pages from the script of *Root Picker*, 2021, HD video, color, sound.

(Fig. 06)
Rian Ciela Hammond, *Root Picker*, 2021, video still, HD video, color, sound.

(Fig. 07)
Rian Ciela Hammond, *Root Picker*, 2021, video still, HD video, color, sound.



(Fig. 08)
Rian Ciela Hammond, *Root Picker*, 2021, video still, HD video, color, sound.

REFUSING BIOCOLONIALISM AND DECOLONIZING BIOMOLECULES: AN INTERVIEW WITH BIOETHICIST AND GENETICIST DR. KRYSTAL TSOSIE

Rian Ciela Hammond:

A lot of what I was looking at in *Root Picker* came from the research of Gabriela Soto Laveaga, who wrote a book called *Jungle Laboratories*. In this book, she's looking at how the creation of synthetic hormones was reliant on the knowledge and labor of Indigenous campesinos in Mexico, who developed methods to identify and collect wild yams with the highest levels of diosgenin (a molecule used to produce progesterone and other steroid hormones). Even though these transnational pharmaceutical corporations were completely dependent on the knowledge, labor, and even access to the land of these Indigenous peoples in Mexico, the Indigenous people involved were ultimately excluded from the downstream benefits of creating the hormone as we know it.

At its root, this is a story about biocolonialism, so I'm excited to have a chance to talk with you since you actually study this phenomena in a broader sense—the ways that it plays out today—and you are actively developing frameworks for anti-colonial science.

Maybe the first thing we can do is to define "biocolonialism." What is this from the most expansive perspective, and then more specifically in relation to what you work on?

Krystal Tsosie:

Biocolonialism to me is very intrinsically tied with a commercialism, in which we are seeing a one-way power dynamic of biological information and data being extracted from disenfranchised, disempowered peoples or communities or groups for the benefit of the people doing the extraction or the people that hold the power in that relationship.

This could be scientists entering, for instance, Indigenous communities and taking biological data and information for their own scientific purposes. It could be for-profit companies entering into disenfranchised communities or groups and seeing data for their own commercial profit and benefit. But generally, it's a description of the one-way extraction of data and biological information to support the colonizers in whatever power imbalance you're referring to.

RCH: What would be a specific example that you look at in your work?

KT: A classic example is the Human Genome Diversity Project. This was a large-scale diversity project that started in 1993 by Luca Cavalli-Sforza at Stanford University. He was a population geneticist and originally a demographer. The whole point of the project was to sample as many populations as possible worldwide to be able to understand human genetic diversity.

I want to bring attention to their original language in the 1990s. For them, it was a huge rush to sample Indigenous people before they — and scientists actually used this word — "vanished." There was this huge rush to sample genetic data and DNA from Indigenous peoples before they were basically made "extinct" because of processes related to forced assimilation and termination of their peoples.

Understand that these scientists weren't interested in stopping colonialism from occurring on said peoples; they weren't interested in stopping why people were being forcibly removed from their homelands. That wasn't their aim. Their aim was just to collect as much data and DNA as possible before they "vanished." It's horrible, colonial framing.

RCH: Is this language that the scientists are using in scientific papers or in public communications?

KT: In the 90s, yes, in both public communications and in their actual published works. Today we don't see such egregious use of terms like, "we need a sample of Indigenous peoples before they vanish." That would be, thankfully, now flagged by a reviewer or editor. We do see some words that are colonial in intent. Particularly in the ancient DNA world, among paleogenomicists, there is this rush to collectivize as much data and DNA from Ancestors as possible.

You have to understand that DNA has a very short half-life, and Ancestors were not always preserved because they were not always in locations that were protected. A lot of times, elements related to the surrounding environment would cause the lack of preservation of DNA. Especially in the last century, there have been a lot of museum collections that have collectivized Ancestors' bodies: their DNA, their bodies, their hair and nails, everything related to their biological personhood.

Also, the line has been blurred between the collection of data from Ancestors and their contemporary descendants because now, paleogenomicists are trying to make inferences from statements about the past to create evolutionary biology and evolutionary medicine statements about people today. There's a lot of suppositions that we don't know.

It basically assumes, for instance, that people remained stagnant. That contemporary peoples today didn't move around and are found in the same places as their Ancestors. The major thing though, to go back to your original question, is that paleogenomicists have described the collection of ancient DNA from Indigenous people as "the last *frontier*," or a missing link related to our global understanding of human migration movements across the globe.

That is a horrible way to describe this research. If you think about the Out of Africa hypothesis (what's referred to as OOA), even that is not a clear, distinct demarcation of movements from the Bering Strait into the Americas. There's a lot of other competing and complementary hypotheses supporting alternate migrations that were going on in earlier times than we think (i.e., movements from Pacifica into South America).

Regardless, we have to understand that this type of interest in investigating human population movement, "the human story," so to speak, is not the story of Indigenous peoples. We as Indigenous people actually don't care about a universal global migration narrative. We have a fundamental understanding of who we are and where we have been that's been supported by our cultures, and it's not biologically intrinsic; it's not biologically encoded at all.

All this interest related to this "story about us" actually stems from non-Indigenous peoples, from people that like to reduce Indigeneity to biology. The fact that this type of information continues to be extracted from Indigenous peoples exemplifies the power dynamic at play — that this type of information comes largely from researchers in the U.S.

If you look at the provenance of research data, you'll see that most genomic information collected from Indigenous peoples originates south of the U.S. and Mexico border into Central and South America. Very little of that information is actually collected here from U.S. Indigenous groups. This reveals a disparity between U.S. and Central and South American Indigenous groups. There are 574 U.S. Indigenous nations with federally recognized sovereignty, whereas groups in Central and South America may not even be recognized by their own colonial governments. Some colonial governments to this day may even wish to remove Indigenous people from their homelands or just refuse to admit that they exist.

Guess which groups are being used to provide data that informs these narratives about Indigenous peoples? It's not coming from U.S. peoples, it's coming from these exploited groups, and the directionality of the exploitation is very clear: we see just this one-way movement of data out of countries in Central and South America to researchers in the U.S. and Europe.

RCH: I feel like there's so many different points that I'd like to tease out here. One of the most important things that I've heard from a lot of different people, and particularly researchers who work directly with Indigenous populations in South America, is that open-source as a movement — that touts itself as being inclusive and wanting to right the wrongs of the world type of thing — actually most often ends up propping up the pre-existing power and wealth imbalances that have been set up through the past centuries of European colonization.

Maybe you can just tease that out a little bit. Why is it that open-source initiatives ultimately end up strengthening these hierarchies rather than doing what many people want or say that it should do, which is level the playing field, give access to everybody, and remove barriers?

KT: It's because nobody remembers history. Nobody remembers the history of their own field. I've given talks about the Human Genome Diversity Project to students that are being trained as geneticists and data scientists now, just this year alone, and they have never even heard of the HGDP. They've never heard of the Havasupai Nation versus the Arizona Board of Regents.

And when they hear about this, about their own field, they're shocked. They're not getting this type of critique from researchers in their own field. The problem with this type of data science is that it's actually just repeating the same mistakes of the past. We have a lot of equity, diversity, and inclusion efforts related to how universities conduct research. The problem is that they use diversity and inclusion as synonyms for equity.

But we have to remember that the large-scale diversity projects of the past — HGDP, 1000 Genomes, the Genographic Project by *National Geographic* magazine — also had the same aims of increasing the inclusion of diverse, under-represented peoples in research. They did it horribly because they did it in such a colonial, extractive way. Then these projects were lambasted; several hundred global Indigenous populations went to the United Nations and recommended cessation of large-scale diversity projects.

Out of this came the United Nations Declaration on the Rights of Indigenous Peoples Related to Genetic Information. It's the same sort of messaging today for the current All of Us diversity project: "if we want to ameliorate health inequities, we need to increase diversity and inclusion." What is not being centralized here is equity. If we want to stop repeating the same problems that data extraction caused in the past, then we have to think in terms of data

equity. In that case, having communities take charge of their own data shouldn't be considered a radical idea. In fact, that should be part of the whole remediation of justice.

If we are supposed to be coming with a reckoning that racism does, in fact, exist and acknowledge that we must right the wrongs of racial injustices, then honestly, having data that's owned by the communities that provide us that data should not be such a radical idea.

But what many scientists, particularly those in power, are advocating is horrible. For instance, some paleogenomicists came out with a statement recently that lists five global principles related to ancient DNA ethics. They wrote that scientists should default to a non-U.S. country's standards of ethics, even if it's less stringent, for the extraction of Indigenous data.

This is wrong because most ethicists would default to the most stringent ethical standard to minimize harm. What some palegenomicists state is that the U.S. has more stringent guidelines by requiring engagement with communities and recognizing Indigenous communities' rights to the oversight and governance of their own data. But they state this is actually problematic to the pace of progress.

Many scientists who express concern with community-centered ethical frameworks may actually be worried that these ethical processes of engagement may slow the process of scientific innovation, or rather that it inhibits their own bottom line. Researchers operate under a publish-or-perish pressure in academia and have to continually output a certain number of publications per year in high-impact journals. There are structural factors that pressure fields to innovate constantly. But there's not really a push to pause and instead do the right thing of engaging the communities in this process.

This is just the field of ancient DNA. This type of extraction also exists in environmental science, in terms of medicinal plants and the bio-commercialization and exploitation of cultural knowledges. There's a statistic, something to the effect of 70 to 80 percent of the world's biodiversity is being stewarded by Indigenous peoples who have stewardship over 5 percent of the world's land, right? You'll find this statistic touted over and over again. What this shows is that there's a direct interest in viewing Indigenous peoples as these nature-minded, environmental stewards. Taken to an extreme context, this can result in an almost fetishizing perspective of Indigenous peoples.

RCH: Yeah, a romantic idea.

KT: Exactly. That may be a little bit over-glorifying us, but in reality, Indigenous people have either had our homelands stripped from us or we've been able to sustain our ways of living because we had a vested interest in protecting the environment around us.

At the same time, people seem to only look to Indigenous peoples' knowledge and wisdom when we have something to offer Western science. For instance, there were a lot of headlines with the California wildfires that occurred, I think either the last year or the year before, that read, "what can we learn from Indigenous peoples about fire management?" That's such an extractive wording because it basically states that Indigenous peoples and knowledges only have value when they serve Western people, Western science, or when using Indigenous knowledge to fix the mistakes caused by non-Indigenous peoples. That's extractive.

There are also concerns in terms of interest in commercializing Indigenous wisdom. Aspirin (acetylsalicylic acid), for instance, is something that comes from Indigenous medicinal knowledge, from willow trees. Now it's pharmaceutical companies that profit from that wisdom. I know of several non-Indigenous pharmacology researchers who would be very interested to learn that, for instance, some Indigenous peoples have plant knowledge specific to the treatment of cancer.

That is sacred protected information that only certain Knowledge Keepers can have. There have been repeated efforts to try to infiltrate and utilize that for their own purposes. To give you another example, there's a lot of interest in utilizing plant knowledge from Amazonian Indigenous groups because there's this perceived... what was that movie? There's a movie called *Medicine Man* [laughs], from 1992 with Sean Connery. It's about a biochemist going into the Amazonian rainforest to find a cure for cancer. It's framed as a struggle between his efforts versus the logging company's aim to extract from the rainforest. But really, it is a push for this white guy taking Indigenous knowledge to support pharmaceutical research. It's a very white-framed narrative of the white guy being the good guy and being the white savior.

RCH: Yeah, Sean Connery.

KT: If you can find it, it's horrible.

RCH: Yeah. Maybe we need some screenshots from this movie.

KT: [laughs] You can buy it for 3.99 from Apple TV.

RCH: Oh my gosh.

Both: [laughter]

KT: Anyway, sorry, I'm going on a thousand different tangents here. I apologize.

RCH: I love it; this is really interesting. Maybe to go back a little bit, we can go to one of the things I was interested in looking at initially. I read an article about your IndigiData workshops and it was talking about that it's not just about human DNA because there is also a foundation of a lot of the pharmaceuticals we have today in Indigenous knowledge of plants. Specifically, you were advocating for thinking about data not just as personal genomes, but also, for example, as soil microbiomes, which is a really fascinating one to me.

It sounded like you were advocating more of an expansive idea of what communally controlled data could be, as encompassing biocultural heritage more broadly. It makes me think of this term "plantcestors," (coined by Layla Kristy Feghali), which relates the notion of plants that communities developed in relationship with over thousands of years, over generations.

KT: Indigenous peoples have always been data stewards in some form. Data at its very, very simplest definition, is just a form of information. When we think about that in a very globally expansive viewpoint, data can be almost anything. It could be as discreet as a genetic variant on one base pair of our genome, but it could also be more broadly inclusive to mean cultural knowledge.

In the Indigenous viewpoint, things are all linked together. There's not really this distinction of human versus non-human. It's just all part of our world and they're all related. The microbiome is a great example of that. So you have these gut bacteria that line our GI tracts. From a very anatomical point of view, the GI tract is considered external to the body because the human body...

RCH: ... we're like a weird doughnut kind of... [laughs]

KT: Like a torus, yeah. But it's really strange because our gut is interlinked with so much about the body. There's this gut-brain axis. The gut is able to transfer nutrients into us and extract the byproducts of that digestion out. The gut, however, gets separated as a micro-bacterial realm versus what is classified as human cells. It's a human versus non-human distinction.

This distinction actually differs even by the country you're working with. In the U.S., data coming from the gut microbiome is considered non-human subjects data, which is very fascinating because you can obtain so much about a person. You can obtain human DNA when you're collecting, for instance, fecal samples and you actually have to entrust researchers to bioinformatically remove "human" information to isolate microbial information. You're really relying on the trust of the researchers to extract and make that distinction. In other countries outside of the U.S., because the data is derived from a human specimen, it's considered human subjects data. So, this already tells you that there's an arbitrary nature in the distinctions of what constitutes our own data, right?

RCH: Wow, that's fascinating. So essentially, because humans are treated differently from nonhuman beings in scientific ethical frameworks, you have to make this distinction whether you're going to consider this gut microbial community a part of someone's body, even though it's just as integral to the functioning of a person's body as any other organ.

KT: Yes, and these distinctions are also arbitrary: what constitutes human subjects research versus nonhuman subjects research. If you directly collect primary data from human participants for the first time, you are consenting a person for the first time for inclusion in the study. That's considered primary data and you have to get informed consent data from them.

But, if you remove the personal identifiers from that data, then it becomes secondary use data and therefore, it does not need to be re-consented. This is dangerous in the realm of data harmonization and open data because it relies on de-identification conferring some sort of protection against risks to the individual, right? This means that removing personal identifiers is considered adequate for de-identifying data and it's actually not.

There have been a number of papers that have shown that it is bioinformatically possible to re-identify a person's supposedly de-identified data from as few as three parameters. In particular, I'm talking about biological information. That's with demographic data, survey data, and census data, right? But particularly for biological data, you're not just having the risk of biological re-identification of you as an individual, but everyone you're biologically related to, which could be a lot of people, especially if you're coming from a small, under-represented community.

So, this idea of de-identifying information as being adequate for preserving data privacy is a myth. We have classified this as secondary use data and nonhuman subject data to serve our needs in collectivizing the data. That's really what we've done.

RCH: One of the things that keeps coming up in different ways is that for any scientist interested in or attempting to create a justice-driven methodology, or an anticolonial, anticapitalist methodology, there's the constant pressure of the economic framework that we live in that continuously incentivizes doing the opposite.

One example you gave is the publish or perish pressure that discourages all these different things that you would need to do in order to gain proper consent from communities and allow people to have ownership of their own data. With a lot of this, it sounds like we need slower science. We need slower, more thoughtful science instead of the flashiest, most exciting, most cutting edge innovations being funded.

KT: It is considered a trope that technology is outpacing the discussion of ethics. I actually want to say that this is the wrong framing because, to be honest, these ethical questions have been existent in the literature and have been contemplated for decades, sometimes even centuries, before the technology even existed. We just have these disciplinary silos. It's really funny, scientists, and particularly population genomicists, are finally coming to this reckoning that genetic races do not exist.

This is something that has been voiced by social scientists for decades, particularly scholars of color. So, if scientists just read across the disciplines, they probably would have been savvy to the discussion years ago. CBPR, or community-based participatory research, has just recently been embraced by biomedical research, but it actually has its roots in environmental justice research of the 70s in participatory research and action research models.

So, from the 70s to our *Nature Communications* paper in 2018, right? It just took scientists that long to be able to realize that community engagement is important.

It's also interesting to observe all the recent academic rhetoric about the next innovations in technology and the next open data-sharing. Hard science is all about how to do the science, but more thoughtful critique and time should be spent on whether or not the science *should* be done and *why* it is important. I don't think we as scientists stop and have enough of an ethical pause to ask why we are doing

the work that we're doing and how it is applicable or how it is being translated. We don't think about that. We are just always pushing to innovate, as you say.

RCH: There's definitely a parallel, I think, in the queer community and the trans community because there's so much research. Throughout the 1900s up to today, so much money has been poured into trying to find, I don't know, a male and a female brain or a gay gene or a trans gene, all of these things, and I always want to ask: why? We're not a problem to be repaired in the first place, so what is all of this research for? Especially when we don't have enough research into healthcare outcomes and efficacy of different hormone preparations and things that are actually needed and being asked for by trans people. I mean hormone use in transgender patients at this point still hasn't even been approved by the FDA. I think the defense of the brain and genome studies to "identify" transness or queerness on a molecular or microscopic level is often curiosity, or we just we want to know. We want to understand. But the subtext is always: "we want to understand what went wrong."... "what's the aberration?" So there are really important questions about allocation of resources and protection of populations who get rendered as undesirable for whatever reason. Why do we need to do this research?

KT: Another way to ask this is why are we funding certain types of research and not other types of research? And who are the power people at play? Why is it that we have so much knowledge about disease related to cisgender white males, but not women? Or, what about anyone who's not cisgendered or who's not white or who's not male?

For instance, for heart attacks we have a wealth of information about how myocardial infarction occurs or symptomatically presents in men, but for women that's something we don't know. When you think about gynecological research, so much of it is under-funded. We have to question why? Why are some of these questions at the forefront and why are some questions being excluded?

To circle back to the beginning part of the argument, why are we so interested in the global human migration story and why are we not interested, for instance, in looking at conditions that specifically affect disenfranchised and disempowered populations in people?

RCH: Yes!

KT: Oh, I'll give you another example for the commercial interest that ties into this. I want to try to say this in as broad of terms as possible. The Native Biodata Consortium is an Indigenous-led biological data repository. When we first sought funding from outside partners, we had a lot of initial interest from for-profit companies that viewed us as a resource or an access point for them to obtain Indigenous genomes. We made a point from an ethical standpoint that we did not want to partner with companies that just effectively wanted to data mine us, to use us as a means for data extraction from Indigenous groups.

Indigenous peoples, because they've largely not engaged in genetic studies, are considered again this fountain of data that is going to inform genetic diversity, but a huge driver of this interest is from pharmaceutical companies who are interested in Indigenous genomic information to find the next genetic variant that is commercially viable. So, this is actually really interesting.

When they were questioning the type of research that we do and the type of research questions that we're interested in, there was a conflict. We are very interested in research questions that are of interest to the Indigenous communities with whom we partner. They were only interested in using Indigenous genomic information to study conditions that were commercially viable, meaning affecting the majority population, and not Indigenous people. Essentially, they wanted Indigenous information to benefit non-Indigenous folk. If we tried to pique their interest in studying conditions that affected Indigenous people, they basically said "No, there's just no money in it. We don't see the commercial value." And I'm like, "Wow."

RCH: If you're comfortable sharing, did companies reach out to you directly wanting to partner, or how did that work?

KT: Two things. Most of this information was solicited because we presented our framework to a number of scientific conferences, and these are the same conferences that are attended by exhibitors from these companies. So, they heard, "Oh, an Indigenous-specific biobank! Yes, of course, that means we have Indigenous variants that we could potentially gain access to. What do you have? What's your sample power? What diseases have you looked at?"

We would take these meetings more to get an idea of who they were, but we were very upfront that we were not interested in partnering with them because we want to ensure that any intellectual property that could be created from Indigenous-specific variants was owned by the Tribe.

RCH: One thing I've thought about a lot in my work, and also just through my experiences navigating the medical system as a trans person, is how important refusal and autonomy are as liberatory practices. I think the Native Biodata Consortium is a really powerful example of community autonomy empowering people to engage with medical technologies on their own terms.

I wonder if you could reflect on how refusal and autonomy show up in your work through the Native BioData Consortium, or more broadly as a Diné scientist and bioethicist.

KT: The great thing about having Indigenous-led research structures in place is that when Indigenous peoples are empowered as data stewards, their decision to participate (or not participate) in research is also upheld. We can ensure that the data that comes from Indigenous community members actually benefit Indigenous peoples. Not in several decades but benefits us first.

However, this also entails education of all Indigenous people about the value of their genomic data and power that their data confers. Unfortunately, if people are not aware about the *value* and power of their data, someone else who does understand it and wants that kind of authority can easily take it away.

That's why I hope that more and more people carefully consider the value and power of their data, both of their own and also their communities. Data has an infinite lifespan, and the impacts of the data decisions that we make may outlive even our own individual lives.

(Fig. 09.)
Rian Ciela Hammond, *Root Picker*, 2021, video still, HD video, color, sound.

ROSÆ CANINE COLLECTIVE
Bethsabée Elharar-Lemberg, Maïwenn Le Roux, Elena Souvannavong

a collective of activist and feminist herbalists fighting for the reappropriation of bodies

● **France, *en itinérance***

MARIANA RIOS SANDOVAL
an anthropologist trying to make sense of accelerated environmental change and damage through writing, film, sound making, and collaborative experiments

● **Ile de France/Mexico City**

POST-INDUSTRIAL SELF-GYNE-COLOGY PLANT MANUAL

"Rosa Luxemburg, Parks, Bonheur... So many militant women who bear in their name the symbol of the free spirit and the strength of the rose."

"The reputation of plants sometimes precedes them. They whisper into our ears keys for healing. Rumors are to be taken seriously and delicately in order to understand their origins and their subtleties."

"Rose hip seeds with stinging hairs, gratte-culs, could be used as delicious weapons by knowledgeable avengers. Joyful and subversive, the rose has been recognized for its benefits since antiquity. Legend has it that it was named rosa canina in reference to the use Romans made of it to treat dog bites."

"If I were a plant, I would be a weed, an invasive plant with spontaneous growth, a wild plant that intrudes into unstable and disturbed soils."

Taking root in feminist self-help health practices and herbal healing traditions, this essay playfully weaves photography and drawings, prose and posology. As in a botanical guided exploration, it creatively engages with a series of plants of gynecological use that can be found in fields, mountains and urban parks througout France. These plants are a means to access and heal bodies and subvert power relations. They attest to the blurry boundaries between compounds—metabolites, industrial chemicals, hormones, prescription drugs, pollutants—making up the molecular conversations going on in and between bodies and landscapes. Finally, the vegetal beings featured in this chapter embody some of the perils, pleasures, and paradoxes of healing with plants in times of environmental crisis.

Post-Industrial Self-Gynecology Plant Manual

> "Deviant existences face a great challenge. That of making of their own medicinal and medicated gardens, their soils of hormones and Truvada[1], something other than a dying land governed by the law of the market and capitalism. For flowers are always a little mutant, Vita Sackville-West[2] reminds us; behind the appearance of a technical system, their genetically modified colors have the depth of our attachments, our desires and our intimate and collective needs. Faced with the great redemptive enterprises that would seek to expel by force the deviant subjects out of their purified spaces, what will be our perverse flora and what eco-systems can they invent?"[3]

This post-industrial self-gynecology plant manual can be read front to back or back to front. On polluted days or under a clear blue sky. It reads well overlooking the sea, at the break of dawn, or in a packed subway at rush hour. It can be read alone but is best enjoyed with others. It does not contain medical advice, yet in it you will find valuable, emancipating knowledge to take care of your health.

Botanical walks and *cueillettes*, the French word for plant picking or harvesting, inspire and structure the manual. As you will see we walked and harvested for different reasons: to get to know a landscape, other people and ourselves, to raise awareness, to heal. In the following pages, you will find plant portraits including some guidance on how to use them, and a few entries to our harvest diaries, our *journal de cueillettes*. Our texts are diverse, even disparate. We hope together they convey a complex picture.

This text is the result of cross contamination and pollination as we believe purity is a fiction that can be deadly. We are mutants. And sometimes we are enraged mutants,

1
A combination of two antiretroviral drugs, Truvada is currently used for prevention through PrEP (pre-exposure prophylaxis), or as treatment for people living with HIV.

2
Vita Sackville-West was a British poet, novelist, essayist, biographer, translator and gardener. She is also known for helping to create her gardens at Sissinghurst Castle in Kent, for her exuberant aristocratic life, her strong marriage to Harold Nicolson, and her passionate affairs with women such as Violet Trefusis and the novelist Virginia Woolf.

3
Cy Lecerf Maulpoix, *Écologies déviantes: Voyage en terres queers* (Paris: Cambourakis, 2021).
This, and all subsequent translations, unless noted otherwise are by the authors.

longing for not-so-distant futures where there is room for hope, desire, and all forms of life. In the meantime, with plants as our allies, we walk, harvest, and fight together.

JOURNAL DE CUEILLETTE
Elena
I
Interactions
26 January 2022

In October, we were walking in the countryside to pick mushrooms.

Essential breaths.

From amanites to clitocybes, our wicker basket was full of comforting fall colors.

Settling down together is lonely and makes you look for love everywhere in the fields, around a home that is not yet yours.

It makes you glean love to nibble joyfully on its flesh.

The pleasure of “what is next”—looking for mushrooms to find apples, cenelles, and rose hips.

Picking with someone is the most touching thing in the world for me.

I always mark on my harvest tags who I picked with. As if to remind myself that the plant is our spectator, and that each person who ingests it will be imbued with the love of our connection at that moment. I remember the savory in the Quint Valley, picked naked, with B. When we were trying to make ourselves invisible to the cars passing by on the side road, giggling. Yarrow picked with L. at my mom’s house, just before stealing a flag at the firemen’s ceremony when we were in love. Of beech buds confined with P. at the villa...

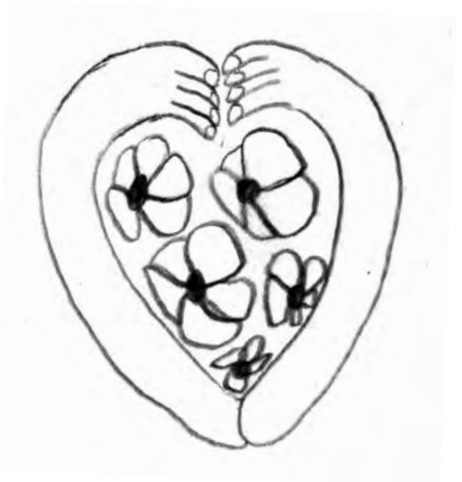
Like a photograph, the medicinal plant sends me back the image of a moment: it is already healing me.

1 May 2022

“Everything” is part of me.

Leaving on an April afternoon. Walking, always on the same path. In the shade of the hazel trees, the wind is cool. There are cows in the field above. With horns. Red.

There is in my field of vision the 4G antenna that always pierces my eyes, wide open. Blinded by a thousand infinite grasses that fill every crumb of emptiness in the landscape. Like an unlimited pattern. Unlimited of unlimited. And barbed wire along my path. Around my house there are many small paths, hidden between two fields, suitable for love. Humans like to divide the landscape to find themselves.



(Figs. 01–03)
Drawings, 2022, by Elena.

In this season, the stellar, the chickweed, the broom, the gorse, the pink boraginaceous—whose name I can never remember—the hawthorns, the daisies, the dandelions, the holly, the apple trees, the lilacs, the plantains bloom. It is the pollen walk, the gangbang of Eol, the festival of the pollen tube. And all these smells make me want to sit on the ground. It makes me want to get wet to beauty. It makes me want to harvest.

In the infinite pattern, to stir up the landscape and jump from the barbed wire. Wounding myself with bramble that penetrates the skin. Brushing against blades of grass without consent.

I sneeze and think of the thousand molecules that are passing through my body right now without me really knowing. I think first of all of the pollens, some of which, from pine trees, can bind to my cortisol receptors and which have an action on my behavior: it is an action that I do not control.[4] In this particular case, this action is positive and would constitute one of the probable reasons for the use of sylvotherapy against stress (not that sylvotherapy should be reduced very unfairly to the interaction of a molecule).

As I sit on the grass, seeing the neighbor's farm in the distance, it occurs to me that he probably treats his garden or crops with glyphosate. Since I grew up there, in the Limousin, I have seen many women farmers get cancer. They are not smokers. They also have debts: between the isolation and the forced work twenty-four hours a day, their life is very hard.

I am an herbalist and I observe the pickers, my colleagues, whether they work in the wild or in their fields, and I often wonder if the place where they pick is not polluted. Dildo, a seasonal colleague who collects plants in mass for the pharmaceutical industry, told me with a sheepish smile that several times his harvests had tested positive for endocrine disrupting chemicals (EDCs) in isolated harvesting spots.

In the act of harvesting, there are several politics, several rules to apply: do not trample, leave flowers for bees, be careful with animal urine. But one recommendation remains nomadic and potentially inapplicable: do not harvest on polluted land. Pollution is the destruction or degradation of the biosphere by the introduction of entities (physical, chemical, or biological), or radiations that alter the functioning of this ecosystem. These substances are obviously invisible and cannot be traced. They are also little attached to concrete and barbed wire borders: nature, although fenced in, is—and will remain—indivisible from a total unity containing us as well, where the "nature-culture" binary seems obsolete to me.[5] Nature cannot be stagnant, it exists rather

4
M. Šaden-Krehula, M. Tajić, and D. Kolbah, "Sex hormones and corticosteroids in pollen of Pinus nigra," 18.2 (1979), 345-46.

5
Judith Butler, *Gender Trouble* (New York: Routledge, 2006).

as a network of complex interactions. The recent modification of the definition of biodiversity, no longer as a simplified number of species but as the complexity of the interaction between the different ecosystems and beings, highlights the complexity of the living. Thinking about all this fascinates me and loses me, even more, in the infinity of the plant pattern extending around me: the question of possible pollution and of the presence of EDCs is not solved. So, I pick daisies.

"I" am Part of the Whole

The stem of the plant is green. Its flowers are all small and tubular, and white ligules around the edge of the inflorescence remind me of my playful childhood. I am faced with an obvious physiological radical otherness.[6] As an animal, I can choose where I go and I am an individual in the sense that my body is not divisible (like a plant being).

"I" feels divided. Because in a sensitive way I pick these daisies one by one with a repetitive gesture and I have the impression from the bottom of my guts of feeling that something is happening. I can't divide myself, I can't get rid of my carnal envelope and yet I feel divided by them, to them. I have the deviant impression that a trance is operating and that the eroticism that emanates from this moment favors the intention of care that I already have for my harvest.[7] It is difficult for me to make this inner sensitive world tangible because it seems to me that Francis Hallé is right: I speak "a language of animals that does not lend itself well to the relation of a vegetal truth."[8]

6
The concept is borrowed from Florence Burgat, *Qu'est-ce qu'une plante? Essai sur la vie végétale* (Paris: SEUIL, 2020).

7
Inspired by Audre Lorde, *Uses of the Erotic: The Erotic as Power* (New York: Out & Out Books, 1978).

8
Francis Hallé, *In Praise of Plants* (Portland: Timber Press, 2002).

9 May 2022
(while listening to the album Splattering Eyes by the duo Sauges[9])

I'm tired today. I was woken up by the horn of a pickup truck, white as snow, not very happy that I sleep in a truck near his waterfalls—ah, the joys of territorial virilism! After the wandering and the poetry of a roadside coffee with A., I go back.

I have an appointment with Céline, the market gardener, to answer my questions. I go by bike: it's hot as hell. I interview her for my ethnobotany thesis in her vegetable greenhouse. Her vision of agriculture is simple, fair, pure. She is lonely.

During the interview, she tells me that one of her family members, not very aware of pollution issues, was filling cans with glyphosate (after having cleaned them well!). She tells me with great discouragement and disgust her dismay: she never gets apple juice from this person.

9
Sauges, "Splattering Eyes, by Sauges" (2022), sauges.bandcamp.com/track/splattering-eyes.

(Fig. 04)
Harvest of daisy—*Bellis perennis*. Creuse, 2022, photo by Elena.

(Fig. 05)
Harvest of nettle leaves—*Urtica dioïca.* Creuse, 2022, photo by Elena.

It occurs to me that the lack of information on these subjects is really serious. The industrialists have succeeded in sowing doubt, in denying strong evidence. Maybe it is too hard to admit, polluting for someone who pollutes. It's too hard to admit that we nourish and kill the planet at the same time.

On my way back from her house, I stop on the side of the road to pick some mugwort. Blood red.

THE WILD ROSE — ROSA CANINA ROSACEAE

Rosa Luxemburg, Parks, Bonheur... So many militant women who bear in their name the symbol of the free spirit and the strength of the rose.

These seeds with stinging hairs, *gratte-culs*, could be used as delicious weapons by knowledgeable avengers.

Joyful and subversive, the rose has been recognized for its benefits since antiquity. Legend has it that it was named *canina* in reference to the use Romans made of it to treat dog bites.

Blood red, it was the symbol of the goddess Venus vulgaris, of the ardent love. Rose is the anagram of Eros. It is the flower of the fallen, of the forgotten: beautiful androgynous with an unfurled odor, bringing well-being and care without distinction of gender or social class (if everyone was free to find it in nature and not to buy it in organic stores at a high price).

Rosa canina is interesting to mineralize: these false fruits contain a lot of minerals and vitamin C that will boost the organism and its functions. It can be useful as a cure in spring, autumn, or even during convalescence. Containing iron, can be used when there is anemia.

In these cases, one can use the mother tincture of fruits at the dose of thirty drops, three times a day over three weeks, or a cold maceration of fruits to drink regularly. As vitamin C is very sensitive to heat, cold uses are more recommended in avitaminosis.

In the field of naturopathy, for endometriosis, gemmotherapy of Rosa canina is often recommended at the beginning of the cycle: from menstruation to ovulation. Rina Nissim uses it in this perspective, for example, perhaps because it is a remedy for recurrent localized inflammations.[10]

For herbal teas, the ripe but still firm rosehips are harvested in autumn. They can be dried whole (two to three weeks) or the skin can be separated from the fruit (not without difficulty). They must be dry and very hard, like pebbles.[11]

Infusion is made with five to ten false fruits per cup. Squeeze them with a cloth to extract all the benefits. You

10
Rina Nissim, *Mamamélis: Manuel de gynécologie naturopathique à l'usage des femmes* (Mamamelis, 2001); Francesca Ieri et al., "Phenolic Composition of 'Bud Extracts' of Ribes Nigrum L., Rosa Canina L. and Tilia Tomentosa M.", *Journal of Pharmaceutical and Biomedical Analysis* 115 (November 2015): 1-9.

11
Thierry Thevenin et al., *Le chemin des herbes– Du Midi à l'atlantique* (Paris: Ulmer, 2019).

can also make a cold maceration, as an iced tea, with lemon juice or fresh lemon balm for example.

It is possible to use rose petals in hydrolat or in oily macerate on the skin. The petals that contain the most essential oil are those of Rosa damascena, the Damask Rose, generally used in the cosmetic industry and in aromatherapy.

These preparations have antibacterial, astringent, and antioxidant properties. They can be used in massage to treat dysmenorrhea, and they are also known for relieving anxiety and depression.[12]

The reputation of plants sometimes precedes them. They whisper into our ears keys for healing. Rumors are to be taken seriously and delicately in order to understand their origins and their subtleties.

12
Ali Abbasijahromi et al., "Compare the Effect of Aromatherapy Using Lavender and Damask Rose Essential Oils on the Level of Anxiety and Severity of Pain Following C-Section: A Double-Blinded Randomized Clinical Trial," *Journal of Complementary and Integrative Medicine* 17.3 (October 2020): 1-14; H. Sadeghi Aval Shahr et al., "The Effect of Self-Aromatherapy Massage of the Abdomen on the Primary Dysmenorrhoea," *Journal of Obstetrics and Gynaecology* 35.4 (May 2015): 382–85.

JOURNAL DE CUEILLETTE
Mariana
II
Of witches, peaches and chemical species

I first crossed paths with Rosæ canine in an eco-feminist and witchcraft festival in Montreuil, a city in Paris' Eastern suburbs. It was the summer of 2019, and back then the collective of *herboristes* (herbalists) was named La Vulva. I was there wearing my anthropologist hat, doing fieldwork on emergent, radical thinking on the intersections of contraceptive hormones, bodies, and the environment. Witches, I had been told, had interesting things to say on the matter.

The festival took place in what used to be a several hundred-hectare plot of land, the *Mur à Pêches* (wall of peaches), dedicated to the cultivation of peaches using a locally developed technique of protective walls, dating back to the seventeenth century. By the end of the Second World War, the peach fortress counted 300 hectares, and from that moment on it began to shrink at an accelerated pace to give way to the expanding city. As I write this text, only thirty-four hectares of the plot remain in this rapidly gentrifying urban center. Barely any peaches are grown in the *Mur à Pêches* anymore, but there are other things germinating there. The place has been declared a protected area and is considered a reservoir of biodiversity, a hub for community gardening and agriculture, and a site of resistance, which sometimes adopts the shape of festivals like the one happening that day.

La Vulva, known today as Rosæ canine, hosted two activities at the festival. The first was a performance based on their fanzine "*Jouir"* [from French: to come, to orgasm, to enjoy, to take pleasure, to benefit from]. Sitting on the floor,

backs against each other's, the *herboristes* took turns to read out loud some fanzine excerpts to an attentive crowd that would not budge despite the sudden rain. The three women wove prose, poetry, personal stories and instructions to collect, process, and make use of a series of plants: Artemisia for painful periods, rose hips for heavy flows, vervain to attenuate menopause's hot flashes. It was the *herboristes*' belief that these plants, many of them able to enter in dialogue with bodily hormones, were a means to reclaim our bodies back from the powerful structures governing life, standardizing it, determining what is and what is not normal, and sucking profit out of every last single drop of it: patriarchy, capitalism, and Big Pharma, to name just those at the top of the list.

The second activity was a *balade botanique*, a botanic walk, through the inner gardens of the *Mur à Pêches,* aimed at teaching participants how to identify and make use of some of the plants holding a key to our bodies. The walk was free of charge but limited to six participants. I tried to reserve a place, but it was already full. I learned that botanic walks were the collective's signature action, and that they took place with some regularity in the parks and sidewalks of other suburban towns like Montreuil, in Paris, or in the countryside. Botanic walks in the city generated quite a lot of interest because they seemed counter-intuitive: busy streets often rhyme with traffic, noise, and pollution, not with healing, hormones, or menstrual blood.

I ended up participating in a *balade botanique* several months later, at the Belleville Park in Paris. The walk was guided by Elena. We followed her around the park and learned how it was packed with wonders: cinara, a cousin of the artichoke, to protect the liver; nettle to help with benign enlargement of the prostate; wild vervain for postpartum depression, and so on. We had all been in that park many times before, but it now revealed to us as a new place; a picnic spot had become a medicinal garden. Our excitement, however, was met with a word of caution from Elena. Plants should not be collected in the city, because of the polluted soil, air, and water they use to grow. Like all organisms, humans included, plants' bodies are permeable to the chemical byproducts of industrial activity and consumer capitalism. Although Elena's advice was to a certain extent logical as cities are known to be polluted places, it also felt like a paradox, and a disappointment. By the looks of the other walkers, I could tell they felt something similar. What was the point of learning about all the botanical treasures to be found in the city if they were hopelessly out of reach?

Paris and its surroundings, which together are called Ile de France, stand on a vast and heterogeneous land, divided up in hundreds of cities and towns. Most of these cities show the signs of a long agricultural and industrial past, often in the form of brownfields and polluted soils. Heavy metals such as lead and copper are commonly found in the soil found in and around the City of Lights. This kind of pollution stands not only in the way of undisciplined medicinal plant harvesting, but also of community gardening and other forms of urban agriculture. Many don't know that soil is extracted from rural areas and imported to Ile de France whenever edible crops are to be grown. At least that is the procedure informed by scientific advice in recent years. Before that, as one soil scientist told me in another of my explorations, people in Paris used to clean up some of the pollution in the soil by eating the plants grown in it.[13] The flip side of transplanting less polluted soil into the city is the devastation of great portions of rural land. In order to solve one problem, another one is created, a snake that perpetually eats itself.[14]

We are not used to thinking of cities, covered in concrete and asphalt, as land, soil, or part of a larger ecosystem. We are not used to thinking of bodies in their landscapes or environments either. But bodies and body reclamation, hormonal conversations, plant ecologies, everyday life, industrial activity, harvesting, and resistance are always rooted *somewhere*. Landscapes, suggests the anthropologist Anna Tsing, are not just the result of history, but dynamic spaces where humans and non humans shape worlds together.[15] Together with humans, plants make landscapes; we make worlds together.

In an unevenly, yet permanently polluted world, chemical species also make worlds with us.[16] Conceived for the industrial making of commodities and infrastructures, chemical compounds invariably find their way into the environment and into all that lives. They blow through the air, travel in the water, or sediment in the soil. They invite themselves into bodies, where they accumulate in tissues and fluids, interact with bodily molecules, and tinker with physiology. Pollutants, but also plants, remind us of the multiple and inescapable entanglements of humans and non-humans, from molecules to landscapes.

Think, for instance, of the Wall of Peaches from the witchcraft and ecofeminism festival. At the heart of the former peach fortress is nested a leather and textile manufacturing plant that operated at full capacity between 1871 and 1970. The plant has been shut since, but its legacy of chlorinated solvents and volatile hydrocarbons remain in significant quantities.[17] Chemical compounds shape the

13
Thomas Lerch, personal communication.

14
Nancy Fraser, *Cannibal Capitalism: How Our System Is Devouring Democracy, Care, and the Planet—and What We Can Do About It* (London: Verso Books, 2022).

15
Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton: Princeton University Press, 2015).

16
Max Liboiron, Manuel Tironi, et Nerea Calvillo, "Toxic Politics: Acting in a Permanently Polluted World," *Social Studies of Science* 48.3 (June 2018): 331–49.

17
"Murs à pêches : les études confirment l'ampleur des pollutions et démontrent la nécessité d'agir," Ville de Montreuil, accessed October 2, 2022, montreuil.fr/actualites/detail/murs-a-peches-les-etudes-confirment-lampleur-des-pollutions-et-demontrent-la-necessite-dagir.

(Fig. 06)
Fields of nettles in the early morning. Creuse, 2022, photo by Elena.

history, the everyday life of all humans and non-human beings, and their possible futures. Neighbors, organizations, and scientists have mobilized for years to know how polluted the area around the brownfield is and how it affects those living around it, and to call for depollution. The chemical legacy of the industrial site is not only accumulated in the soil, but also probably continues to accumulate in the cells of those inhabiting the landscape. And, ironically, it is also around this legacy that people gather and mobilize. This burgeoning site of resistance holds space for events like the witchcraft and ecofeminism festival and for botanical walks. Medicinal plants, however, are preferably harvested elsewhere. These vegetal beings embody the complexity of the multilayered and multiscalar process of making worlds together. Through them, we can engage in the molecular conversations regulating vital processes, and by doing this support the body in restoring or maintaining health; a crucial piece of knowledge in times of accelerated environmental degradation and pollution. But being porous organisms like the rest of us, they are also enmeshed with the chemical species they make worlds with, making their effects undesirable, or unpredictable. Botanical walks make this paradox tangible, available to the senses, and to the mind. And who knows, perhaps doing so might open new paths to action. This is a reason, although not the only reason, why botanical walks are mind blowing.

FILIPENDULA ULMARIA ROSACEAE

In the past, the Queen, *la Reine-des-prés,* or Meadowsweet in English, strewed the floor of churches as well as the tables of pagan festivals, perfuming the air with its heady scent. It was a sacred plant, used to purify the air.

Today, the pharmaceutical industry uses it in large quantities to extract its aspirin. The ancient Latin name of the Queen is Spirea, in reference to the spiral shape of its fruits. This is the origin of the name of the famous component.

Keepers of its poetry, female elders from the countryside used it as a remedy to "start the menstruation again,"[18] or for the circulation of bodily flows.

This species is androdioic, a gender curiosity: in fact, some plants are both male and female; hermaphrodites.[19] Others are only male. The Queen, with its characteristic, numerous and very protruding stamens, mainly uses bees and other insects that she seduces with her numerous almond-scented pollens, to reproduce. Independent, in case of hermaphroditism, it can also self-pollinate if no pollen reaches it.

18
Pierre Lieutaghi et Danielle Musset, *Les plantes des femmes: Actes du séminaire organisé du 23 au 25 novembre 2006 à Saint-Michel-l'Observ atoire par le musée de Salagon* (Saint-Michel-l'Observatoire: C'est-à-dire éditions, 2010).

19
Michael Allaby, *La scandaleuse vie sexuelle des plantes* (Paris: Hoëbeke, 2018).

20
Elaine M Drummond et al., "Inhibition of Proinflammatory Biomarkers in THP1 Macrophages by Polyphenols Derived from Chamomile, Meadowsweet, and Willow Bark: ANTIINFLAMMATORY POLYPHENOLS FROM HERBS," *Phytotherapy Research* 27.4 (April 2013): 588–94; Stevan Samardžić et al., "Antihyperalgesic Activity of Filipendula Ulmaria (L.) Maxim. and Filipendula Vulgaris Moench in a Rat Model of Inflammation," *Journal of Ethnopharmacology* 193 (December 2016): 652–56.

21
Jean Valnet, *La phytothérapie: Se soigner par les plantes* (Paris: Le Livre de Poche, 1986).

22
Michael Moore, *Herbal Materia Medica: Outlines of over 500 Major Botanical Medicines* (Arizona: Southwest School of Botanical Medicine, 1996).

The aspirin contained in Meadowsweet—analgesic, antibacterial, and anti-inflammatory—allows the fluidification of blood. It is an anti-coagulant. It is therefore useful in the case of menstruation with a difficult or painful flow. It should be noted that it is preferable to use other plants for menstrual pains if there is an abundant blood flow.

Known to be a great analgesic, Filipendula will reduce pain in general.[20] It is very effective for headaches or latent pain due to osteoarthritis and arthritis.

Moreover, *Meadowsweet* activates the thermal and liquid flows of the body (urine and sweat). These great draining properties can be used in the second part of the cycle to eliminate water from the body in order to reduce water retention (painful breasts, heavy legs) due to premenstrual syndrome (PMS).

The tea is dosed at one tablespoon of flowers per cup. The flowers of Meadowsweet being particularly sensitive to heat, one will take care not to use boiling water.[21]

The mother tincture of fresh flowers is prepared according to a ratio of 1:2, that is to say 100 grams of plants for 200 grams of alcohol at 80°, and dry at 1:5 for an alcohol at 45°.[22]

This plant is not recommended for pregnant people. Do not use if you are allergic to aspirin or if you already take anti-coagulants. As the plant fluidifies blood, do not use it before a surgical operation. Beware of overdosing!

ENDOCRINE DISRUPTING CHEMICALS OF NATURAL AND SYNTHETIC ORIGIN M.

An endocrine disrupting chemical (EDC) is a chemical substance that interferes with the hormonal system of an organism. There are two types of EDCs: those of natural origin and those of synthetic origin. The first ones come mainly from plant sources and are used in phytotherapy to regulate the body's hormone production in order to alleviate disorders and pain related to hormonal imbalance. Synthetic EDCs, on the other hand, are exclusively created by humans. They have been used in large quantities in chemical and toxic products since the industrial era and are found in almost all everyday products. These are the ones that pose a problem because they pollute the environment and living organisms in the long run, causing multiple hormonal disorders that lead to fetal malformations and serious pathologies in childhood and adulthood, sometimes over several generations.

The Rosæ canine collective works with so-called "phyto-hormonal" plants. These plants contain chemical substances, of natural origin, which are precursors of human hormones.

That is to say that the body will, from these precursors, produce (or not) the hormones it needs.[23] One of the major differences between naturally occurring and synthetically occurring EDCs is this principle: when it is natural, the EDC is not necessarily used by the organism, but when it is synthetically occurring, the organism no longer has the choice. It is obliged to carry out the chemical message of the EDC, it cannot decide or not to use them according to its needs. The synthetic EDC imposes an action to the body whereas the natural EDC only proposes it. There is therefore no longer any regulation possible by the body and this causes chain reactions: "The disruption caused by [synthetic] chemical disruptors will affect all the organs that depend on hormones. The whole organism will suffer. The hormonal system interacts with the nervous system and the immune system. We have recently learned that all these systems are also closely linked to the intestinal flora, which is now called 'microbiota. We are therefore going to see, by domino effect, a systemic disorganization of almost all, if not all, the physiological functions of the body."[24] Moreover, the body does not know how to eliminate synthetic EDCs in the same way as natural EDCs. As a result, synthetic EDCs accumulate for years in the body and cause long-term damage. An accumulation of naturally occurring hormones can also cause harmful effects and/or aggravate pathologies, in case organs such as the liver or kidneys are damaged, but their effects are much less powerful than synthetic EDCs. However, one should not underestimate the contraindications and consequences of overdosing on medicinal plants, which can have very serious adverse effects.

EDCS IN OUR PRACTICE

Each organism is different and does not react in the same way to the intake of medicinal plants. This is why it is necessary to start with minimal doses to observe the body's responses and adjust as we go along. Some people are allergic to plants, others will not see any effect because they are not receptive to them, and others will swear by the same plant because of its effectiveness.

The Rosæ canine collective focuses on plants that are useful in the urogenital sphere. The hormonal system, which is very complex, often comes into play and certain plants, known as "phyto-hormonal" (which contain EDCs of natural origin), are used in phytotherapy to try to regulate the hormonal changes that occur during life: puberty, menstrual cycles, childbirth, or abortion, (peri-)menopause, or gradual gender transitions. Indeed, the hormone levels in the body are in constant motion and when an imbalance occurs,

23
"Plantes et phyto-hormones" (2021), santeonaturel.com/plantes-et-phytohormones/.

24
Corinne Lalo, *Le grand désordre hormonal. Ce qui nous empoisonne à notre insu* (Paris: Cherche Midi, 2021).

symptoms and disorders more or less painful appear. But as the hormonal system is very closely linked with the nervous and immune systems, we often talk about plants that act on several parts of the body to address the problem as a whole.

Let's take, for example, verbena officinalis: it acts both on the nervous system to calm tensions and on the uterus to strengthen it. It is therefore very interesting in periods of life linked to a sudden drop in hormone production: after childbirth, miscarriage, or abortion, it alleviates post-partum depression and helps the uterus to recover. It can also help to relax and alleviate mood swings (even depression) during peri-menopause and menopause.

Rosehip, *Rosa canina*, is a general anti-inflammatory and is recommended in naturopathy to stimulate the immune system. It is used in natural gynecology to alleviate the pain of endometriosis, fibroids, and for all pain related to the menstrual cycle and menopause as a background treatment.[25]

Yarrow, *Achillea millefolium*, is an essential plant for menstrual cycles. It has a recognized progesterone-mimetic activity, and it is said to be "progesterone-like."[26] It also has a mechanical action on blood circulation in the pelvic region. It is therefore very useful for painful periods as they are generally linked to an imbalance of the sex hormones oestrogen/progesterone and to the difficult flow of the uterine mucosa, which it facilitates. It is also recommended for polycystic ovaries, fibroids, and endometriosis, which are pathologies linked to hyperestrogenism.

A real problem remains today: the continuous contamination with synthetic EDCs, which has serious consequences on the hormonal system and therefore on the entire organism. It is recognized that "a certain number of affections are suspected to be the consequence of an exposure to EDC: decrease in the quality of the sperm, increase in the frequency of anomalies of the development of the organs or of the reproductive function, lowering of the age of puberty [...] EDCs can also cause growth disorders, neurological development disorders, disorders of the immune function or even the appearance of certain cancers (hormonally dependent cancers) and metabolic diseases such as diabetes."[27]

ESTROGENS IN PARTICULAR

Humans produce sex hormones at varying rates in the body with different functions: estrogens, progesterone, testosterone. The estrogens naturally produced by the body are very important in the balance of the hormonal system: "they play a central role in female and male reproduction. They are also involved in the development of the central nervous system, in the

25
Vicky Chown and Kim Walker, *Mon herboristerie maison - Remèdes faciles pour tous les jours* (Gennevilliers: Editions Prisma, 2017).

26
Claudine Luu, *Le guide Terre Vivante 1000 remèdes à faire soi-même: Teintures mères - Macérats - Baumes-Lotions - Sirops - Tisanes...* (Mens: Terre Vivante, 2021).

27
"Perturbateurs endocriniens," Ministère de la Santé et de la Prévention (2022), solidarites-sante.gouv.fr/sante-et-environnement/risques-microbiologiques-physiques-et-chimiques/article/perturbateurs-endocriniens.

homeostasis of the skeleton and the cardiovascular system. They have effects on the liver and adipose tissue [...] and are involved in the control of the menstrual cycle."[28] Synthetic estrogens are then used in modern medicine in hormonal contraceptives such as birth control pills, in (controversial) hormone replacement therapy for menopause and "by trans women undergoing gender transition: this is hormone replacement."[29]

An excess of estrogen in the body, called hyperestrogenism (true or relative), can be observed during puberty and menstrual cycles and causes water retention, weight gain, breast pain, headaches, fatigue, and the development of fibroids and endometriosis. Conversely, estrogen production drops more or less sharply during peri-menopause and menopause and "hot flashes, vaginal problems (dryness), weight gain or mood disorders may appear, as well as an increased risk of osteoporosis."[30] It is therefore essential to regulate their production to reduce the symptoms of these hormonal imbalances.

Some phyto-hormonal plants contain precursors to estrogens, these are the naturally occurring EPs called "phyto-estrogens." "This hormone-mimetic capacity has led medicine to use them as a natural therapy to replace synthetic hormone therapy (HRT),"[31] and is proposed for peri-menopause and menopause. The consumption of these plants and therefore of these natural EPs will allow the body to produce more estrogens than it would by itself, which attenuates the effects of a too brutal fall of production. "The three most important phytoestrogens are isoflavones (found in over 70 plants), coumestans (young legumes such as soybean, clover, alfafa) and lignans (found in flax)."[32] As each person is different, it is advisable to consult a professional. As each person is different, it is advisable to consult a professional in natural medicine who can propose a personalized treatment: the phyto-oestrogenic plants are, for example, contraindicated in the cases of gynecological and hormone-dependent cancers, of thromboembolic accidents (phlebitis, embolism, stroke), of hyperthyroidism, and in the event of treatment with Levothyrox because they will worsen these pathologies by their direct action on the various systems of the organization (hormonal system, vascular system, etc.) Those containing isoflavones (soy, oats, alfalfa, flax) can cause interactions with anticoagulants.

Scientists and the media are starting to talk about phytoestrogens present in food (soy, hops, etc.) or in medicinal plants (fennel, aniseed, evergreen cypress, etc.), which are increasingly consumed on a daily basis, even though their activities on the organism and the hormonal system are not neutral. But eating fennel is obviously not a public

28
"Œstrogène," *Wikipédia* (23 juillet 2022), fr.wikipedia.org/w/index.php?title=%C5%92strog%C3%A8ne&oldid=195531028.

29
"Œstrogène."

30
"Œstrogène: définition, rôle, taux bas ou trop élevé," (2022), sante.journaldesfemmes.fr/fiches-anatomie-et-examens/2654825-oestrogene-role-definition-femme-dosage-taux-eleve-bas.

31
"Les phyto-œstrogènes, avec modération–Plantes et Santé," (2014), plantes-et-sante.fr/articles/decouvertes-botaniques/2227-les-phyto-oestrogenes-avec-moderation.

32
"Les phyto-œstrogènes, avec modération–Plantes et Santé."

health problem. On the other hand, we observe today a clear increase of disorders linked to generalized hyperoestrogenism as well as to malformations of the urogenital system: endometriosis, fibroids, polycystic ovaries, or "simply" very strong pains during menstrual cycles or sexual intercourse. Almost similar disorders due to chemicals discharged into the sea, air, or land have been observed in animals since the 1950s. EDCs and, in particular, the synthetic estrogens are implicated. They are present in large quantities in food (use of numerous pesticides classified as EDCs in agriculture, plastics for transporting food, etc.), hygiene products (tampons, sanitary napkins, etc.), cosmetics,[33] medicines, and even in products for babies (bottles, diapers, etc.), while "during certain periods of life, we are more sensitive to exposure to substances, such as during a child's development: from the beginning of pregnancy until the end of puberty."[34] Water is also an important source of synthetic estrogens: plastic bottles contain a lot of them, and residues of drugs and contraceptive pills are found in city water, which sewage treatment plants are unable to filter. They end up in the drinking water. We are thus contaminated throughout our lives by these EDCs and the ingestion of this huge quantity of synthetic estrogens has dramatic repercussions.

After many studies and multiple scandals, it has been proven that the harmful effects of these products cause cancer and can have impacts on several generations (chlordecone in pesticides,[35] Distilbene drugs[36]). Public authorities can no longer deny the facts and are slowly beginning to recognize the toxicity of EDCs: "With regard to population exposure to endocrine disruptors and health impacts, Santé publique France is continuing to monitor several reproductive health indicators such as endometriosis, cryptorchidism[37] or early puberty, and wishes to extend this monitoring to other health indicators that may be related to exposure to endocrine disruptors."[38] But, as it is technically complicated for industries to do without chemicals classified as EDCs (they are in a huge number of everyday products), sanctions are not about to be imposed and capitalist profits will continue to come before our health for a long time to come.

33
Elisa Polegato and Eléa Fournier, «Perturbateurs endocriniens : effets sur la santé et conséquences sur l'environnement», AgroParisTech, 2020, agroparistech-service-etudes.fr/perturbateurs-endocriniens-effets-sur-la-sante-et-consequences-sur-lenvironnement.

34
«Limiter les perturbateurs endocriniens», 1000 Premiers Jours, 2019, 1000premiers-jours.fr/fr/limiter-les-perturbateurs-endocriniens.

35
Cryptorchidism, also called testicular migration disorder, or more commonly maldescended testicle, is the absence of one or both testes in the scrotum (usual introscrotal position in humans and in animals with external testicles).«Cryptorchidie», in *Wikipédia*, 24 décembre 2021, fr.wikipedia.org/w/index.php?title=Cryptorchidie&oldid=189184172.

36
«Distilbène : modèle de perturbateur endocrinien», *DES France* (blog), 2021, desfrance.org/distilbene/modele-perturbateur-endocrinien.

37
Luc Multigner et al., «Chlordécone: un perturbateur endocrinien emblématique affectant les Antilles françaises», *Bulletin Epidémiologique Hebdomadaire*, no 22.23 (2018): 480–85.

38
«Perturbateurs Endocriniens», Ministère de la Santé et de la Prévention, 2022, https://solidarites-sante.gouv.fr/sante-et-environnement/risques-microbologiques-physiques-et-chimiques/article/perturbateurs-endocriniens.

(Fig. 07)
Hawthorn leaves—*Crataegus*. Chance encounter with a hawthorn tree. Joyful and subversive harvest companion. Creuse, 2022, photo by Elena.

(Fig. 09)
Clover—*Trifolium*. Souvenir of harvesting in the Dévoluy mountains, in 2021, with Fauve. Creuse, 2022, photo by Elena.

(Fig. 08)
Treated wheat fields. Creuse 2022, photo by Elena.

(Fig. 10)
Japanese sickle. Gift from a friend. Creuse, 2022, photo by Elena.

Moreover, “in the workplace, workers in certain sectors such as agriculture (use of plant protection products), the pharmaceutical industry (production of hormones) and the chemical industry (manufacture of pesticides, plastics, etc.) may be exposed to certain EDCs in higher doses than the general population. The protection of workers exposed to EDCs is provided for by the labor code. In particular, workers must be trained and informed on this subject and have appropriate means of protection.”[39] Collective and union struggles in the wonderful world of work sometimes allow us to better protect ourselves against the risks that industrialists take on employees. A grain of sand in the capitalist machine.

EDCS, HARVESTING, AND BIO-INDICATION OF PLANTS

Synthetic EDCs have a direct link to our practice of herbalism because they are chemical pollutants that are found everywhere in the environment (water, soil, and air). It is therefore complicated to find unpolluted places to harvest healthy medicinal plants because the soil and groundwater have been contaminated by highly toxic products and continue to be so: “Zinc, uranium, arsenic, hydrocarbons, and so on. In France, 200 years of industrial activity have left their mark. According to the French Agency for Ecological Transition (Ademe), there are between 300,000 and 400,000 potentially polluted sites, or approximately 100,000 hectares.”[40] The question of where medicinal plants are harvested or cultivated is therefore of primary importance. However, it is very difficult to access data on the state of soil pollution. One can obviously look for the most isolated places to avoid over-contamination of the plants one collects, but one can never be sure that there have not been industries upstream or aggressive agricultural practices not far away that have not contaminated the waterways.

One of the members of the Rosæ canine collective lives in Lille, in the North of France. She observes this problem on a daily basis because the Nord-Pas-de-Calais is a good example of a region where it is complex to harvest plants for healing: coal mines, industries (especially textiles and automobiles), as well as intensive agriculture have literally killed the soils and polluted the waterways since the end of the seventeenth century, and for decades to come. By observing the soils of the urban parks around Lille, one can realize this generalized pollution: whole lawns of daisies, dandelions, yarrow or plantain testify to the massacre of the intensive human activity of yesterday and

39
«Perturbateurs Endocriniens».

40
“Des plantes dépolluantes guérissent les sols,” *Mon Quotidien Autrement* (2021), monquotidienautrement.com/dossiers/plantes-depolluantes-phytorestauration.

today. Indeed, bio-indication analyses carried out by renown agrobiologist and botanist Gérard Ducerf allows us to understand the state of the soils: chemical products and continuous leaching have killed all microbial life.[41] Soils are in total asphyxia and are losing their porosity (which worsens the phenomenon of flooding). The dandelion, for example, grows on soils where there is no more oxygen, soils with anaerobic microbial life. Its roots will dig into the earth like earthworms and give it some breath and allow the aerobic microbial life that is a sign of a good soil to develop. Yarrow roots in ramifications, which literally allows it to retain the soil that is eroding. By stopping the soil with its roots, it allows the soil to regenerate. It is found in porous, lifeless, and crumbling soil. The plantain is a sign of compaction of the soil which prevents a good oxygenation (consequence of the heavy agricultural machines). And the daisy, in great number, indicates a decalcification of the soil, that is to say that “the fertility of the soil is decreased, the elements such as phosphorus (P), potassium (K) and magnesium (Mg) are less available for the plant.”[42]

41
Gérard Ducerf, *L’encyclopédie des plantes bio-indicatrices alimentaires et médicinales: Guide de diagnostic des sols* (Briant: Editions Promonature, 2008).

42
Institut Technique de la Vigne et du Vin, “Maitrise de l’Acidité des Sols,” undated.

JOURNAL DE CUEILLETTE
Fauve
III
Forcalquier, 29 April 2022

I am in Forcalquier for a few days, after a passage in La Deviation in Marseille, where we had the project to set up a self-managed herbalist shop. The issue of soil pollution and the pertinence of harvesting and using plants that have grown in the brownfield of l’Estaque came up.Taking the responsibility for using these herbs on oneself is one thing, sharing them is another, using them to treat others is yet another one. I had therefore prevented myself from picking plant on site: rosemary and thyme in bloom, however beautiful. Arriving in Forcalquier and finding this Mediterranean flora on “healthier” lands is auspicious and reassuring, particularly in the face of all of this that agitates me.

If I were a plant, I would be a weed, an invasive plant with spontaneous growth, a wild plant that intrudes into unstable and disturbed soils.

Fertile, too fertile.

For ten days, my breasts are tense, painful, nausea invades me at any moment; a nausea made of all the uncertainties that traverse me at this moment, an emptiness of the soul, a *mal de mères*, a giddiness that confuses me. For ten days I have been pushing the lover, without telling him, for an answer I don’t have myself.

Yesterday, my body found its way: endless contractions, a tearing in the hollow of my belly, an endogenous withdrawal that leaves me alone with my equivocal desires.

I resent the lover; that this space of my body is not a common space. Unreasonable anger of not being able to share my pain and my trouble; legitimate anger too, for feeling he's so outside, so detached from it all. A dull rage devours me; I would like to escape from myself for a moment and find a place of respite.

I leave to spend some alone time with my vegetable lovers and let myself be lured by the hawthorn and the helichrysum.

Harvesting is also a way of healing oneself, of impregnating oneself with the favors of the plant, and I fancy not knowing the object of my picking beforehand to allow myself to be carried away by my emotions and wandering attractions. It is only afterwards that I scrutinize the harvest based on what I know about its chemical properties: the heart mender and the companion for emotional shocks came to me today.

I thank my intuitions as much as my vegetable loves to take care of me; it will be necessary to break some silences still, it will be necessary that the lover hears what rumbles here in my lower abdomen, and that the breaches of our embraces are shared so that our bodily dialogues can resume.

Vallon de Combeau, 14 May 2022

To breathe the mountain, to feel under my feet the ground, limestone, secular, organic; in front of me the horizon, peaceful and infinite in spite of the contempt certain leaders have for our lands. I feel intimately linked to this place, to these Diois mountains that surround me and soothe me, in syncretism with this fierce and wild nature.[43] Getting away to harvest here is to get out of the world for a moment, from the systems of domination that govern a game where everyone loses, where for the soil and human beings is scorned in the name of profit; here, I take a step back, but above all, I take a run-up.

At 1700 meters high, among the fauna and flora, the revolution is quiet.

Down below, social injustices, state control of bodies and territories, reminds me that the revolt that unites us in Rosæ canine is just and necessary, and this joyful struggle for the free circulation of people and knowledge nourishes me as much as this land. In these places, I let myself be softened by the beauty that surrounds me, the "small communism" of the plant world as much as the happy debauchery of colors and smells of flowers exalted by the first days of spring.

43
From Die, a town in the Drôme region, part of the French Alpes.

This ecosystem is the proof of a nature in sharing; here is revealed a whole social ecology based on mutual aid and collaboration among the individuals. The idea here is not to add to the opposition nature/culture, but to question the systems of oppression and normalization that organize our societies.

In activist circles, we come across the notion of intersectionality, which speaks quite accurately of intersecting trajectories. It is a matter of naming and denouncing, in our societies, the plurality of dominations, whether they concern gender, class, race, ability, or sexual orientation; discriminations that are mixed and thereby frequently reinforced.

Thus, the need for the re-appropriation of our bodies and our spaces coexist: our sexualities belong to us as much as our ways of living. It is interesting to note that the right to abortion is receding in many parts of the world, just as municipalities here impose standardized housing on us and condemn light, portable housing. Everywhere the state dominates and imposes, a state at the service of capitalism, which subjugates and constrains us, which decides for our bodies as much as for our soils, with profit and profitability as the only ambitions.

Around me, the mountain is serene, an impassive monolith; here I take a step back, but above all, I gain momentum before coming back to leap into the core of our struggles. Certainly, we will not see the total achievement of that for which we struggle, but the path is favorable and flourishing for those who resist.

With rage and love,
Fauve

ALCHEMILLA VULGARIS // ALPINA[44]

This small, discreet and delicate plant delights the alpine meadows with its pretty leaves in a scalloped or star-shaped cup where a pearl of dew sparkles at dawn. It is this drop that the alchemists preciously collected as "celestial water," dragging sheets across the fields in the early morning.

All the Alchemilla plants have the same properties, although those of the Alpina group seem to be more active. The root is the officinal part but, in practice, one collects the whole plant, with the bloom, from June to September according to the altitude.

The Alchemilla plants have astringent virtues and participate in the elimination of water in excess in tissues. They are decongestants of the liver and preventative of fibroids.

Above all, Alchemilla has particular hormonal virtues, and behave as mimetics of progesterone. They can therefore

44
Valnet, *La phytothérapie*; Christian Escriva, *Précis de phytothérapie* (Brussels: Amyris, 2010); Pierre Lieutaghi, *Le livre des bonnes herbes* (Arles: Actes Sud, 1996).

be effective in premenstrual syndrome and dysmenorrhea, taken from the tenth day of the cycle until the end of the period. They are of interest in a number of pathologies accompanied by progesterone deficiency or excess estrogen: uterine fibroids, ovarian cysts, endometriosis, mastoses, etc.

In some cases, they can promote fertility: by its calming effects on the uterus, they promote implantation in people who tend to miscarry during pregnancy. They are also useful at the end of gestation when there is a risk of premature contractions. After childbirth, they help to put the uterus back in place and to heal wounds in the uterus, in case of episiotomy or cesarean section. They have a tightening action and contribute to the recovery of the cycle. During breastfeeding, they are useful in the event of milk oversupply.

When vulvar pruritus occurs, the mother tincture diluted to the tenth can be applied locally in compresses. In the event of termination of pregnancy or miscarriage, they facilitate the cicatrization and the return to hormonal balance. At the time of the peri-menopause and the menopause, they contribute to the arrival of a new hormonal balance: they make a beautiful synergy with the yarrow in the event of menorrhagia or metrorrhagia.

Posology: thirty drops two to four times per day, over three weeks, starting around ovulation and until the end of menstruation.

WILD VERVAIN, VERBENA OFFICINALIS[45]

Parts used: leaves and flowering tops

Once adored as a bewitching and magnetic plant, its discreet, sober, almost derisory appearance has made it a forgotten plant today. Sacred herb, panacea, talisman, it was the object of singular harvests, in the respect of the plant and in conscience; loving exchange, the body listening and entirely engaged in this exchange.

Many consider it “inhabited” by a force able to drive out the negative energies, for which it is used in numerous rituals, preparations, love protection philters.

Hermaphrodite, it blooms from June to September. It reproduces easily, because each of its flowers gives four seeds, which will disperse by gravity near the mother plant. The wild vervain is homogamous, meaning that its male and female reproductive organs mature simultaneously, which allows self-fertilization and self-pollination.

Wild vervain has affinities with impulsive, agitated, sometimes tempestuous people, who can feel overwhelmed, overtaken, both physically and emotionally. It allows a more positive vision, clarifies emotions, without negative judgments on our feelings or expectations. It is a neuroprotector that does not muzzle, a sensual and vulnerable wilderness suitable for injured felines.

Sedative, anxiolytic, antidepressant, the verbena officinalis calms the nervous tensions and exerts a regenerative action on the nerves. It acts on the foundations of the nervous system and helps to undo certain old mechanisms which seemed anchored and from which we suffered. It can thus accompany a withdrawal from an addiction. It is also a wonderful companion for postpartum depression, as much by its uterostimulant property, which supports the uterus in its recovery; its hormonal action, which restores regular cycles; as by its action on the nervous system. We also recommend it after an abortion, for the same reasons. It also has a relaxing and antispasmodic action on skeletal muscles, and thus acts on shoulder and neck tensions, but also on sciatica and lumbago. For these properties, we advise using the mother tincture of fresh plants, in three-month cures: slowly increasing intake from thirty to ninety drops four times per day over a period of three weeks, resting for one week, and repeating the process two more times.

Wild vervain is also a very effective antispasmodic to relieve the pains of menstruation: the catamenial migraines and the abdominal cramps. It slows down the synthesis of estrogens when this one is very active, which can be very useful when the PMS is due to a hyperoestrogenism. For these properties, the mother tincture of fresh plants is taken five days before the period, thirty to fifty drops three times per day, according to the intensity of the pain.

Its depurative action of the liver is also interesting, because it allows a better hormonal balance, hence easing premenstrual syndrome discomforts. As seen above, it can also make menstrual cycles more regular. By its uterostimulant action, it facilitates childbirth and uterine recovery afterwards. It is moreover a galactagogue. By its cooling energy, it modulates perimenopausal hot flashes. It is also recognized as having aphrodisiac virtues.

⚥ This plant can block the action of estrogens in the context of a transgender transition.

Contraindications: due to its utero stimulant properties, Vervain officinale is not recommended for pregnant women. It is advisable to use the plant with caution in the people presenting a hepatic insufficiency or taking anticoagulant treatments.

45
Bellakhdar Jamal, *Médecine Traditionnelle et Toxicologie Ouest-Sahariennes - Contribution À L'étude De La Pharmacopée Marocaine* (Casablanca: Editions Techniques Nord-Africaines, 1978); “Christophe Bernard et l'équipe d'AltheaProvence,” AltheaProvence (consulté le 30 juillet 2022), altheaprovence.com/christophe-bernard-equipe-altheaprovence; François Couplan and Yves Doux, *L'Album des plantes et des fleurs: L'identification des familles botaniques* (Lausanne: Delachaux & Niestle, 2001); Jean-Michel Morel, *Traité pratique de phytothérapie* (Paris: GRANCHER, 2008); Thierry Thévenin, *Le chemin des herbes: les plantes sauvages: connaître, cueillir, utiliser*, (Limoges: Lucien Souny, 2019).

ANNABEL GUÉRÉDRAT
a choreographer, dancer, performer, researcher, and *bruja* practicing somatic body-mind centering

a founder of *Artincidence* dance company and co-founder and co-curator of the FIAP Martinique (Festival International de l'Art de la Performance)

● Martinique

ENSAR-GASSE -MOI

"I am contaminating sargassum just as it contaminates us. When I say 'us,' I mean the natives of Martinique, we who are subject to sargassum and its nauseating toxic gases emitting heavy metals, massively piled up and drying on beaches, we who are forced to move elsewhere because we live too close to the shore."

In this contribution by Annabel Guérédrat—consisting of a statement in which she reflects on her performative rituals and a speculative narrative *Mammisargassa 2.0*—we are introduced to her decolonial ecofeminist practice in which intimacy and politics are intrinsically entwined. Guérédrat gives insight into her performative rituals with the sargassum seaweed that is invade the coasts of Martinique, and which contains a large number of heavy metals, alongside organic compounds including contamination by the now prohibited insecticide chlordecone. Nestling in the sargassum, engulfing herself in the seaweed, Guérédrat intoxicates herself with heavy metals and inorganic arsenic, contaminating herself. Mobilizing Afro-diasporic bruja witch power, she embodies a Caribbean heroine who has survived despite the years, centuries of colonization, contamination, occupation.

Ensargasse-Moi: The Body of a Contaminated Caribbean Witch Decolonizes Herself

I consider my performances to be instances of care, rituals that reconnect me to the invisible world, the archetypal world. By burying myself in sargassum while knowing that this seaweed is a potential health hazard, I am creating the magical act of colonizing in turn this seaweed that is colonizing us.

I am contaminating sargassum just as it contaminates us. When I say "us," I mean the natives of Martinique—we who are subject to sargassum and its nauseating toxic gases emitting heavy metals, massively piled up and drying on beaches, we who are forced to move elsewhere because we live too close to the shore.

Through this act of witchcraft, of magic, I understand that I will be reborn differently when I emerge from the seaweed. That I will have made them mine. That they will have stuck to my skin, burrowed in my mucous membranes, into my private parts, that I will have made love with them. The land of Martinique is already contaminated by chlordecone. And chlordecone can accumulate in sargassum, sometimes in high concentrations.

So this is where the *bruja*, the witch, comes in to develop care in a contaminated environment, while waiting for reparations. When Malcom Ferdinand says that this chlordecone affair sends us back to the dehumanization of our people, it's a strong statement! That's why becoming a sargassum woman may be an act of witchcraft that I assume in order to rehumanize myself. In this all-encompassing globalized world that ferociously swallows up the slightest individual initiative, sensitive on the surface of my own skin, among the sargassum, I mobilize Afro-diasporic bruja witch power. By sargassumating myself a bit more each day, I extract myself from a form of globalized witch politics to make my witch, a living bruja in the Caribbean, anchored on this land of Martinique, a heroine of the current era who has survived despite the centuries of colonization, contamination, and occupation.

My commitment to resilience and transcendence, my life force, my creative force, and my Afro-diasporic religious rituals, allows me to move the cursor, and the apprehension between witch, whiteness, Europeanness, Middle Ages, Christian Occident and bruja, metisse, Afro-diasporic rituals, Ebbo, contemporary, insularity, Caribbean region linked to the all-encompassing world. Through these acts of

sargassumated bruja, I revivify my Caribbean witch genealogy, my relationship with my body, this contaminated Afro-diasporic feminist figure who contaminates in turn.

I don't identify as a disaffected human being in need of natural spaces to feel better. On the contrary, my relationship with sargassum is full of affection, sweat, stink, flesh and bone, and poison. I become wild with the seaweed; I have made it mine, and it is now part of my intimacy.

I am alive. And I create an act through sargassum. This is what I take away from my sargassumation, my sargassum burial. I become a black, metisse heroine, attracted and intimately connected to trash, to this invasive and toxic, contaminating nature. I am a contaminated heroine. A living and surviving archive, like the living plankton and nematodes living in sargassum.

(Fig. 01)
Annabel Guérédrat, *Ensargasse-Moi*, 2021, Martinique.
Photo by Yann Mathieu Larcher. This photo and all subsequent images courtesy of the author.

(Fig. 02)
Annabel Guérédrat, *Ensargasse-Moi*, 2017, Martinique.
Photo by Jean-Babtiste Barret.

(Fig. 03)
Annabel Guérédrat and Henri Tauliaut, *Taking Care of Each Other*, 2021,
Martinique. Photo by Yann Mathieu Larcher.

(Fig. 04)
Annabel Guérédrat, *Ensargasse-Moi*, 2021, Martinique.
Photo by Yann Mathieu Larcher.

MAMISARGASSA 2.0

We are in 2083, in a desert island inside the Caribbean area. This island used to be called (before, a long time ago): Martinique. But because of the years and centuries of colonization, contamination, occupation and tourism, no humans, no animals, no plants exist anymore. Just sargassum, toxic seaweed, survived.

Manman Dlo did not survive anymore. A new entity, a kind of avatar is created: who takes the human form of a woman, genetically modified. She stays on this beach during days and nights, nights and days: Mami Sargassa. To keep alive, she is burying herself in sargassum while knowing that this seaweed is a potential health hazard. She is creating the magical act of colonizing this seaweed that was colonizing the human beings who used to live there a few years ago. Sargassum has nauseating toxic gases, massively piled up and drying on the beach.

During each ritual burial, Mami Sargassa takes the time to absorb the smell, the swarming of bacteria and other crawling insects scratching her skin.

Through this act of witchcraft, of magic, she's reborn each time she does it. Day by day, she rehumanizes herself. She becomes a heroine, attracted and intimately connected to trash, to this invasive, toxic, and contaminating nature.

Mami Sargassa: a new contaminated heroine in the Caribbean area.

Mami Sargassa begins to give birth to new beings to repopulate Martinique. She invaginates bits of sargassum which replace the male sperm substance, and mixed with her own oocytes, she becomes pregnant quickly and gives birth as quickly, without waiting 9 months for the fetus to grow in her uterus. Hybrid beings, half-human, half-Sargassian. They do not need oxygen to live and feed on the insects that breed in Sargassum. Hybrid beings who sing and dance, rather than talk and walk.

Nous sommes en 2083, sur une île déserte dans la mer des Caraïbes. Cette île était appelée Martinique, il y a longtemps. Mais, à cause d'années et de siècles de colonisation, de contamination, d'occupation et de tourisme, aucun humain, aucun animal, aucune plante, n'a survécu. Seules les sargasses, ces algues toxiques, sont restées et ont survécu.

Mamman Dlo n'a pas non plus survécu. Une nouvelle entité, sorte d'avatar, l'a remplacé. Qui a gardé l'apparence humaine d'une femme, génétiquement modifiée, qui reste là, sur la plage, jours et nuits, nuits et jours: Mami Sargassa. Pour rester vivante, elle s'enterre elle-même dans de la sargasse fraiche. Elle créé l'acte magique de coloniser à son tour cette algue qui a colonisé les êtres humains, tout un peuple, qui avait l'habitude de vivre là, des années auparavant. La sargasse toxique dégage des gaz toxiques nauséabonds. A chaque rituel d'enterrement, Mami Sargassa prend le temps de sentir l'odeur, le grouillement et pullulement d'autres insectes gratter sa peau.

A travers cet acte de sorcellerie, de magie, elle renaît autrement, se ré-humanise, jour après jour. Elle devient une héroïne attirée et connectée intimement au trash, à cette nature envahissante et toxique, contaminante

Mami Sargassa: une nouvelle héroïne contaminée dans la région Caraïbes

Mami Sargassa se met à enfanter de nouveaux êtres pour repeupler la Martinique. Elle invagine des bouts de sargasses qui remplacent la substance masculine spermale, et mélangés à ses propres ovocytes, elle tombe enceinte rapidement et accouche aussi rapidement, sans attendre 9 mois que le fœtus grossisse dans son utérus. Des êtres hybrides, mi-humains, mi-sargassiens. Qui n'ont pas besoin d'oxygène pour vivre et se nourrissent des insectes qui se reproduisent dans les sargasses. Des êtres hybrides qui chantent et dansent, plutôt que parler et marcher.[1]

1
Translated into French
by Annabel Guérédrat.

Sé an lanné 2083 sa fèt.

Asou an ti lilèt adan bannzil karayib-la. Non lilèt la sété matinik.

Mé apré plizyé lanné boulvès, krim, kolonizasion, pwézonaj, touris, tout pyé bwa, tout zèb, tout lavi té disparèt.

Nonm kon zannimo. Sèl bagay ki té tjenbé sé an vyé modèl wawèt yo té bay non sawgas.

Menm Manman Dlo té pèd ta-y la akoz di sa. Sé Mami Wawèt ki té pwan plas li. Tala toujou té ni an koté fanm, épi an ADN mofwazé. I té ka rété bòdlanmè lannuit kon la-jounen. Pou i pa mò i té ka maré kòy adan an nich wawèt fré akondi sé adan an kabann i té yé. I dématé jé-a nan maji pou pran épi viré pwan tout sa wawèt té za pwan yonn dé tan avan. Lidé-y sété di viré pwan pou tay tou sa sé wawèt-la té za tjoué, tout nanm ki té ka viv anlè sawgas la té ni pou sèviy. Wawèt la té ka dégajé an lodè zé pouwi, ki té ka pwézonen épi dékatjé. Sé anlot linivè ki té ka wè jou. Moun pa té jenn wè sa !

Dépi Mami Wawèt té ka téré kòy an twèl wawèt, ti bèt té ka eklò. Yo té ka fè chyen anlè tout kòy. Yo ka dansé anlè lapoy pou bay an gratèl san fen.

Dépi I fè zafèy-la, i té ka viré mété kòy doubout. I té nèf kon nèf ka ékri. Bouden-y té plen lavi afos manjé sé ti bèt la ki té ka viv anlè sawgas la. I té ka viré mouné kò-y li yonn. An mitan pwézon-an i té ka tjenbé i té ka fè yonn épi lanvirondaj toksik tala.

Mami Wawèt, an mètpyès fanm nèf, pwézoné an karayib la.

Mami Wawèt ka mèt ba dot model lavi pou viré mété an lot pèp an péyi-a. Adan prop fondasion'y ki tay i ka mété sé wawèt la pou pran plass fifin larin sé nonm lan. i pa bi-zwen pliss ki sa pou plenn koy li menm. Apenn i met ba i ka viré mété adan san attann nèf mwa. Sé zé a ka grandi adan prop'matris li menm. Sé model mun tala kolé bèt, mi nonm mi bèt, pitit sawgas, dé ych sawgas. Yo pa bizwen loksijenn pou viv. Sé sé ti bèt ki ka viv adan sé wawèt la yo ka man-jé. Yo simen chanté épi dansé. Ba yo, sa ni plis pwa ki maché épi palé.[2]

2
Translated into Creole from Martinique by Nicolas Nelzi.

Estamos en dos mil ochenta y tres, en una isla desierta en el mar del Caribe. Esta isla se llamaba Martinica, hace mucho tiempo. Pero, a causa de los anos y los siglos de colonización, de contaminación, de ocupación y de turismo, ningún ser humano, ningún animal, ninguna planta sobrevivió. Solamente sargassas, estas algas toxicas, se quedaron y sobrevivieron.

Yemaya tampoco sobrevivió. Una nueva hija de Orisha, tipo de avatar, lo remplazo. Quien ha guardado la apariencia humana de una mujer, genéticamente modificada, que se queda ahí en la arena, día y noche, noche y día: Mama Sargassa.

Para quedarse viva, ella misma se entierra en la sargassa fresca, mientras que se sabe que la sargassa es toxica. Ella crea el acto mágico de colonizar a si misma esta alga que colonizo los seres humanos, todo el pueblo que tenía costumbre de vivir ahí anos antes. La sargassa emite gases tóxicos nauseabundos.

A cada ritual de entierro, Mama sargassa corre el tiempo de oler el olor, de sentir el enjambre de bacterias y otros insectos que rascan su piel.

A través ese acto de brujería, de magia, ella renace de manera diferente y se re humaniza día tras día. Ella se convierte en una heroína atraída y conectada íntimamente a la basura, a esta naturaleza invasiva, toxica y contaminante.

Mama Sargassa: una nueva heroína contaminada en la región del Caribe.

Mama Sargassa da a luz a nuevos eres para repoblar Martinica. Ella invagina pedazos de sargassas, mezcladas a sus propios huevos. Ella pario a seres híbridos, mitad huma-nos, mitad sargazos. Seres que cantan y bailan, más bien que hablan y caminan.[3]

3
Translated into Spanish by Annabel Guérédrat.

(Fig. 05)
Annabel Guérédrat, *Ensargasse-Moi*, 2017, Martinique.
Photo by Jean-Babtiste Barret.

ADHAM FARAMAWY
an artist and lecturer thinking through issues of materiality, touch, and toxic embodiment to question ideas of the natural in relation to marginalized communities

● London, UK and Cairo, Egypt

SKIN FLICK

"I wish I could change my body at will, become someone else, become something else, something both more and less than human."

Adham Faramawy has included the script and stills from their 2019 video *Skin Flick*—a work exploring desire, gender, and skin as both a physical and political boundary. Their contribution examines bodies absorbing and interacting with organic matter and chemicals such as beauty products, drugs, and supplements. In so doing, it draws attention to the porosity of our skin, and entanglements with more-than-human ecologies of bodily fluids, ointments, creams, environmental contaminants, bacteria, and other microorganisms. *Skin Flick* explores and celebrates the non-human desires of fungi and asexual marine invertebrates, investigating ideas of gender fluidity and inviting a new perspective on human appetites and behaviors.

Skin Flick

IN THE GARDEN

Remember that time we were out on the lawn? We were surrounded, enveloped by the sound of crickets, we couldn't tell if it was dawn or dusk, but there we were, playing. Our bodies splayed out, coiled, ready to jump into action, just like the insects.

I think about that time, about your touch, about your hands, your fingers and mine, sliding and wiping, smearing ointments and creams on yourself and on each other.

I dreamt I touched your skin, my fingers slid straight through. Your skin dried out by wind and sun propelling hydration with a cream that's not a cream. Foaming, frothing, fizzing, keeping your skin moist. You buff with fruit extracts. Wet your face a little, rub around your nose avoiding your eyes. You smell like walnuts, vanilla milk toner.

Where's your foaming face wash? Where's your serum, your moisturizer?

You feel ... fresh.

The image of my fingers reaching for the doorknob, it's oily, they slip and nothing happens. My hands are still covered in soap, one leg still in the shower. My body stretched out across the room, thinking you're on the other side of the door.

I'm still the coke and the ice cracking as you pour me. We could sit together knowing the tension, not addressing it, just like the time I was kissing the back of your knee and you looked down and spat at me.

I never liked it when you spat at me. You told me it was lust but your eyes betrayed you. The white of your skin threatening to ooze caramel from your pores. You tell me I have a problem with body fluids and I should figure it out but you'll stop. And you did, you stopped, but I've learned my lesson and I don't want you near me. Your words are sticky and stupid, and they're running down my leg.

(Figs. 01–03)
Adham Faramawy, In the Garden, still from *Skin Flick*, 2019. These and all subsequent images courtesy of the author.

THE BUDDLEIA

My studio is by some train tracks. In the summer the route is lined by roses, celandine, oxlip, daisies, dandelions, and a flowering bush called a Buddleia (davidii). The Buddleia (davidii), also known as the butterfly bush, is native to the Sichuan and Hubei Provinces of China. They are hermaphroditic, with perfect flowers, rich in nectar, and strongly scented of honey. In 1887, an Irish sinologist sent its seeds from Ichang to St. Petersburg. They are well travelled, often classed as an invasive species. They have been naturalized in Australia and in most cities in southern Europe, but are classed as invasive in the UK and New Zealand, and as a noxious weed in several North American states.

(Fig. 04)
Adham Faramawy, *The Buddleia*, still from *Skin Flick*, 2019.

BODY PARTS

In the last few years, I've noticed myself feeling increasingly ill at ease with my body. Not that I've ever been fully at ease with it. I can't take a compliment. I can't really believe you mean what you say. I'm feeling my body and I'm finding the changes in my metabolism. I'm discovering new wrinkles, losing hair that's turning white, putting on fat in different ways, in different places, and I'm finding it all difficult to accept.

Aging feels like a betrayal.

When I look at my own image, I can't see myself. I can't see how I fit into things and in my spare time I've let my mind wander, stray, speculate. What if I were someone else?

For a while I went to plastic surgery consultations. I told myself it was just for fun. I wanted to know what the specialists would recommend, and they didn't surprise me, but honestly, I let them hurt my feelings.

For lots of reasons (changes in my appearance, my stamina, my libido), I started taking supplements and experimenting with drugs I'd buy online. Mostly anti-aging stuff that veered into messing around with hormones, kind of like a self-prescribed HRT plan. I'd take one thing (or truthfully several) and I'd feel great, stronger, more stamina, more sexually charged, able to focus, more confident, and then I'd notice a side effect.

(Fig. 05)
Adham Faramawy, *Body Parts*, still from *Skin Flick*, 2019.

One time I ended up taking a drug called Tamoxifen, which blocks the production of excess estrogen. I'd been taking a daily pill to stop my hair falling out, just from male pattern baldness, and I started to grow breast buds. That didn't bother me as much as you might expect, but I looked online to see how other people dealt with it.

I found Tamoxifen on a bodybuilding forum and when I took it I felt incredible for about a week. Then one night I noticed what I thought was a heat rash. I went home but it didn't go away. The bumps spread across my right forearm, my face, my knees. My skin reddened and became hard to the touch. I remember having heat rashes as a child, and I don't think these symptoms are related, but my chest developed, swelling, and my nipples seeped milk. I couldn't understand why but for some reason none of this shocked me. I felt like I was under water. I was disoriented; I'd walk into walls. I had no appetite and the itching sensation felt like I had something crawling under my skin. I felt stupid and vain, too ashamed to go to a doctor. I found out I'd been taking a breast cancer drug and the side effects were quite common. I slathered my body in creams and I took an oral antihistamine that's only available in the UK as a sleeping tablet. After a few weeks spent drowsy, itchy and alone, the symptoms started to clear but my skin will never be the same.

My body, sexuality, and aging, are inextricably linked to drugs and supplements, to ideas of disease.

(Fig. 06)
Adham Faramawy, *Body Parts*, still from *Skin Flick*, 2019.

DAPHNE & APOLLO

And now a myth—
Daphne spurned many lovers. Preferring the forest, she dedicated herself to maintaining her virginity. Apollo, cursed by Cupid, continually followed her, begging her to stay, but the nymph Daphne fled. Seeing that Apollo was bound to reach her, she called upon her father.

"Help me, Peneus! Open the earth to enclose me, change my form! Let me be free of this man!"
A heavy numbness seized her limbs; her breasts were surrounded by bark, her hair changed into foliage, her forearms transformed into branches, her feet, now roots. She became a laurel tree.
Despite this rejection, Apollo vowed to love her forever.
"Always my hair will have you. My lyres will have you, and my quivers will have you, laurel tree."
Apollo used his powers of eternal youth and immortality to render Daphne evergreen.
She could not escape him.

(Fig. 07)
Adham Faramawy, *Daphne & Apollo*, still from *Skin Flick*, 2019.

AN ORGY OF PISTON-LIKE PARTS

I want to tear out of my own flesh.
I have these fantasies that my sexuality is somehow redemptive, that my gender fluidity's left me open to new ideas, open to different types of people.
I don't think that's true.
I wish I could change my body at will, become someone else, become something else, something both more and less than human.
Stretched out like a sphinx, I wish I could feel new forms of touch and taste. I wish I could take on the parts of other animals, insects and simulate their processes.
See through their eyes.
I wish I could choose my form and that it could be monstrous. Licking your white teeth as though honey might flow through them.
You have multiple limbs, eyes, tongues, and hair.
An orgy of piston like parts eating their way through time like a worm distressing the earth.
It turns out species are more open ended than I thought, individuals more molten.
MOIST
Ovulating and ejaculating, my stigma touches my stamen.
I wish I could spread my consciousness out through a root system. Mycelial, like a fungus.

(Fig. 08)
Adham Faramawy, *An Orgy of Piston-Like Parts*, still from *Skin Flick*, 2019.

(Fig. 09)
Adham Faramawy, *An Orgy of Piston-Like Parts*, still from *Skin Flick*, 2019.

PYURA CHILENSIS

The Pyura chilensis is a marine invertebrate. It resembles a mass of organs inside a rock. It lives off the coasts of Chile and Peru. It's born male, becoming hermaphroditic at puberty. It is capable of asexual reproduction, expelling a fertile cloud of sperm and eggs. If alone, it can self-fertilize. Its blood is clear and contains vanadium, a toxic heavy metal most commonly found in crude oil and tar sands. Fishermen slice them with a handsaw, using their fingers to pull out the siphons, locally referred to as "tetas," or udders. These udders have been described as tasting strongly of iodine.

(Fig. 10)
Adham Faramawy, *A Mushroom Death Cult*, still from *Skin Flick*, 2019.

A MUSHROOM DEATH CULT

The sex life of plants is a complex affair. Plants and animals, even understood as other than people, are ubiquitously queer. Not naturally so, but plants insinuate forms of polymorphous perversity, unimaginable to human bodies.

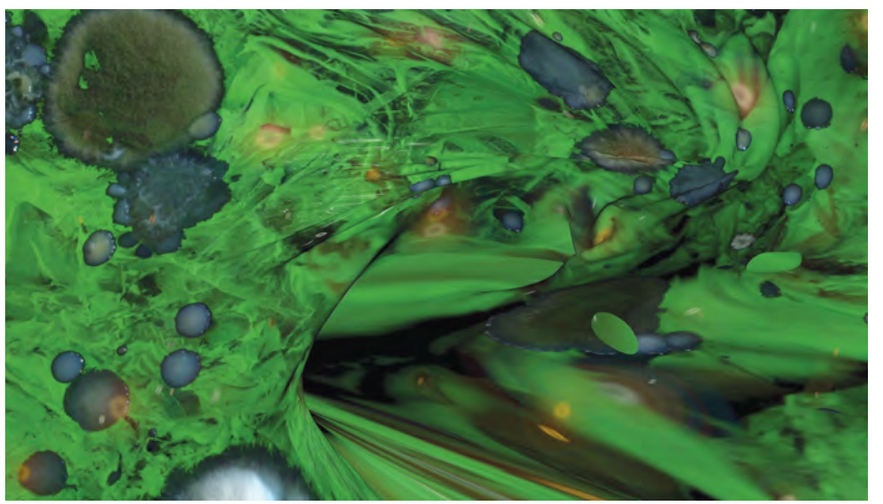
Under scrutiny, our own sexualities become illegible, unfamiliar.

I wish my desires were more vegetal, fungal.

My micro-biome, the bacteria in my gut, shines a light to guide the way. They show me a vision of my body as a multi-species matrix, fighting its way through the city.

I let my arms drift upwards, spreading they embrace a sticky sweet night. Everything outside loosens, distends, nothing solid to hold onto. I look up at my arms, my hands and find them replaced by screens showing Cindy Crawford drinking Pepsi. She stands

on a suburban street and I think about cola rotting my gut.
I think about toxins.
Plastic bags and bottles, cans, containers and packaging, excess, floating like a city in the ocean.
Octopus milk drips slowly from sucker shaped teats, mutated.
Pesticides drift in the air, drooling into the water; while underground, mushrooms build a city in the roots of plants, reaching up through the trees. No forest without them, no bees without them.
I let my mind wander and I think of my death.
I want to be buried in a mushroom death suit.
I want them to eat me, metabolize me and the toxins in my body. Mercury and lead. Contaminants accumulated over a lifetime. They won't be left to pollute the soil.
As I kiss the back of your knee, you spit on me.
Dust to dust.
It doesn't feel right.
Your body mingling with mine.
Your white teeth spill benzene. Pores oozing Freon.
My body shouldn't be this toxic.
When I decompose, I want the earth around me fruitful.
I want to be a tree like Daphne.
Transforming from a patch test on my skin, growing through the worms, the mushrooms, and the bacteria.
I want to become an apple tree in an orchard of apple trees.



(Fig. 11)
Adham Faramawy, *A Mushroom Death Cult*, still from *Skin Flick*, 2019.

"Aesthetics are recuperated by capital quicker than you can recognize them and I don't know about you but my frame of reference is fucked."

Lauren Velvick

(Fig. 12)
Adham Faramawy, *A Mushroom Death Cult*, still from *Skin Flick*, 2019.

POST-SCRIPT: GREEN BURIAL

The mushroom death suit is an artwork and based on the work of Jae Rhim Lee.

"The Mushroom Death Suit is green couture for the modern and futuristic postmortem body. Over a lifetime, we consume energy and resources such that our bodies accumulate up to 219 toxic pollutants, including pesticides, heavy metals, and preservatives, according to the U.S. Centers for Disease Control. The Mushroom Death Suit facilitates the decomposition and partial toxin cleaning of bodies using a collection of fungi, 'Infinity Mushrooms,' which are known to remediate toxins such as methyl mercury, dioxins and furans, and polychlorinated biphenyls (PCBs), among others. These environmental benefits go hand in hand with the return of the body to the earth and taking responsibility for our own pollution of the earth."[1]

1
Jae Rhim Lee quoted in "Design for Death: Mushroom Death Suit by Jae Rhim Lee," *designboom*, designboom.com/project/mushroom-death-suit.

NOTES ON THE *PYURA CHILENSIS*

The *Pyura chilensis* is an underwater biological rock, a rock with intestines. It's born male, becoming hermaphroditic at puberty. It is capable of asexual reproduction, expelling a fertile cloud of sperm and eggs. The larvae are planktonic. They also secrete vanadium, most commonly found in crude oil and tar sands. Served raw or minced and boiled it is said the flesh has a flavour a little like iodine, bitter and soapy to the taste. A similar edible tunicate in the Mediterranean is Microcosmus sabatieri, also called a sea violet. Colonies of tunicates occur in a range of forms, and vary in the degree to which individual organisms, known as zooids, integrate with one another. In the simplest systems, the individual animals are widely separated, but linked together by horizontal connections called stolons, which grow along the seabed. The body of a tunicate is surrounded by a test or a tunic. This varies in thickness between species but may be tough, resembling cartilage, thin and delicate, or transparent and gelatinous.

KER WALLWORK
an artist and activist with a multi-disciplinary practice addressing themes of language, queerness, sickness, and the welfare state

● London, UK

OUT-WITH AND WITH-DRAWN

"I hear on the radio that every cell in your body knows what your sex is and behaves accordingly. Your kidney knows if it is a male kidney or a female kidney. So can a kidney know it is a con-fused-as-fuck kidney, a neither/nor kidney?"

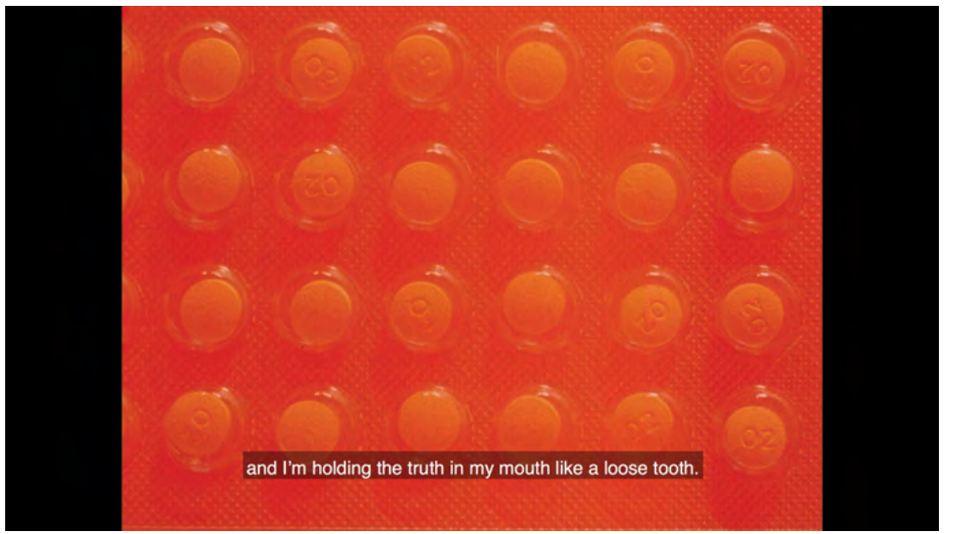
Outwith and Withdrawn is an adaptation of the 2016 film _Approach/Withdraw_ by Juliet Jacques and Ker Wallwork—a ten-minute experimental 16mm film exploring how public understandings of estrogen and endocrine-disrupting chemicals affect the sense of self and relationships of trans people and those who feel at odds with their assigned gender. As Wallwork reflects on the process of making of the film, stills from the film and extracts of the script, written collaboratively with Jacques, intersect and intertwine with their memories, thoughts, and desires. Shifting between the past and the present and between the passages from the script and experiences and events of Wallwork's life, the narration explores conflicting, yet interconnected thoughts, feelings, and perceptions encountered at the intersection of queerness and sickness.

Outwith and Withdrawn

Outwith and Withdrawn is an adaptation of the 2016 collaborative film *Approach/Withdraw* by Juliet Jacques and Ker Wallwork, commissioned as part of the Wellcome funded BFI, no.w.here and King's College project *Queering Love, Queering Hormones*.

Approach/Withdraw is a ten-minute experimental 16mm film, which explores how public understandings of estrogen and endocrine-disrupting chemicals affect the sense of self and relationships of trans people and those who feel at odds with their assigned gender. The script was written through conversation between the artists, then blurred into a single shifting voice which encompasses conflicting but related experiences surrounding hormones. It was intended to create a narrative which refuses the simplistic arc of traditional trans and romantic narratives, which present love and identity according to the logic of pursuit and conquest. Alongside archive and research material, the film visually explores materials which are known, or suspected, to cause hormonal changes in the body.

Extracts of the script, written collaboratively with Juliet Jacques, are indicated by italics.



(Fig. 01)
Still *Approach/Withdraw*, 2016. Photo and all subsequent images courtesy of the author and Juliet Jacques.

I'm sat at work, on a yellow chair at a white table with a green mug of coffee.

The chair is plastic, plastics give off Xenoestrogens

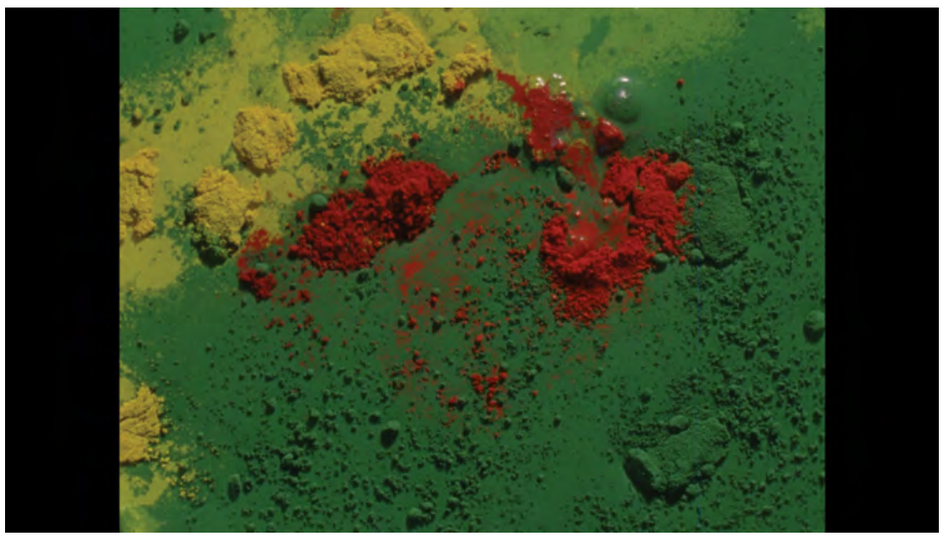
Xenoestrogen
Xeno—foreign
Estrus—sexual desire
Gene—to generate

Fo-reign-oes-tro-gen

The Milk in the coffee is soya
Soya contains isoflavones, a phytoestrogen
Phytoestrogen
Phyto—plant
Estrus—sexual desire
Gene—to generate

Phy-toes-trogen-horse

According to imaging studies, estrogen can cause growth and depletion in the brain. Traditional fermentation of soy products reduces the levels of plant estrogens two- to-threefold. Modern factory processes do not. Can I feminize my brain over breakfast?



(Fig. 02)
Still from *Approach/Withdraw* (2016).

1.

Going into the project, I falsely considered the body an autonomous entity that could be consciously altered through science—a closed system that hormones would develop in predictable and knowable ways. I came to understand myself as a porous and leaking system living within a sea of endocrine disrupters whose interactions could not be known. The work was particularly shaped by Dr. Celia Roberts' writing on the environmental proliferation of endocrine disruptors. Our material choices for the visuals of the film were guided by her lists of commonplace products whose chemicals could be received by our bodies as stealth signals, a form of coded communication involving non-linear relationships between chemical signals and where those signals interact. I found the idea that one of capitalism's inadvertent consequences could be the wide scale feminization of the population at large almost comical. What could be queerer than fucking with your hormones using scatter cushions and a nice new rug—consumerism's dark joke.

(Fig. 03)
Still from *Approach/Withdraw* (2016).

I'm not here. I'm not in this document, and this medication was not designed for me. When it warns that it may cause "changes in sex drive," it says nothing about changes of sex, as the clinicians used to call it, let alone gender identity.

When I was young, I would look for signs that my body was more female, scientifically, than it was perceived to be. These thoughts would override the fact that my voice broke, and my facial hair grew before I started secondary school. They fermented for years, even as my body and mind drifted further apart.

When I'm 17, I take the combined pill Microgynon30. It contains two hormones that my body will recognize as estrogen and progesterone. My skin clears up and my chest swells. Two beacons of femininity lurch in front of me. Isn't this what I wanted? Yet now my mind plays tricks with this dumb shape.

(Fig. 04)
Production image from *Approach/Withdraw* (2016).

At the outset, our aim was for the film to flow like a flood of images, reflecting an idle mind awash with hormones—memories, thoughts and desires layered, conflicting and entwined. The script shifts between the past and the present, voice and on-screen captions, and mine and Juliet's experiences—moving the narration between our respective bodies and the contrasting decisions that were open to us, determined by the bodily position we were in.

We concentrated on reflecting on the interaction between the scientific research and our subjective experiences of bodily and emotional change while taking medical estrogen (the pill, and HRT). It felt important to draw attention to the fact that the hormones given, or more often denied, to trans women are exactly the same pills that are routinely, and assertively, prescribed to cisgender women and, on occasion, non-binary people and trans men.

(Fig. 05)
Still from *Approach/Withdraw* (2016).

I hear on the radio that every cell in your body knows what your sex is and behaves accordingly. Your kidney knows if it is a male kidney or a female kidney.

So can a kidney know it is a confused-as-fuck kidney,
A neither/nor kidney

There is
Cellular sex
Hormonal sex
Organismal sex
Cerebral sex

I imagine my kidneys in strap-ons

(Fig. 06)
Still from *Approach/Withdraw* (2016).

2.

When making the film, I got sick. I got sick with a *man's disease*, or at least a disease that was associated with men and boys. At times, there was a small part of me that was pleased with this diagnosis. I had been expecting testicles to be found hidden inside my anxiety-swollen belly. I imagined them emerging lost and pale, like rescued children from a wreckage, their emergence causing a flood of relief, celebratory tears as if sense was returning to the world. The hidden testicles never materialized but perhaps this new sickness was the next best thing. An indication that I was right in thinking that something was wrong. If I was going to be sick, at least it was in a way that signaled my position against the binary.

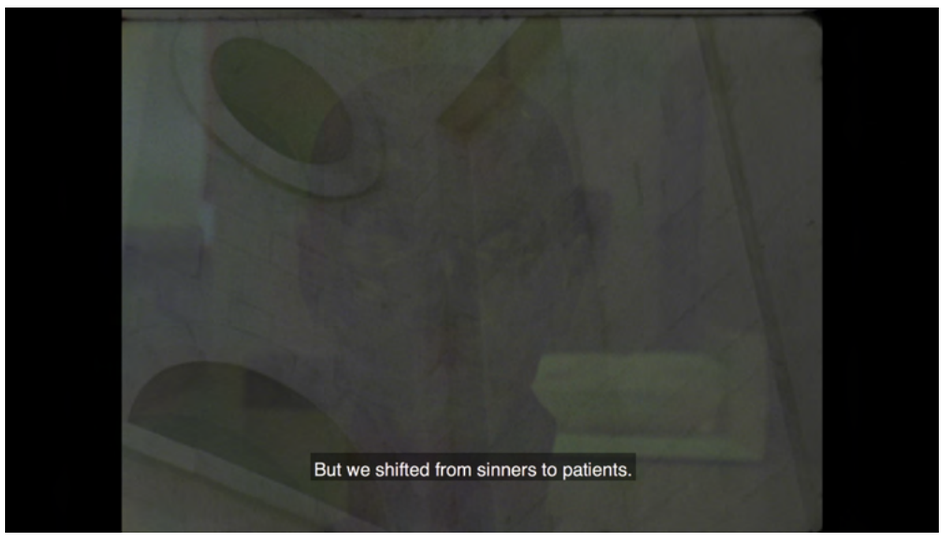
My man's disease was largely resolved after a few years but what was left in its place was a bewildering array of new symptoms, appearing and disappearing like echoes against rocks. Fevers, fatigue, blind spots, red-hot aching joints, muscle spasms, my eyesight fizzing. I often couldn't read words, take in language, my hands appeared too big, too far away, and floors were tilted, shifting. I struggled to sleep or think clearly.

Symptoms like this are often described as nonspecific—too vague to be much use to physicians. They sparked a series of diagnoses and re-diagnoses. My account of symptoms would be questioned, and the previous conclusions of other specialists would elicit subtle signals of distrust. Test results would be regarded as the word of God by one doctor and dismissed out of hand by another.

(Fig. 07)
Still from *Approach/Withdraw* (2016).

I tried to picture the routes that hormones, neurotransmitters, and the chemicals that imitate them, were taking through my body. I found that having one's experiences medicalized turns your self-perception into a scientific gaze. You develop an illusion of distance. You observe yourself, and you distrust yourself—perhaps you aren't ill, just weak, or dramatic. Internally, as well as externally, you become a mistrusted mind in a mistrusted body. I desired external validation for my experiences, as if this would allow me to crack the code of wellness and rejoin the world of the healthy.

The longer my symptoms went on, the more certain I became that most of modern medicine is an elaborate guessing game. As the guesses accumulated like litter, it became clear that many of these professionals agreed I could not be trusted to give a reliable account of my body. This is a fundamentally feminine position to be placed in. Gone was the medical establishment's certainty over treatment for my man's disease. In time, I got used to a pattern of perpetual waiting for assessments before being told there is no real treatment: only a few off-brand pills that can be trialed, but the statistics weren't great.



(Fig. 08)
Still from *Approach/Withdraw* (2016).

Once I handed myself over to the Gender Identity Clinic, I learned that no, my estrogen and testosterone levels were "normal" for "someone male." They were measured in picomoles—a unit I'd never heard of before, or since, and which I still don't understand.

In time, we go from sin to sickness. Psychiatry appropriated sexuality from the church, as the nineteenth century sexologists tried to categorize people in order to destigmatize them. But we shifted from sinners to patients. From sodomites to homosexuals, from cross-dressers to transgender. It was a year after my birth before homosexuality would fall out of the DSM. And you were ten years old before the World Health Organization removed homosexuality from its International Classification of Diseases.

(Fig. 09)
Still from *Approach/Withdraw* (2016).

3.

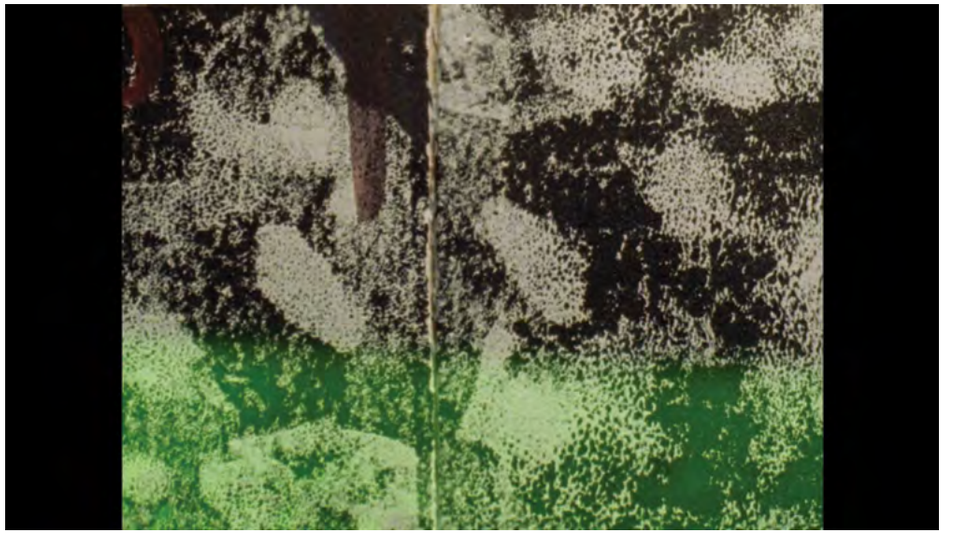
As I lie in bed a jellyfish floats above me frothing. Its shape follows the bacon streak of my nerves, currents shooting through knotting joints, hot organs. I am trying to relax my neck enough for the pillow to take the weight of my head, but my muscles have ideas of their own.

When we began making *Approach/Withdraw,* I was working several zero-hour contract jobs, all of which I despised, and the plumbing in my six-month tenancy flat-share had disintegrated, leaking raw sewage through the hallway ceiling, right above the front door. I started having out of body experiences. What can take a lifetime of meditation was unleashed on me over the course of a weekend. I was flying then falling, elation turned to terror. Since then, every time I have a slight fever, I leave the confines of my body.

I found the shame of sickness entwined with the shame of queerness. I returned to an adolescent desire to be invisible as if I were only a mind, totally separate from a body that does not belong to me. This shame made it harder to unpick the outer body experiences of gender dysphoria from the out of body experiences of sickness. Caught in this double-bind, I questioned my motives in hunting for hidden testicles and misfiring hormones. Was my search for chemical or physical influence a search for validation to follow desires? A reluctance to take responsibility for my choices?

While a small part of me felt vindicated by having a man's disease, the majority of me found it petrifying. Wanting to dispel this discomfort I compulsively read research papers available online. I learnt that estrogen is considered a protective factor against recurrent and severe illness. As such, my willingness to slip beyond the binary remains troubled by the memory of my man's disease.

After years of sickness, I am also wary. I have knocked at the doctor's door too many times to have any faith in the system or in my ability to achieve my desires within the bounds of medicine. I have tried to let go of my desire to resolve my identity through a hormonal process of becoming legible. But instead, I have bristled with envy towards those who have more actively brushed their hands through that porous divide between the genders, flimsy like gauze.



(Fig. 10)
Still from *Approach/Withdraw* (2016).

Previously, scientists have searched for some kind of intermediate gland in homosexuals. A search for proof of a distinct body misfiring hormones, a third sex with neat little gills.

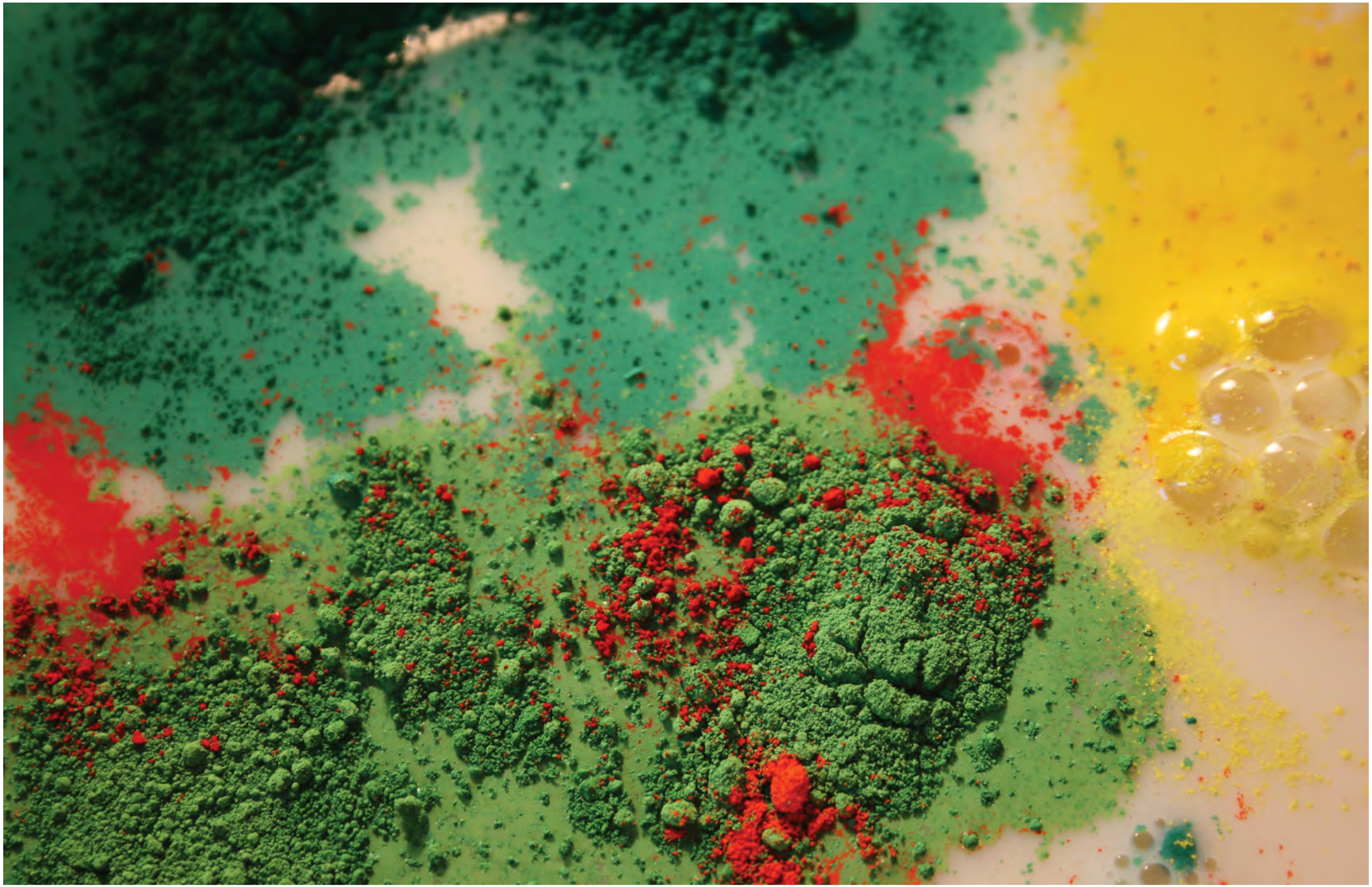
I think I have found my gill. A radiating pain in the right side of my pelvis, which I'm sure is a small moon-like bollock. Just one. A talisman to confusion buried in flesh. I put off going to the doctor for months. By the time I see her, everything has become so layered. A simple exchange and I'm holding the truth in my mouth like a loose tooth.

4.

The cactus on the windowsill by my desk has taken human form. It has fallen in its soil. Its rounded body has lost a lot of its protective spikes and slumps forlornly in the pot. It narrows into a long, constricted neck which can barely support the weight of a bulbous head which lolls over the edge of its confines. Growing almost at a right angle, it looks as if it is straining to lift a heavy head from the pillow of a sick bed, refusing to give in to the pressure of gravity. Peppered along the sides of the cactus, smaller cacti have sprouted like tumors or small children clambering over a maternal body.

My cactus looks sick and I project my exhaustion onto her. I cannot know if the endocrine disrupting chemicals from her plastic pot affect her growth. I have read that the reason our hormonal systems can be affected by plant hormones and endocrine disrupting chemicals can be traced back to communication between plant roots and microbes in the soil. So much of life has evolved through this openness to our environment. Our bodies read signals from upholstery because a plant started speaking to mud.

I am too tired to repot my cactus in a non-toxic pot and right now; I am too tired to reach for gender euphoria. However, actively or not, I am in process with my environment, a state of becoming that is always in motion, a non-linear relationship between call and response which troubles the narrative of resolving gender identity through the logic of pursuit and conquest.



(Fig. 11)
Production image from *Approach/Withdraw* (2016).

FEMINIST TECHNOSCIENCE GOVERNANCE COLLABORATORY
Jacquelyne Luce with Vrisha Ahmad, April Albrecht, Sarah Hyde, Amanda Kearney, Lainie LaRonde, Alek Meyer, Cassie Pawlikowski, Karisa Poedjirahardjo, Emily Pollack, Anjali Rao-Herel, and Ella Sevier

a transdisciplinary collaboratory committed to engaged, collective, and collaborative inquiry in the field of feminist technoscience governance studies—employing reflexive queer feminist methodologies, and challenging disciplinary and temporal constraints of knowledge-making

● South Hadley, Massachusetts, USA

RETRO-SPECTIVE EXPOSURE

What associations are made between in utero exposure to diethylstilbestrol (DES) and experiences or understandings of gender/sex/sexuality?

How did DES exposure impact gender and sexuality outside the arena of reproductive health?

Why does the idea that DES is a cause of queerness/transness hold currency for some individuals?

What informs the belief that DES exposure could have caused queerness/transness?

Why were questions about the impact of DES exposure on gender/sex/sexuality marginalized?

This contribution by Feminist Technoscience Governance Collaboratory (FTGC) brings together excerpts from archival research and in-depth interviews with people who believe they were exposed in utero to diethylstilbestrol (DES), a synthetic estrogen and endocrine disruptor, to explore how circulating knowledge about DES continues to shape understandings of gender/sex/sexuality. The interwoven reflections and perspectives bring the theoretical offerings of their interlocutors and themselves into conversation, illustrating the work of navigating sites and styles of knowledge-making and drawing out queer and trans disarticulations from DES activism and research. The contribution draws on qualitative research, analysis, and writing undertaken for "The DES Project" (2017 to 2022). FTGC recognize the core contributions of Jacquelyne Luce, Sarah Hyde, and Alek Meyer in bringing their work into this current form.

Retrospective Exposure: Tracing Narratives of Chemically Induced Transgressions

FRAMING TRANSGRESSION

Jacquelyne:
Would it make a difference to you…Or, does it make a difference, if DES [exposure] is related to bisexual feelings or desires?

Sally:
Yes, it does. It makes a huge difference. And the reason for that is [that] people who are bisexual, lesbians, or gays who are genetically conceived that way, to me, that tells me that their experience is really…it goes back to the beginning, to conception. That, for them, is healthy behavior. For me, with DES, the bisexual behavior that I have is from the pathology.
(DES Project interview)

In February 2020, Troisi et al. published an article in *Archives of Sexual Behavior* entitled "Gender Identity and Sexual Orientation Identity in Women and Men Prenatally Exposed to Diethylstilbestrol."[1] Diethylstilbestrol (DES) is a synthetic estrogen that was prescribed to millions of pregnant people, resulting in the *in utero* exposure of millions of offspring.[2]

1
Rebecca Troisi, Julie Palmer, Elizabeth E. Hatch, William C. Strohsnitter, Dezheng Huo, Marianne Hyer, Karen I. Fredriksen-Goldsen, Robert Hoover, and Linda Titus, "Gender Identity and Sexual Orientation Identity in Women and Men Prenatally Exposed to Diethylstilbestrol," *Archives of Sexual Behavior* 49 (February 2020): 447.

2
DES was originally authorized for use in relation to "symptoms" of menopause in 1941 and then for complications of pregnancy in 1947. DES was also used in the clinical management of intersex variations, castration of gay men, and to stunt the growth of more than above average height in girls, all treatments based on (entangled) notions of normal and deviant gender, sex, and sexuality. In this contribution, we limit our discussion to *in utero* exposure.

One of many articles that have appeared over the past decades to take up the question of whether and/or how hormones influence, or even determine, gender/sex/sexuality, the article is particularly interesting due to the fact that it is based on analyses of data from members of the official combined cohort of the DES Follow-up Study.[3] This cohort, established in 1992 by combining participants with a confirmed *in utero* exposure to DES and unexposed controls from previous studies, has received a study questionnaire at regular five-year intervals since 1994, thereby providing a means of studying the (emergent) effects of DES over time. In 2016, the latest (and possibly last) survey of the DES Follow-Up Study was administered to 3306 assigned female at birth and 1848 assigned male at birth individuals (exposed and unexposed). The publication of "Gender Identity" coincided with analyses we were undertaking on the "DES Project,"[4] in which we explore how circulating knowledge about DES continues to shape scientific and everyday understandings of gender/sex/sexuality. In contrast to Troisi et al., we work with *narratives* of those who *believe* they were (or most likely could have been) exposed to DES. Many interlocutors in our project, whether interviewees or figures in archival material, do not have a confirmation of DES exposure. They would not have qualified as research participants for the Troisi et al. study.[5] Furthermore, our project does not address whether DES-exposed individuals are more or less likely to identify as or belong to gender or sexual identity minority groups. Instead, we're interested in why such questions are posed, who poses them and how, and the contexts in which ideas, knowledge, and understandings about DES's potential to affect or define gender/sex/sexuality circulate.

The idea for the DES Project was sparked by reference to "gender issues" on the initial versions of a poster advertising a symposium organized by DES Action USA at Mount Holyoke College in 2017 and questions that students posed during the conference about the exclusion of nonbinary exposed individuals from the categories of DES Daughters and DES Sons that are commonly used to describe people exposed *in utero*. Over a number of decades, DES Action USA had received inquiries about the possible biochemical effects of DES on gender and sexuality. Our contribution to this volume brings together excerpts from the DES Action USA archive, our DES Project archive (documents sent to us throughout the project), publicly circulating books and social media posts, and twenty-five in-depth interviews with people who believe themselves to be DES-exposed.[6] Queer feminist interventions challenge rhetoric often employed to garner support for regulatory action to address and contain the amount of endocrine disrupting chemicals in the environment, naming invocations of fear of variations in sex development and changes in reproductive behavior as queerphobic and transphobic. This rhetoric and these framings are nevertheless what interviewees and archival interlocutors often referred to as evidence of the harm inflicted by *in utero* exposure to DES. Adapting a concept from occupational and environmental health, we engage with "retrospective exposure"[7] narratives of chemically induced gender/sex/sexuality transgression; narratives that emerge through a triangulation of mindbody experiences, engagement with knowledge about the mechanisms of DES and effects of exposure, and a reconstruction of exposure possibilities. The interwoven reflections and perspectives (in italics throughout) bring the theoretical offerings of our interlocutors and ourselves into conversation, illustrating the work of navigating sites and styles of knowledge-making and drawing out queer and trans disarticulations from DES activism and research.

EMERGING AND RETROSPECTIVE KNOWLEDGE

During the first half of the twentieth century, "prior to the discovery of DNA as the master molecule of the life sciences, hormones occupied a similar explanatory role by promising the secret behind vital processes."[8] Hormone rejuvenation therapy was a luxury sought out for the promissory potential of hormonal intervention to rejuvenate aging bodies.[9] The initial uses of DES were closely tied to these hormonally-centered articulations of youthful sexuality in aging, and also integral to the gendered process of medicalizing and pathologizing changing levels of estrogen in menstruators at menopause. Synthesized in 1938 in England and never patented, DES emerged on the American market in 1941 as a cheaper alternative to the limited availability and expense of natural estrogens for clinical treatment. In 1947, the FDA granted approval for the use of DES in relation to pregnancy complications.[10]

3
See dceg.cancer.gov/research/what-we-study/des-study.

4
"Embodying Transgenerational Exposure: Gender/sex/sexuality and experiences of being DES-exposed," otherwise known as the "DES Project," was approved in September 2017 by the Institutional Review Board at Mount Holyoke College. It was supported by initial funding from DES Action USA and received on-going support for undergraduate student summer internships and research practicums from Mount Holyoke College. All names of interviewees and figures in archival material which are not also publicly available are pseudonyms in order to protect an individual's privacy.

5
The scientific validity of the knowledge generated by the DES Follow-Up Study is thought to rest on the fact that the research subjects have a confirmed documentation of exposure. Study participants are limited to those enrolled in 1992 .cancer.gov/about-cancer/causes-prevention/risk/hormones/des-factsheet.

6
DES is understood to have primarily (but not exclusively) been prescribed to white women. Interviewees are predominantly white, with one interviewee self-identifying as Jewish and one as Portuguese. The socio-economic status of many had fluctuated throughout their life, enabling them to speak in relation to various experiences of income, livelihood, and education. We have not assigned definitive gender/sex/sexuality identification labels to interviewees; rather, we hope to convey the complexity of such demographic categories throughout.

7
"Retrospective exposure assessment" involves retrospectively reconstructing possible exposure to toxins in order to develop more thorough estimates of exposure and epidemiological outcomes. See: Yu-Cheng Chen, Gurumurthy Ramachandran, Bruce H. Alexander, and Jeffrey H. Mandel, "Retrospective Exposure Assessment in a Chemical Research and Development Facility," *Environment International* 39.1 (2012): 111 and Lesley Rushton, "Retrospective exposure assessment in environmental epidemiology," *Occupational and Environmental Medicine* 66.9 (September 2009): 572.

8
Michael Pettit, "Becoming Glandular: Endocrinology, Mass Culture, and Experimental Lives in the Interwar Age," *American Historical Review* 118.4 (October 2013): 1053.

9
Aimee Medeiros and Elizabeth Siegel Watkins, "Live Longer Better: The Historical Roots of Human Growth Hormone as Anti-Aging Medicine," *Journal of the History of Medicine and Allied Sciences* 73.3 (July 2018): 333–59; Cheryl Logan, *Hormones, Heredity, and Race: Spectacular Failure in Interwar Vienna* (New Brunswick: Rutgers University Press, 2013).

10
For rich analyses of the regulatory processes related to the approval of DES by the recently formed US Food and Drug Administration (FDA), see Susan Bell, "Gendered medical science: Producing a drug for women," *Feminist Studies* 21.3 (Autumn 1995): 473; and, Nancy Langston, *Toxic Bodies: Hormone Disruptors*

For many years, DES was touted as a "miracle drug," prescribed to mainly, but not only, white individuals experiencing the increasing medicalization of reproduction.[11] A key indicator for DES prescription: a perceived risk of miscarriage.

In 1971, DES was associated with a rare vaginal cancer in young girls who had been exposed *in utero* and the drug was labeled contraindicative with pregnancy.[12] While the incidence rate of the rare cancers remained relatively low in relation to the number of fetuses exposed, during the 1980s it became apparent that *in utero* DES-exposure had contributed to both conception and pregnancy complications. A number of exposed assigned female at birth individuals were found to have a t-shaped uterus, difficulties conceiving, and higher than usual rates of miscarriage and premature birth. The majority of advocacy, education, outreach, and litigation efforts throughout the 1980s and 1990s focused on the transgenerational reproductive health impacts of DES exposure, and the profound harm resulting from this disruption to women's reproductive capacity and, thus, experiences of motherhood/womanhood.[13]

The room is quiet and still as Sally and I talk. It's been quite a while since our interview. It was an unexpected call. Sally wonders if I've found out whether or not DES is responsible for the feelings she has toward women. Her words, her tone, bring me to ask her if she is in a safe space. Is there anyone she can talk to? I find myself responding to her questions, reiterating that I'm not asking that particular research question, but also telling her that there are strong beliefs and support now for the idea that women being attracted to women is not immoral. As our conversation ends and I rest the receiver, tears stream down my cheeks. Over the course of this project, I have encountered such suffering in the stories of interviewees. Narratives of suffering in which in utero exposure to DES carries significant explanatory weight. Narratives of suffering that I distance myself from.

(DES Project notes)

Consumer organizations, journalists, and artists have sought to raise awareness about the potential effects of *in utero* exposure to DES, and the recommendation that those exposed undergo different forms of vaginal and cervical cancer screening.[14] These interventions rendered visible the difficulties posed by the routinized prescription of DES, which was often presented and understood to be a prenatal vitamin, the cultural silence and shame surrounding pregnancy loss, and the time that had elapsed since the pregnancy in which exposure occurred.

and the Legacy of DES (New Haven: Yale University Press, 2010).

11
The research subjects upon which the Troisi et al. paper is based (who are part of the combined cohort of the DES Follow-Up Study) are primarily (98%) Caucasian. The demographics of participants in the Follow-Up Study combined cohort may have been shaped by the limited targeting of emerging prenatal health initiatives toward people of color during the peak prescription period of the 1950s and early 1960s, as well as access to the clinics at which the original studies were conducted.

12
Arthur Herbst, Howard Ulfeder, and David Poskanzer, "Adenocarcinoma of the Vagina—Association of Maternal Stilbestrol Therapy with Tumor Appearance in Young Women," *New England Journal of Medicine* 284.15 (April 1971): 878–81.

13
See Pat Cody, *DES Voices: From Anger to Action* (Columbus, DES Action, 2008); Susan Bell, *DES Daughters: Embodied Knowledge and the Transformation of Women's Health Politics* (Philadelphia: Temple University Press, 2009); and, the DES Action Timeline, desaction.org/des-timeline.

14
For examples, see the DES Action USA website: desaction.org and especially the DES Timeline: desaction.org/des-timeline.

15
Theo Colborn, Dianne Dumanoski, and John Peterson Myers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival?—A Scientific Detective Story* (New York: Dutton, 1996).

16
See Giovanna Di Chiro, "Polluted Politics? Confronting Toxic Discourse, Sex Panic, and Eco-Normativity," in *Queer Ecologies: Sex, Nature, Politics, Desire,* eds. Catriona Mortimer-Sandilands and Bruce Erickson (Bloomington: Indiana University Press, 2010).

17
Melissa Hines, *Brain Gender* (Oxford: Oxford University Press, 2003). Melissa Hines is a neuroscientist who participated in the Wingspread conference at which the term endocrine disruptor was coined.

18
Deborah Rudacille, *The Riddle of Gender: Science, Activism, and Transgender Rights* (New York, Anchor Books, 2006). The book includes a chapter called "Fear of the Pink Planet," and an interview with Dana Beyer, a DES-exposed individual who identifies as both transgender and intersex.

19
Scott Kerlin, "The Presence of Gender Dysphoria, Transsexualism, and Disorders of Sexual Differentiation in Males Prenatally Exposed to Diethylstilbestrol: Initial Evidence from a 5-Year Study," paper presented at 6th Annual E-Hormone Conference New Orleans, 27–30 October, 2004, diethylstilbestrol.co.uk/the-presence-of-gender-dysphoria-transsexualism-and-disorders-of-sex-differenti

"Ask your mother." "Tell your daughter." Posters and leaflets circulated in clinical spaces and women's health networks. Concerns about DES were primarily addressed to and experienced by the generations affected through direct exposure.

(DES Project analytical memo)

The relevance of DES for the broader public began to shift in the 1990s. Scientists were linking changes in the reproductive patterns and anatomies of wildlife to alterations to their endocrine systems as a result of chemical pollution. The term Endocrine Disrupting Chemical (EDC) was coined. In *Our Stolen Future*: *Are we Threatening our Fertility, Intelligence, and Survival? A Scientific Detective Story,* Theo Colborn and colleagues narrate their pathway to identifying EDCs and their implications.[15] DES, with its known effects on the reproductive and genital tracts of exposed offspring, figured as the prototypical EDC. DES-exposed individuals were transformed into living human vestibules of evidence of the impact of EDCs on humans. While the effects of DES on reproductive experiences had predominantly circulated within women's health conversations, a larger framework of "sex panic" expanded public perceptions of DES's potential effects and the meanings these might hold for affected individuals.[16] References to gender-bending and gay wildlife as a result of EDCs met studies seeking explanations for both non-heterosexual sexual orientation and non-binary and transgender behavior. The explanatory power of DES as a *cause* of transness and queerness took hold, circulating in popular science and journalistic literature such as *Brain Gender*[17] and *The Riddle of Gender,*[18] as well as social science studies, such as an oft-cited presentation by Scott Kerlin.[19]

The Internet enabled a broader and often decontextualized circulation of ideas across major temporal and spatial distances.[20]

Literature hypothesizing a connection between prenatal hormone exposure and gender/sexuality cross-references each other. Interviewees exploring DES exposure as an explanation for their transness and queerness cite this literature. Neither the literature nor interviewees refer to feminist work which challenges biologically deterministic frameworks of sex, gender, and sexuality.[21]
(DES Project analytical memo)

Troisi et al. (2020) are aware of the multiple threads of inquiry and speculation in which the question of DES's influence on gender/sex/sexuality has been posed. Drawing on baseline information about the DES Follow Up Study cohort members' sexual partners which was collected in 1994, in 2003 a number of the same authors published an article entitled "Psychosexual Characteristics of Men and Women Exposed Prenatally to Diethylstilbestrol." They reported that "prenatally DES-exposed women were *less likely* than unexposed women to report same-sex partners ... but prenatally DES-exposed men *were slightly more likely* to report same-sex partners than unexposed men."[22] In 2016, recognizing advances in thinking about gender and sexuality, instead of asking about the identity of sexual partners, the DES Follow Up Study questionnaire asked specific, and much more expansive, questions about "sexual orientation identity, a person's identity based on their attractions, related behaviors, and membership in a community of others who share those attractions and asked about gender identity."[23] The questions read as follows:

Which of the following best represents how you think of yourself? Gay or lesbian; bisexual; straight, that is, not gay, lesbian or bisexual; other, please specify; prefer not to respond; and
Which of the following best represents how you currently think of yourself? Woman; man; other, please specify; prefer not to respond)[24]

Based on their analyses of the responses, Troisi et al. (2020) report:

[...] women who were prenatally exposed to DES were *significantly less likely* to report being lesbian or bisexual. In contrast, while men who were prenatally exposed to DES were *somewhat more likely* to report being gay or bisexual, the estimate was very imprecise and compatible with chance. Finally, *very few* individuals reported currently *thinking of themselves* as a gender different from that assigned at birth in either the exposed or unexposed group (emphasis ours).[25]

What is the difference between the findings reported in the 2003 and 2020 articles? What knowledge about DES's potential influence on sex/gender/sexuality is gained or revised? For us, what is interesting are the ways in which attempts to recognize the significance of self-identification and belonging may in fact highlight the stigma attached to expressing non-normative desires and living non-normative lives and further obscure the stories, and questions, of those whose various identities and experiences do not align.

Voice message from Sally: 'Please change my response to heterosexual. That is safer.' Retrieving the demographic form, I make a note to change her identification from genderqueer to heterosexual, recalling the complexities of the conversation we'd had about identity categories pertaining to sexuality and gender identity.
(DES Project notes)

Troisi et al. have been at the forefront of knowledge production about the impacts of *in utero* exposure to DES. With access to a cohort with confirmed exposure, and data that spans decades, they have the possibility to weigh in on a complex discussion. Yet, their analysis is presented within a frame of distanced assessment of variables, responses, and measures. In many ways, they can be perceived as asking the question to which Sally wants an answer: is DES exposure responsible for non-heterosexuality? How would Sally have responded to the survey questions? Where do fantasy, desire, and sporadic encounters fit? How does data reflect degrees of identification and/or disidentification and lives steeped in social toxicity?

IN SEARCH OF COMMUNITY

The stories that jump out from the documents resonate with the stories we heard during the interviews. They are stories about seeking community, belonging, and recognition.
(DES Project analytical memo)

At the turn of the millennium, support was sought by and for DES-sons (assigned male at birth individuals who had been exposed to DES *in utero)*. Advocacy and education ef-

ation-in-males-prenatally-exposed-to-des. Many interviewees referred to Kerlin's research. One stated: "It was the Kerlin [paper] that started it, so...If you've read it, he said essentially about a third of males exposed to [diethylstilbestrol] are trans or somewhere in between." In 2021, Kerlin uploaded an unpublished overview of his continuing research, seemingly inspired to do so by the same article that opens this chapter. See Scott Kerlin, "My 25 Years of Academic Research into Prenatal Diethylstilbestrol (DES) Influences on Gender and Sexual Development in Men and Women, 1995 to 2020," unpublished manuscript (18 November 2020), uploaded June 2021 at researchgate.net/publication/352465694_My_25_Years_of_Academic_Research_Into_Prenatal_Diethylstilbestrol_DES_Influences_on_Gender_and_Sexual_Development_in_Men_and_Women_1995_to_2020.

20
See the websites "Hormones Matter," hormonesmatter.com/author/hugh-easton and "Diethylstilbestrol DES Journal of a DES Daughter," diethylstilbestrol.co.uk/studies/des-and-gender-identity.

21
See Anne Fausto-Sterling, *Myths of Gender: Biological Theories about Women and Men* (New York: Basic Books, 1985); Rebecca Jordan-Young, *Brain Storm: The Flaws in the Science of Sex Differences* (Cambridge: Cambridge University Press, 2010); Retha R. Newbold, "Gender-Related Behavior in Women Exposed Prenatally to Diethylstilbestrol," *Environmental Health Perspectives* 101.3 (August 1993): 208–13; Katrina Karkasis, *Fixing Sex: Intersex, Medical Authority and Lived Experience* (Durham: Duke University Press, 2008); Jennifer Terry, ed., *Deviant Bodies: Critical Perspectives on Difference in Science and Popular Culture* (Bloomington: Indiana University Press, 1995); and, Jennifer Terry, *An American Obsession: Science, Medicine, and Homosexuality in Modern Society* (Chicago: University of Chicago Press, 1999).

22
Linda Titus-Ernstoff, Kimberly Perez, Elizabeth E Hatch, Rebecca Troisi, Julie R Palmer, Patricia Hartge, Marianne Hyer, Raymond Kaufman, Ervin Adam, William Strohsnitter, Kenneth Noller, Kate E Pickett, and Robert Hoover, "Psychosexual Characteristics of Men and Women Exposed Prenatally to Diethylstilbestrol," *Epidemiology* 14.2 (March 2003): 155–60.

23
Troisi et al., "Gender Identity," 448.

24
Troisi et al., "Gender Identity," 449.

25
Troisi et al., "Gender Identity," 453.

forts related to DES exposure tended to focus on the impact of DES on women, advocating for knowledge and awareness of cervical and vaginal cancer risks and reproductive health complications for those exposed *in utero*, and breast cancer risk for those who were prescribed DES. Consumer organizations and researchers recognized that any fetus of an individual who took DES was exposed to the chemical but, as an interviewee active in a DES consumer advocacy organization noted, DES was viewed as "a women's health issue." The DES Sons Online Discussion Network (later the DES Sons International Network) was founded in 1999.[26] Research conducted on assigned male at birth offspring exposed *in utero* had primarily explored rates of testicular cancer, hypospadias, and cryptorchidism. Noting a gap in knowledge due to the predominant focus on DES daughters, alongside a focus on the *physical* effects of DES, leaders of the new network conducted and advocated for research which focused on identity issues experienced by "individuals born as males who were exposed prenatally to DES."[27]

Especially between 2001 and 2005, correspondence in emails and documents formulates connections between DES exposure and gender identity, most often as experienced by assigned male at birth individuals. In 2004, Scott Kerlin, founding manager of the DES Sons Network, delivered an oft-cited presentation at the E-hormones conference, in which he reported on research conducted with members of the network.[28] Within the archival materials we worked with, studies about brain sexual differentiation and the role of prenatal hormonal exposure on sexual identity, as well as studies about DES as an endocrine disrupting chemical with "gender bending" properties, were often mentioned. Discussions on the DES Sons listserv, for example, seemed to generate a sense of belonging and access to collective evidence of embodied knowledge. Ciswomen who had sought environments in which to talk about experiences that fell outside of the reproductive health frame also found engaged interlocutors on the DES Sons listserv and later a DES Trans listserv. Having previously experienced the marginalization of discussions about gender identity on a DES daughters' listserv, they were relieved to be in a space in which such conversations around gender and identity could take place.

I do just want to say that I am pleased that it seems like we can now discuss the gender identity issue on this listserv. Like [the author of the original post] I remember the time when there was no tolerance for bringing up the subject. Which only made people like me, for example, feel more isolated.

(Email sharing a listserv post, DES Project archive)

26
A DES Trans online group began in 2002. A Facebook Group, DES: Society of Sons and Daughters (So Sad), noted as supporting Trans DES-exposed folks, began in 2013.

27
[anonymized] *"The DES Sons Online Discussion Network: Critical Issues and the Need for Further Research,"* Unpublished report, February 2001, 5 pages (DES Project Archive).

28
Scott Kerlin. *"The Presence of Gender Dysphoria."*

Expressing a similar experience of belonging, an author's note on an unpublished paper synthesizing emerging research into ways in which prenatal hormonal exposure, and specifically DES exposure, relates to gender identity formation reads:

When I joined the DES Sons International group, I discovered many others like myself who had also been looking to DES exposure as a possible answer. In fact, one out of 4 people who have been in contact with the group have gender identity concerns.

(Author's note, DES Project archive)

Knowledge circulated as emails from various listservs were forwarded as background to conversations, ideas were reposted, and evidence was gathered and shared.

Individuals voicing these reflections and questions found they were not always well received or endorsed. While the archival material we engaged with doesn't show outright refutation of the connections being made between gender identity, sexuality, and DES exposure, interlocutors often questioned the soundness of the research and, relatedly, the certainty with which claims about DES's effects were made. In correspondence about the (in the end unpublished) paper mentioned above, a DES consumer organization leader requests the removal of specific quotes in which the author cites assertions that DES exposure *will* produce specific outcomes in exposed individuals. "If that were true," the leader writes, "everyone [would] be affected—he [should] have written 'may' produce." In response to another email sharing the outcomes of a recent study, the same organization leader suggested that the research may be better received once more data has been amassed, expressing concerns that in its current state the research would not stand up to scientific scrutiny. Such responses were often experienced as gatekeeping, perpetuating a discrepancy in resources allocated to study women's versus men's exposure, and an emphasis on the physical body. For others, the responses reflected a commitment to advocacy, education, and collaboration with scientific researchers and the Center for Disease Control. As an interviewee noted, many consumer organization activists used the term "association" in relation to DES's effects, consistent with scientific literature on the topic. Cause is much more difficult to prove. Maintaining linguistic specificity and accuracy was critical given the role that consumer organizations were playing in relation to regulatory initiatives and ongoing litigation movements. Emphasis was placed on advocating for

short and long-term research and staking claims to knowledge that would withstand scientific and legal scrutiny.

How would attending to queer questions have challenged the cohesiveness of the figure at the center of the movement? How was the relationship between biology, identity, emotions perceived? What were the stakes?
(DES Project analytical memo)

In 2016, DES Action published the article, "Transgenderism and DES: Is there a Link?" in their newsletter, *Voice*.[29] More recently, a letter from a DES trans member has been added to the DES Action website.[30] DES Action granted initial funding for our DES Project and added new options for identity categories to their membership form. These actions signal a move toward greater inclusivity and a (public) recognition of a more gender/sexuality diverse population of DES-exposed people. In several ways, these actions may hold particular meaning to DES-exposed individuals who view queerness and transness as pathological and DES as the pathogen.

AN ENDURING EXPLANATORY POWER

Knowledge is uncontainable. It's not always easy to recall when or where you came to know, but there are some defining moments in life that become embedded in our stories of (synthetic) becoming.
(DES Project analytical memo)

The notion that DES was associated with human queerness/transness leaked from the various articles, reports, and news coverage into conversations with therapists, the pages of developmental psychology textbooks, social media, and, more recently, material shared by DES Action. Interviewees seeking an explanation for their transness found it, took it in, and often experienced relief.

I had been going to a therapist, and she worked at an office in a hospital that dealt with transgender issues, and she had a lot of information—this was the early nineties, or mid-nineties. And she had mentioned that there was a possible correlation between DES and transgender identification. So, that's when I started thinking about it. I asked my sister. She had told me that, yeah, they pretty much, my mom had five miscarriages before me [...] and they pumped her with this DES. And then I started to try and do the research on what effects DES had medically on women that were pregnant and the fetus and that's when I had the start of my quest. Oh,

29
Anonymous, "Transgenderism and DES: Is there a Link?" *Voice*, 149 (Summer 2016): 1, 5.

30
desaction.org/wp-content/uploads/GIDLetterfromDESSon.pdf.

this might be an answer to my quest, why I am the way I am. [...] *I don't want to say [I'm] Christian but, you know, I believe in God and Christ, and so there were always some spiritual issues with me in regards to that. I wanted to have an understanding [of why I am transgender] and I came to peace with that and I'm totally okay on a spiritual level with who I am and I think God is too. I think God created me the way he wanted me to be. But I do think DES had something to do with that.*
(Anna, DES Project interview)

Again, because I do have a medical background as a paramedic and I'm an educator, I've always wanted to know, is there a cause? Was there a cause of who I am? It wasn't until I actually found my sister, I found out about her, and started looking at the DES ... I always knew that there had to be a cause. Why was my brain told that I should have been female?
(Iris, DES Project interview)

I mean it's not like certainty. I think it's probable, but not a definite. That's all I could say. I mean, my wife is really big... she's a school teacher, so she wanted to know whether it was nature or nurture. Because if it's learned, theoretically, it could be unlearned although ... But, no, I think that was the cause and, to be honest with you, it's given me some peace because now I have an explanation instead of 'Why?' So, it gives me comfort in thinking that that's what it was, so I accept that. I have a little bit of doubt, but okay. [...] *I guess I could say DES probably causes mental or brain transgender for my generation, because that's when it was given. And endocrine disruptors at other points, or DNA issues, start from the beginning. So, I guess what I'm really trying to say is, I think DES, which is a specific endocrine disruptor or artificial estrogen, would cause what I have.*
(Frankie, DES Project interview)

Interviewees offered nuanced reasoning as to why they understand DES to be closely associated with, or the cause of, being transgender. Some interviewees point to a long history of scientific observations of queerness and transness in nature, naturalizing (and thus normalizing) their own queer and/or trans behavior, even if their "nature" was chemically altered. Others, like Sally, align with a rhetoric of pathology caused by chemical intervention "after the beginning;" their queer desires and complex gender identities are viewed as evidence of unacknowledged pharmaceutical harm. Many interviewees expressed relief and comfort at being able to identify a basis for their queerness or transness outside of the framework of "choice." Their reasoning resonates with, but also complicates, a "born that way" rights discourse, a

position that many LGBTQ individuals embrace and one that many have refuted and resisted. The complexity of this position—of a biologically determined queerness or transness rooted in the unintended consequences of chemical intervention during fetal development—is not lost on interviewees. The narratives can be contradictory, simultaneously occupying a naturalizing (read: inevitable) and pathologizing space; likewise, while narratives of biological transness may comfort and validate many participants (some of whom encompass other trans folk of their generation as "chemical kin"), the destigmatizing efforts of such articulations also hold the potential to exclude younger generations, nonbinary people, and those who challenge the biologization of difference and/or invoke and play with gender and genderlessness as chosen.

Descriptions of anatomical differences are common. A note in Histories of the Transgender Child[31] *states that Stilbestrol (diethylstilbestrol) was used within treatment protocols to "manage" intersex patients. Why is the concept of "intersex" so markedly absent?*

(DES Project analytical memo)

DES exposure doesn't appear as a topic within the public facing material of intersex organizations with which we engaged. Ideas about the concepts and categories of intersex and transgender, and the meaning these might hold for lived experiences, also do not fit neatly into normative understandings of the terms. Vanessa, who describes DES's impact as a "full body slam," was the only interviewee who mentioned any interaction with the Intersex movement:

When I wrote them [Intersex Society of North America], I talked about feeling like I really resented that I had realized this about myself, that I was in fact intersex anatomically...

(Vanessa, DES Project interview)

Talking about the mechanisms by which DES and other endocrine disruptors interact with the development of what is understood as sex, Vanessa recalls responses she has received from others when sharing this information. She situates the complexity of biological frameworks for understanding appearances or behavior that transgress sex and gender expectations within a socio-political context:

I have mentioned [biological explanations, related to animal studies] to DES daughters [that I've met] who present very nearly as male and who say that that doesn't, that's not why they are who they are; who they are is just fine and they don't need a biological explanation. I know that there was a huge flurry created to some extent by a gay man back in the '90s, I think, about whether or not it was politically wise to even go to the point of saying there's a biological basis for part of this, or any of it. And that was sort of the wisdom for a number of years. And what I'm saying is, then, how do you explain my body, my life, my experiences? And I'm not the only one.

(Vanessa, DES Project interview)

Peter identifies as both a transman and intersex, but in contrast to the "anatomically intersex" description that Vanessa uses, Peter describes the intersexuality of DES-exposed transgender people as an intersexuality of the brain, or "invisible intersex." For Peter, taking on intersex as a label is a strategic move.

Back in my generation there was tremendous stigma, and you didn't want to tell anybody [that you were trans] unless you had to, because to admit [that] meant to tell people that you were a kook. So, to hear that it's possible that DES caused a chromosomal abnormality and caused rushes of testosterone through my fetus while I was in the womb and this may be the reason why I had the gender dysphoria, that takes me out of the realm of kook and puts me in the realm of intersex, which I consider to be a very respectable box to be in if I need to.

(Peter, DES Project interview)

Identifying as intersex enables Peter to bolster claims to biological variation (albeit induced by pharmaceutical intervention) and thereby distance himself from the stigma of transgender identity, which has been/is often viewed as unnatural or as an indication of being psychologically unwell. "*I feel safer and better about myself saying I'm intersex than to say I'm trans.*" Peter anticipates a dovetailing of trans and intesex populations as research progresses over the next few decades.

Interviewees' narratives highlight the historical and social specificities of gender expectations and transgression. Entangled in the broader interview narratives are also reflections on the interrelatedness of gender identity and sexuality. The previous excerpts draw out reflections that were shared specifically in relation to transness, as well as ideas around identifying as intersex. Interviewees perspectives complicate stories of identification and affinity and shed light on the diverse compositions of membership and participation in social and health movements. Who might find belonging in narratives of chemically induced gender/sex/sexuality transgression? Who might such narratives leave behind? Why might one resist such framings?

31 Jules Gill-Peterson, *Histories of the Transgender Child* (Minneapolis: University of Minnesota Press, 2018), 105, 108.

COMPETING KNOWLEDGES/ METHODOLOGIES/COMMITMENTS

We talk at length about the ways in which to share stories without perpetuating harm, narrate complexity, adhere to variability in understanding, belief, politics. Ideas are shared in moments of trust and intimacy. Coalitions and movements are not grounded in sameness.

(DES Project analytical memo)

Our criteria for participation in the DES Project were significantly different from research projects that study the behavior of DES-exposed individuals to understand gender identity and sexual orientation and studies that view DES-exposed individuals who express non-heterosexual and noncisgender desires, behaviors, or identities as a source of information about DES. In an invitation letter to potential participants, we noted that we were interested in how DES may have shaped people's experiences and/or understandings of sex/gender/sexuality. Rather than requiring a confirmation of DES-exposure, we invited people who identify as DES-exposed to share stories about their life experiences. Distributed primarily through the networks of DES Action, a key consumer advocacy and education organization, the invitation to participate in an interview was most likely received by people already familiar with the organization. A number of interviewees were among those who reached out to DES Action while seeking reasons for their experiences outside of normative cisgender and/or heterosexual frameworks. In many ways, this is a key limitation to the scope of our project. In other ways, though, it enabled us to explore intersecting questions and experiences that are a part of the DES movement's history. We explored narratives of identity formation, belonging, and marginalization that appeared in the archival material and interviews. We learned, from the interviewees we've centered here, but also many others, about how the social and political environments of the 1980s, 1990s, and early 2000s influenced their life experiences, including sex with multiple partners, infertility, sexuality following cancer treatment, and family relations. Interviewees talked about how being DES-exposed had shaped their lives and speculated about what aspects of their experiences it may have influenced (many of which are gendered and sexed). Throughout this essay, we've shared some of the questions that were being asked and the work we've been doing to better understand why people might be invested in a causal explanation for their queerness/transness. We also came to wonder why these questions may

have been marginalized. The most obvious potential reasons are the configuration of DES exposure as a women's health issue and feminist resistance to biologizing discourses of identity. Building on this, we further engaged with the boundary work reflected in the archival material and interviews that seemed to be undertaken (intentionally or not) with regard to attending to and validating certain lines of inquiry. DES-related activism produced a damaged reproductive body as its central concern; an assigned female at birth body that was heteronormatively and cisnormatively "womaned." Experiences which countered or disrupted the coherence of this damaged gendered figure would have been peripheral to, and potentially distanced from, the movement. This would have included many of the interlocutors in the archives and interviewees who posed questions about gender identity as DES sons and are women. Additionally, when questions about the effects of DES on gender identity and sexuality initially began to gain traction, the concept of EDCs, and the need to regulate their ubiquity, was still quite new and contested.[32] Emerging research about EDCs was called upon as evidence of queer and trans chemical causality. DES consumer activists were engaging in both public health work and legal struggles. Establishing degrees of scientific certainty about the impact of DES and its association with, for example, cancer and reproductive health complications was crucial to their work. The combination of engaging questions suggesting DES caused nonnormative gender identity and sexual behavior and engaging with an emerging area of contested scientific research and activism, may have been seen as compromising the efforts of DES consumer organizations to be recognized as credible partners.

Now just over fifty years since the public announcement of DES's risks, accounts of DES are most often narrated as a story of the past; an episode in medical and pharmaceutical regulatory history. We recognize the valuable and enduring work of activists in the DES movement and the continuing need to address the highly gendered and essentialist foundations that informed the initial FDA authorization of DES, its place on the market for so long, and the limited allocation of resources to support the development of comprehensive knowledge about DES's long-term effects. Our efforts in this contribution visibilize the ways in which some folks' lived experiences of gender/sex/sexuality, and claims to DES knowledge, were marginalized. The excerpts we've shared here do not reflect the totality of experiences. They are stories about the explanatory power of a synthetic hormone, speculations about the possibilities of chemically

32
See Langston, *Toxic Bodies,* and Nancy Langston, "Precaution and the History of Endocrine Disruptors," in *Powerless Science? Science and Politics in a Toxic World*, eds. Soraya Boudia and Nathalie Jas (New York: Berghahn Books, 2014), 29–45.

induced gender/sex/sexuality transgression, and claims to recognition as harmed. They are stories about seeking knowledge and understanding. Interviewees do not uniformly (individually or collectively) equate transness/queerness with/as pathology. The excerpts reflect portions of an interview and portions of people's lives—lives in which a number of interviewees are also seeking and belonging to communities of queer and trans folk. As queer, straight, non-binary, trans, cis, BIPOC, white, mixed class, early, and established scholars, we recognize the work that goes into validating one's experiences and identities. We are grateful to interviewees and archival interlocutors for sharing such nuanced knowledge. We hope that the excerpts that we have woven throughout this paper, including the reconstructions of some of our own sense-making processes, generate greater understanding of the enduring effects of entangled social and chemical toxicities.

MARNE LUCAS
a multidisciplinary artist working at the intersection of art, feminism, and health and the end-of-life doula whose practice is informed by the events and emotions of the community around her

● New York, USA

HRT {(^)} IRT

How might our thought processes, personal drive, and creativity be driven by hormonal changes?

What happens to our self-perception when hormone levels change? Are we still truly the person we thought we knew?

This visual essay explores hormones, hormonal medicines and experimentation with synthetic hormones, and hormone-disrupting chemicals through an "artveillance" practice. Using a feminist lens within the intersection of art and technology, artist Marne Lucas investigates the potential of infrared thermal imaging (IRT), a prevalent surveillance technology, to depict the hormone-related transformations of the human body. How might our thought processes, personal drive, and creativity be driven by hormonal changes? What happens to our self-perception when hormone levels change, such as in menopause or andropause? Are we still truly the person we thought we knew? And what can self-experimentation and biohacking do to the effects of aging, endocrine disruption, or evolutionary outcomes? Thinking with her artworks, created from the stills from her ongoing *Transmundane* infrared thermal video projects, Lucas reveals the magic and fragility of human existence embedded in more-than-human hormonal worlds.

HRT {(^)} IRT: Hormone Replacement Therapy Reimagined via Infrared Thermography

INTRODUCTION

In this visual essay, I explore hormones as they relate to birth, puberty, fertility and ovulation, pregnancy, gender affirming care, menopause and andropause, and the posthuman body. In recent years after menopause, I realized that not just my physical lifecycle but also my artistic interests and expression have been ultimately directed by my hormones. I clearly see that while my earlier artworks, made at the fertile ages of 20–35, were about the body, intimacy, and sexuality, I explored childbirth in my mid-thirties and when I went through a final hormonal peak—what I call an "extinction burst" of estrogen. After that, as I experienced perimenopause, I made an experimental film *Haute Flash* about the hormonal transition of menopause. Now, at the age of fifty-four, six years post menopause, I pursue artistic endeavors related to the final chapter of life: aging and dying and death.

(Fig. 01)
Marne Lucas, *Open Palms*, 2022, IRT still. This image and all subsequent images courtesy the artist.

I use infrared thermal imaging (IRT) as a way of viewing the literal heat bodies and landscapes emit. IRT helps me to visualize the invisible, while referencing the invasive technology that is used publicly and privately for surveillance. Transporting the viewer into an “otherworld” space within art and technology, thermography captures the surreal beauty of heat-signatures radiating from the bodies, offering a glimpse of our temporal coalescence of ancient stellar energy: we are truly beings of light. The human body is luminous. Conceptually I interpret the body as part of the spirit world, and by extension, the lightbody can be viewed as post human.

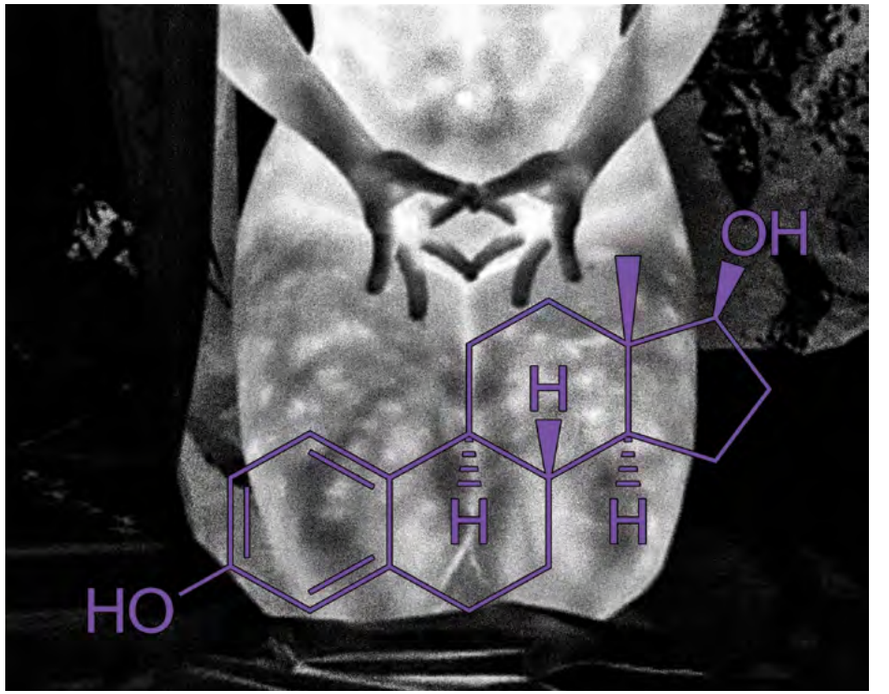
> The cosmos is within us. We are made of star-stuff. We are a way for the universe to know itself.
>
> Carl Sagan

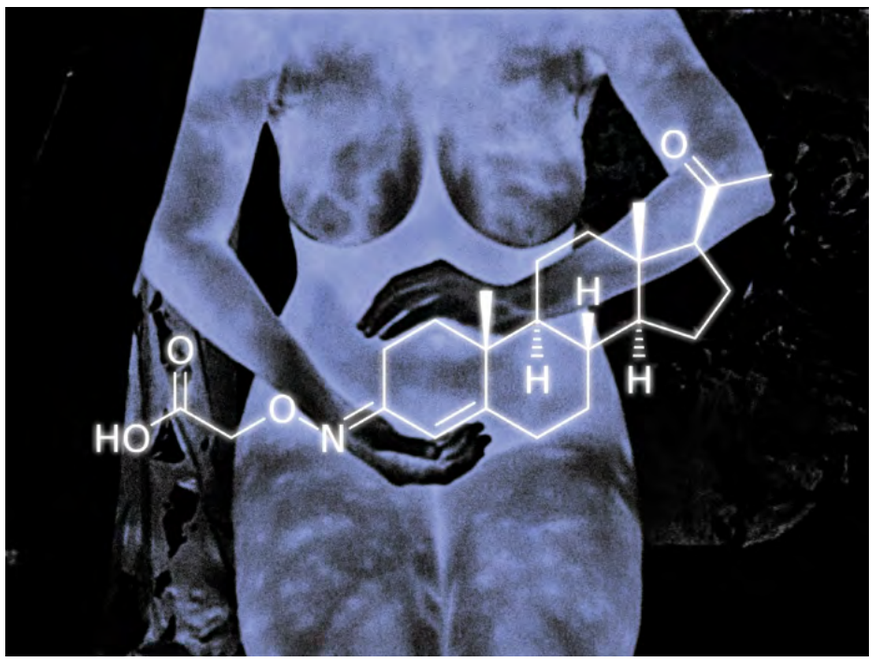
The heat-signatures captured by IRT show how incident energy—the measure of heat striking an object—dissipates, depicting the impermanence of energy. All objects above 0 degrees Kelvin emit thermal infrared energy. Forward-looking infrared device (FLIR) thermal imagers can see objects regardless of the presence or lack of ambient light, depicting heat signatures expressed from objects and people invisible to the human eye. What is hot appears white, and cooler or wet objects appear black. Warm veins, cold extremities, and breath are visible in real time, without special effects. The visual appearance is quite arresting: objects, landscapes and people have seemingly black-and-white negative film qualities, possessing a transparency and inner glow.

(Fig. 02)
Marne Lucas, *Celestial Navigator*, 2022. Courtesy the artist.

ESTROGEN

Estrogen is a sex hormone linked to the development and regulation of the female reproduction and secondary sex characteristics. The many different functions of estrogen within the human body also include neuroprotection and DNA repair, regulation of skeletal, cardiovascular, and immune systems, or effects on brain and behavior, affecting cognitive functions and mental health. Additionally, estrogen is associated with the stimulation of sex drive, in both women and men.

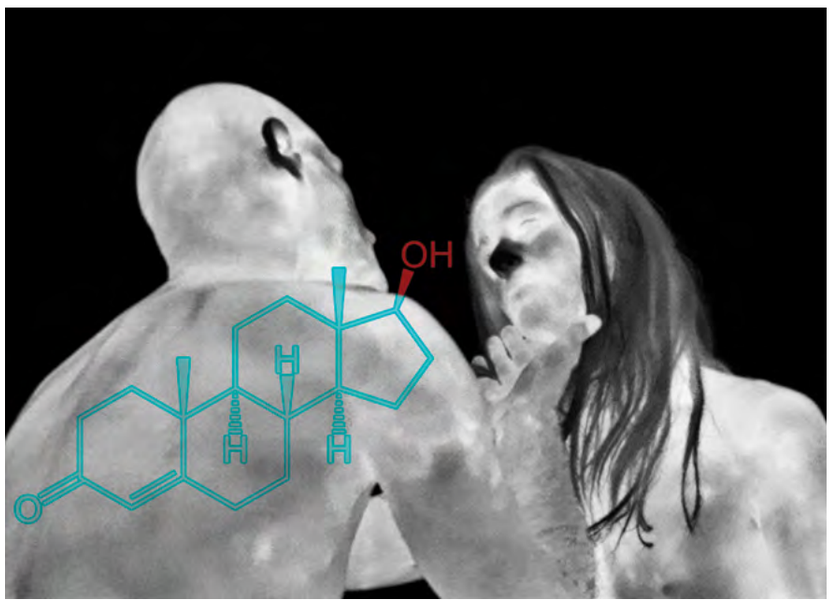




(Fig. 03)
Marne Lucas, *Estrogen Gesture*, 2022.
(Fig. 04)
Marne Lucas, *Progesterone Gesture*, 2022.

PROGESTERONE

Progesterone is a sex hormone involved in the regulation of menstrual cycle and pregnancy. Like other sex hormones, progesterone performs many different roles in the body, affecting the functions of most organs and tissues, including the role as a neurosteroid regulating brain development and function. Additionally, progesterone acts as a metabolic intermediate in the production of estrogen, testosterone, and other steroidal sex hormones, such as the corticosteroids.



(Fig. 05)
Marne Lucas, *Testosterone Coupling*, 2022. Image sourced from *Incident Energy*, a four channel IRT film by Jacob Pander and Marne Lucas (2013).

TESTOSTERONE

Testosterone is a sex hormone associated with men, playing a key role in the development of male reproductive tissues and secondary sex characteristics, such as increased muscle mass, the growth of facial and body hair, or the deepening of the voice in puberty. It is one of many androgens (male sex hormones) in females and has impact on ovarian function, bone strength, sexual behavior and normal libido. Too much testosterone can cause unusual aggressive behavior, mood swings, irritability and impaired judgment.

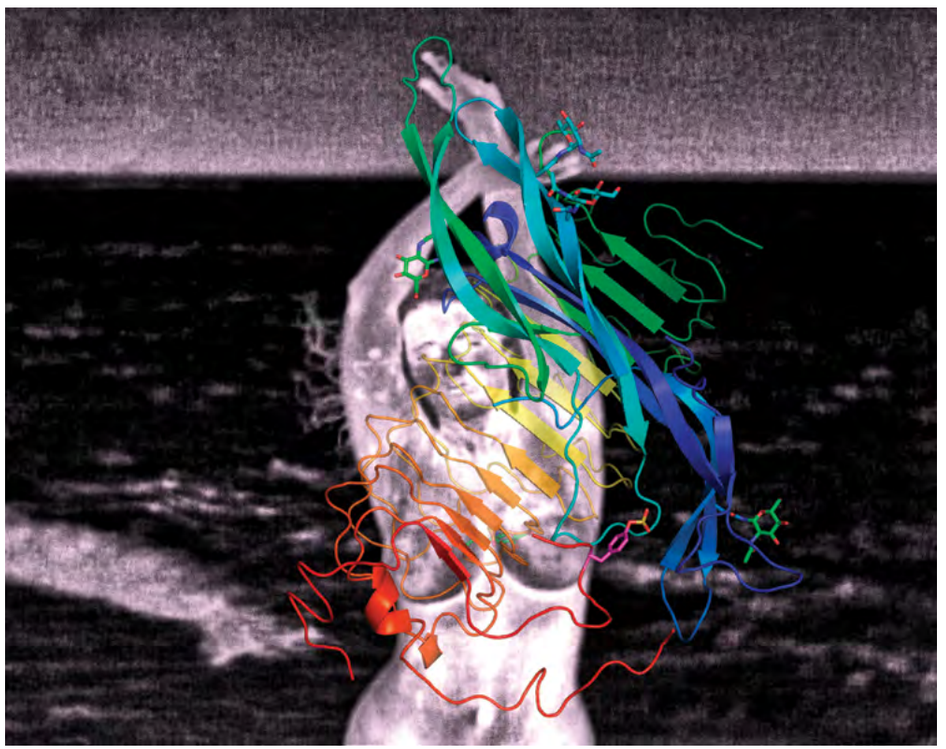
Andropause refers to an age-related decline in testosterone levels in men experienced during their mid-life. Symptoms linked to andropause include decreased energy, less muscle mass and more body fat, swollen or tender breasts, loss of body hair, and decreased libido and fertility. Some men also report anxiety, depression, decreased attention span, insomnia, or feeling more emotional.

Could andropause possibly work to mitigate patriarchal attitudes and expressions of violent behaviors associated with toxic masculinity? What if a “forced andropause” were to be legislated? Could the decreased sense of power and dominance cause the Patriarchy at large to be able relate to the suppression of women and female identifying folks?

(Fig. 06)
Marne Lucas, *Portal*, 2022.

FOLLICLE-STIMULATING HORMONE AND LUTEINIZING HORMONE

Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH) are hormones produced by the pituitary gland that work together to regulate the growth, pubertal maturation, and reproductive processes in both female and male bodies.



(Fig. 07)
Marne Lucas, *FSH Goddess*, 2022.

HUMAN CHORIONIC GONADOTROPIN

Human Chorionic Gonadotropin (hCG) is a hormone known as the “pregnancy hormone” that promotes the establishment and maintenance of pregnancy and ensures the sustenance of the growing fetus.

(Fig. 08)
Marne Lucas and Jacob Pander, *Pregnant*, 2013/22.

(Fig. 09)
Marne Lucas and Jacob Pander, *Birth*, 2013/22.

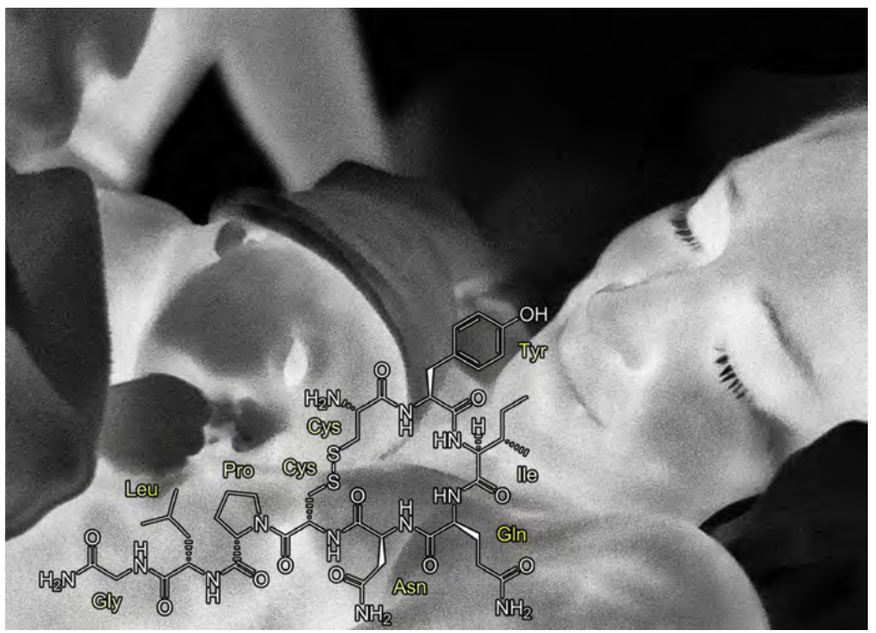
OXYTOCIN

Oxytocin is an attachment hormone produced by the pituitary gland during labor and in response to sexual activity, which is why it is also called the “love drug” or “love hormone.” The primary function of oxytocin is considered to be the facilitation of childbirth by stimulating uterine contractions. Oxytocin also plays a role in bonding with the child and promotion of milk production in the breasts for an infant.

Could oxytocin be used in humans to promote attachment and a sense of peace, calm, and love? Could it possibly counteract feelings of anger, rage, and violence and promote deeper relationships towards love and acceptance? How could society benefit from supplemental oxytocin treatments?

In my experience this bonding hormone has quite an impact on the formation of my personality.

Oxytocin is my (naturally occurring) “drug of choice” and has enhanced my relationships and connection to others. While I am childless, I am quite maternal. I use this maternal energy in my practice as an end of life doula, a role dedicated to serving those in need of spiritual and emotional support at the end of life.



(Fig. 10)
Marne Lucas, *Oxytocin, Mother, and Baby*, 2022. *Incident Energy*, a four channel IRT film by Jacob Pander and Marne Lucas, 2013/22.

(Fig. 11)
Marne Lucas and Jacob Pander, *Breastfeeding, Mother, and Baby*, 2013/22.

(Fig. 12)
Marne Lucas, *Haute Flash*, 2017.

Menopause, defined by a decrease in estrogen production by the ovaries, marks the time in female reproductive lives when menstrual periods stop permanently and the physiological ability to bear children is lost.

I made *Haute Flash*, an experimental short film about the hormonal transition of menopause, in response to my own journey through menopause and the physical, mental, and spiritual issues I experienced with the shift in my biochemistry. *Haute Flash* is an ode to the shift in my perspective of what it means to be feminine and to exist as a woman and what constitutes female power as I age within a Western culture that doesn't deal with menopause or represent it in media.

Shot entirely with an IRT rifle scope, the crosshairs are visible throughout the film, referencing the targeted feeling of radically shifting hormones experienced throughout peri/menopause. *Haute Flash* depicts the transformation from an earthly, middle-aged woman into a gracefully aging, voluptuous goddess on a primordial beach, endowed with newfound strength. In the film, a glass Head represents "Hormones," and the character "Woman" is a gracefully aging, voluptuous goddess existing on a primordial beach; the heating and cooling effects on her body can be seen. The Head washes ashore, and Woman experiences a menopausal transition upon touching it, she becomes a transformed powerful creature.

BIOHACKING

As a post-menopausal woman, I am curious to experiment with adding a minute amount of testosterone in order to alter my sex drive and boost my ability to be more productive. An artist peer, the Long Beach, California, USA based transgendered senior Misc. Pippa Garner has been a gender hacker for the past thirty years. Pippa has intimated to me in conversation that she takes testosterone alongside an estrogen regimen to keep her energy levels and sex drive enhanced, which for her, leads to more creativity. My gynecologist gave me a blank stare when I asked about the possibility of taking testosterone in tandem with hormone replacement therapy (HRT) hormones, Estrodiol and Progesterone. Medical practitioners prescribe plenty of female hormones for women, but not so much for testosterone, which is naturally occurring in cis female bodies. I miss having more of a drive for life and sex and wonder why I shouldn't (safely) experiment to my own benefit. Perhaps my transgendered friends can shed more light on their personal chemistry set experiments, from which I could hack for my own body?

(Fig. 13)
Marne Lucas and Jacob Pander, *Grappling*, 2022.

HORMONES FOR GENDER-AFFIRMING CARE

Gender nonbinary (GNB), genderqueer, and gender non-conforming people who do not identify with or live within the binary gender narrative use hormones to transition their gender towards preferred secondary sex characteristics.

Is it possible that GNB people who are undergoing HRT may have a better understanding of the complexities of gender, and the effects of hormones on physical and psychological behaviors?

(Fig. 14)
Marne Lucas, *Veiled Gesture*, 2022.

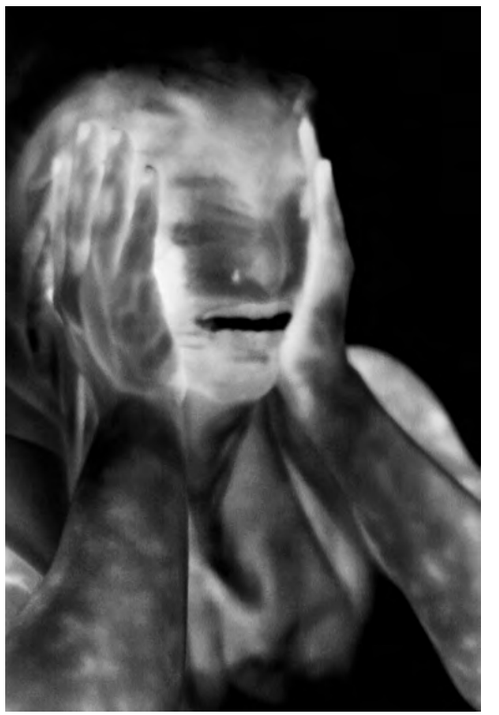
What can we learn from gender nonbinary, genderqueer, and gender non-conforming folks experimenting with hormones about gender and hormonal bodies? What can self-experimentation and biohacking do to change present and evolutionary outcomes in the human body?

ENDOCRINE-DISRUPTING CHEMICALS

Endocrine-disrupting chemicals (EDCs) are substances in the environment, food sources, personal care products, and manufactured goods that interfere with the normal function of the endocrine system. Human and non-human organisms absorb EDCs from many different sources, including the air they breathe, the food they eat, and the water they drink. EDCs can also enter the body through the skin.

A recent study determined that microplastics have been found in the human bloodstream, and, stored near organs. “If plastic particles present in the bloodstream are indeed being carried by immune cells, the question also arises, can such exposures potentially affect immune regulation or the predisposition to diseases with an immunological base?” (Heather A. Leslie: 2022) Such questions are cause for serious concern for future generations as there isn’t sufficient data on the long term effects on the body.

Might this hemo-polymer slurry in our veins cause precocious (early) puberty hormone output in future genertions?



(Fig. 15)
Marne Lucas, *Attaque*, 2022.

With increasing amounts of EDCs interwoven into the fabric of our bodies, who are we becoming?

Certain xenohormones can result in severe health risks such as thyroid problems, endometriosis, and increased risks of testicular, prostate, ovarian, and uterine cancers. Xenohormones ought to be considered a public health crisis; they can be found in agricultural products, cleaning and cosmetic products, contraceptives, plastics and household goods.

Could the effects of Xenohormones be the end of the Human Body as we know it? What possible benefit can come from a future polymer-infused, hormone disrupted body?

THE POSTHUMAN

Through interactions with hormonally active chemicals—natural and man-made, consensual and involuntary, beneficial and harmful—the posthuman hormonal body emerges. What futures, co-shaped by productions and uses of hormonally active chemicals, can we imagine and act out?

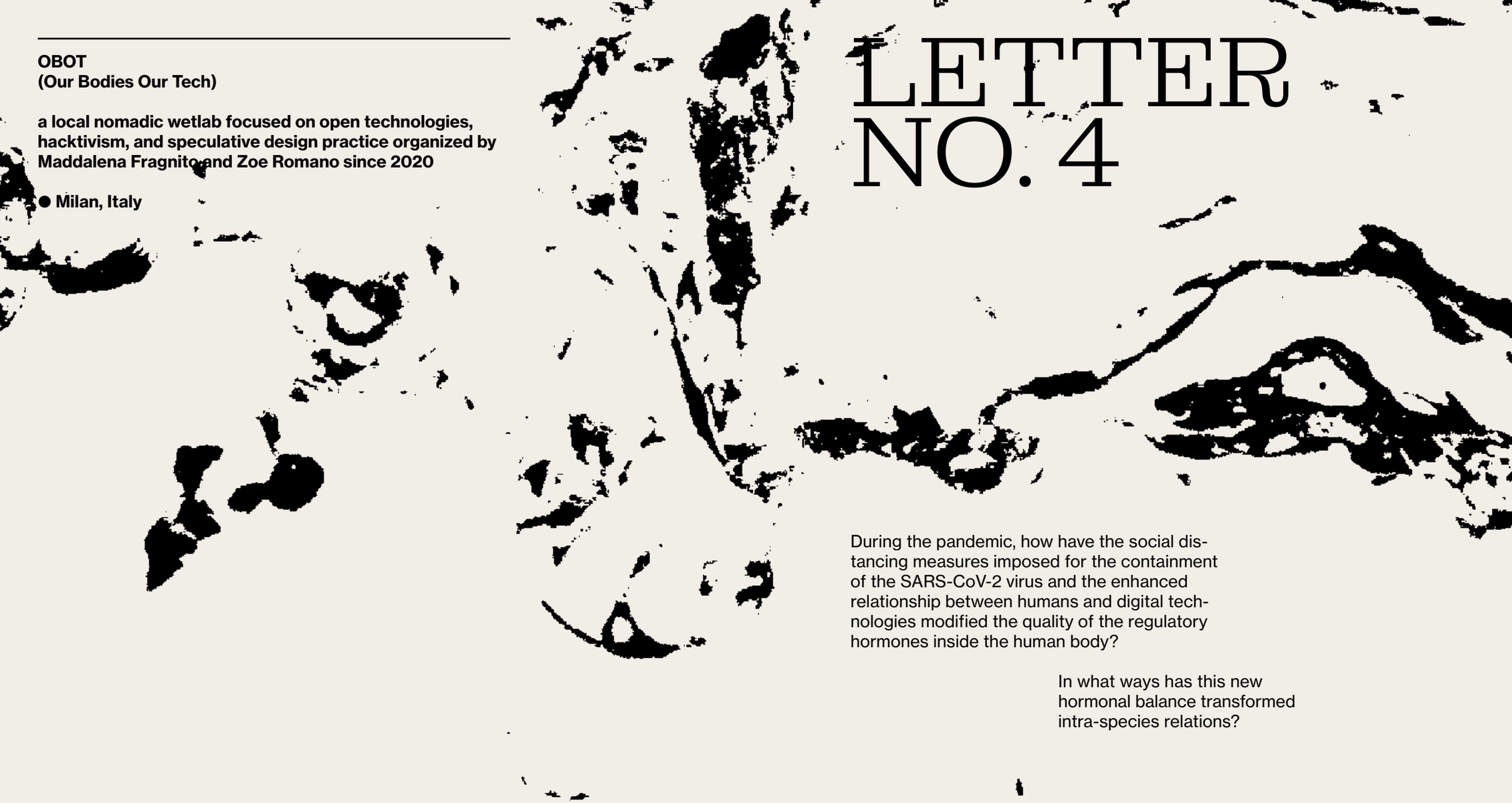
The concept of “Synthetic Becoming” presents dizzying possibilities of a *New Hormone Order* for the human race.

(Fig. 16)
Marne Lucas, *Wet Passengers Cave, Ascension*, 2022.

OBOT
(Our Bodies Our Tech)

a local nomadic wetlab focused on open technologies, hacktivism, and speculative design practice organized by Maddalena Fragnito and Zoe Romano since 2020

● Milan, Italy



LETTER NO. 4

During the pandemic, how have the social distancing measures imposed for the containment of the SARS-CoV-2 virus and the enhanced relationship between humans and digital technologies modified the quality of the regulatory hormones inside the human body?

In what ways has this new hormonal balance transformed intra-species relations?

Carrying on their tradition of writing speculative letters, OBOT addressed their Letter No. 4 to the Gentle Entities of PULP (Multi-Purpose Prevention Presidium—a fictional agency for the protection of life, the microbiota that inhabits it, and the surrounding environment. With the focus on the changes in the production of hormone oxytocin during the SARS-CoV-2 pandemic, the letter examines the entangled relationships between the quality of the population's internal regulatory hormones, more-than-human intra-actions, and public health policies. Drawing on Dr. Jordi Gol's definition of health as "that way of life that is autonomous, supportive and joyful," the letter questions the dominant, positivist model of health focused on the body as a re/productive workforce and proposes an alternative conceptualization of a healthy body as that capable of experiencing joy in leisure, sexuality, relationships, and emotions.

Letter No.4: On the Fall of Joy

Milan, 8 March 2022

To the Gentle Entities of PULP,[1]

We are very grateful to present our last reflections to You, expecting that something will be useful for Your noble mission.

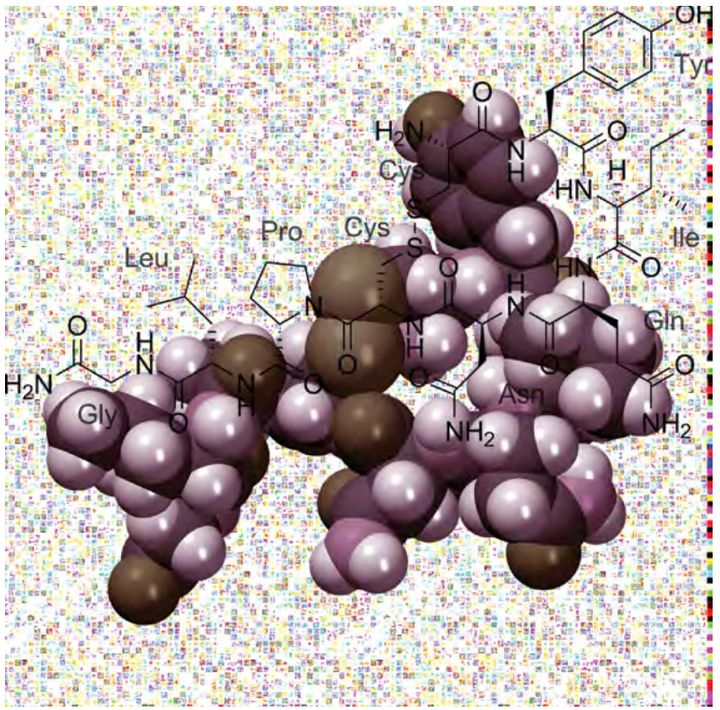
Radical access and accessibility to technologies and scientific knowledge, also guaranteed by Your dedicated work, leads us today to some curious discoveries. With this letter, we would like to bring Your attention to an issue that we had the opportunity to observe directly. In recent times, our work has focused on "polarization," that characteristic that dominates intraspecies human communication whose peak is dated with the onset of the Great Pandemic (GP) at the beginning of the second millennium. As is well known, the peak of polarization reached in the pandemic phase never reabsorbed, causing the collapse of what was called, not without hypocrisy, "liberal democracies." The research we are presenting proposes the reactivation of some investigations on the GP period to make progress in the scientific understanding of the polarization phenomenon.

Common sense holds that the polarization between humans was caused by social distancing measures imposed for the containment of the SARS-CoV-2 virus, such as prolonged lockdowns and curfews, schooling and working from home, and closure of public space. During that period, the condition of isolation—also characterized by claustrophobic phenomena created by confined spaces—multiplied and spread among the population. Although physical distance (1.5 meters between body and body) is a measure that has never been removed to ensure the continuous reopening of activities and workspaces, our research stems from questioning the assumption that restrictions imposed, during and after the Great Pandemic, are the origins of the peak of polarization of human communication. Moreover, since the GP, many people have learned to alleviate isolation through an increased use of the Internet. Several analysts agree that in 2020 alone, there was a global increase of users on social networks of about six percentage points and an average increase in connection time of about ten minutes per day—current data confirm the growth rate. By starting from this growing trend, the research submitted here critically questions the causal link between

1
The PULP (Multi-Purpose Prevention Presidium) is a scientific-cultural structure with technical-imaginative autonomy that carries out activities in public health, environment, nutrition, prevention, and safety in places of care work. The PULP has the function of archiving and mobilizing empirical research and situated knowledge within the de-surroundings. Born at the beginning of the twenty-first century, PULP is today's primary node of collective data for protecting life, the microbiota that inhabits it, and the surrounding environment.

pandemic isolation measures and the peak of human polarization through a dataset derived from new analyses of human chemical reactions in interaction with digital platforms.

There is not much literature on the subject, dating back to the turn of the millennium. Most of the research was carried out by "Dr. Love," a neuroeconomist called Paul J. Zak, and his research group.[2] He published several studies on "digital oxytocin," i.e., the release of oxytocin hormones (C43H66N12O12S2) due to interaction with social networks. According to the then well-known and controversial American neuroeconomist, oxytocin could not be relegated to the reproductive sphere alone, such as childbirth and breastfeeding, but played a crucial role in the mechanism underlying feelings of generosity and trust. Dr. Love argued that oxytocin was the main "glue" in society, so important to influence the economic trends of the population. He believed that the greater the release of oxytocin—primarily due to physical contact via proximity—the greater the trust between people and, finally, the greater the volume of financial transactions between them. From this equation, it is easy to understand Dr. Love's focus on the releasing of digital oxytocin from human's interaction with social networks.



(Fig. 01)
Digital Oxytocin. This image and all subsequent images courtesy of OBOT.

2
Paul J. Zak and Stephen Knack, "Trust and Growth," *The Economic Journal* 111.470 (2001): 295-321; Paul J. Zak, "Neuroeconomics," *Philosophical Transactions of the Royal Society B* 359.1451 (2004): 1737 1748; Michael Kosfeld, Markus Heinrichs, Paul J. Zak, Urs Fischbacher, and Ernst Fehr, "Oxytocin Increases Trust in Humans," *Nature* 435.7042 (2005): 673 676; Paul J. Zak, "Moral Markets," *Journal of Economic Behavior & Organization* 77.2 (2011): 212 – 33.

Although the phenomenon of "digital oxytocin" raises many questions, this research focused on a single query: is there a link between the polarization of social communication and the release of "digital oxytocin"? We considered it plausible that the reduction in intraspecies relational capacities was not a symptom of isolation *per se* but instead of the quality of the internal regulatory hormones released in the enhanced interaction with social networks that has occurred since the Great Pandemic. To test this hypothesis, we took a closer look at the chemical characteristics of "digital oxytocin." The data collected in the early stages encouraged us to go further, it was clear enough that social networks' effects on the population have received only partial scientific attention. The same fact that the bibliography is scarce and concentrated mainly within the field of neuroeconomics[3] shows that the analysis of biological data in the process of digitizing life has been driven predominantly by economic interests.

Having outlined the survey question, and before going into the details of the empirical research, we consider it crucial to direct some of Your valuable attention to frame the context from which the polarization phenomenon emerges: indeed, medical and corporate attention to hormone management is a long tradition. In the twentieth century, techno-scientific hormone research focused on regulating with-gestational-capacities-bodies: human and non-human reproductive bodies have been controlled and regulated to accelerate the production cycles. One thinks of the farming sector and its increased relation to hormones' research and administration to increase and intensify the re/productive cycle of involved animals. But, as researcher Nora Heidorn points out, "hormonal time"—such as menstrual cycles, mood swings, energy levels, reproductive capabilities and aging processes—also became a biopolitical tool for managing human populations' productivity around 1960.[4] One thinks of the biotechnologies developed through synthetic hormones—i.e., the technology of hormone self-regulation as birth control pills—and how these did not merely free bodies from their biological constraints. On the contrary, their development and application have planned and policed the reproductive role of those same bodies. As health and technology theorist Nelly Oudshoorn explains, introducing the concept of "sex hormones" links the reproductive functions of with-gestational-capacities-bodies with laboratory practice and techniques. This connection highlights and emphasizes the reproductive role of such bodies, designating them as a "natural site of intervention."[5] The philosopher Michel Foucault introduces biopolitics, a new form of power

3
See "Neuroeconomics," *Wikipedia*, en.wikipedia.org/wiki/Neuroeconomics.

4
Nora Heidorn, "Lavorare un turno doppio: la biopolitica del tempo ormonale," in *Coming Soon*, ed. Mira Asriningtyas et al. (Roma: Nero Edizioni, 2018), 64–70.

5
Nelly Oudshoorn, *The Male Pill: A Biography of a Technology in the Making* (Durham: Duke University Press, 2003).

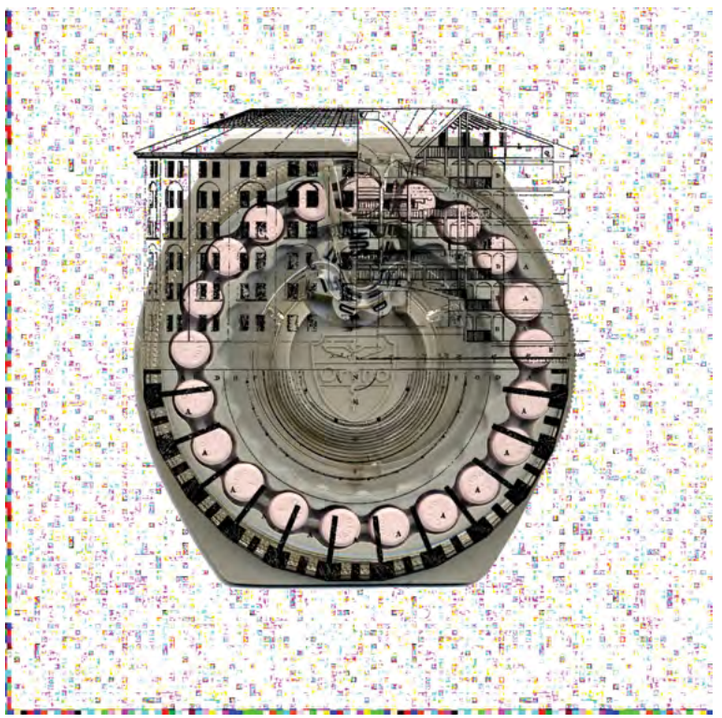
that aims to administer, optimize, and multiply life and its processes: a form of modern governmentality that oversees bodies through normative rather than punitive interventions.[6]

Returning to Foucault's analysis of the disciplinary architecture of the panopticon,[7] Paul B. Preciado develops the concept of biopower from a transfeminist perspective. The philosopher compares the Panopticon's architecture with the packaging of contraceptive pills entering into homes since the 1960s. Like the Panopticon, the pillbox is a disciplinary device capable of changing the behavior of bodies, programming an action, regulating sexual activity, controlling population growth and racial purity. Yet, unlike the control exercised by the governmental hierarchies of the Panopticon, the contraceptive pill is a lightweight and portable device. In the age of biopower, the disciplinary management of bodies persists but its logic is discrete, privatized, and individualized: the population management through pharmacological control is diffuse and molecular.[8]

6
Michel Foucault, *The History of Sexuality, Volume 1* (Harmondsworth: Penguin Books, 1998).

7
Jeremy Bentham's *Panopticon* is a concept-design for an industrial architecture capable of monitoring the production process through the pervasive surveillance of bodies at work.

8
Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2017).

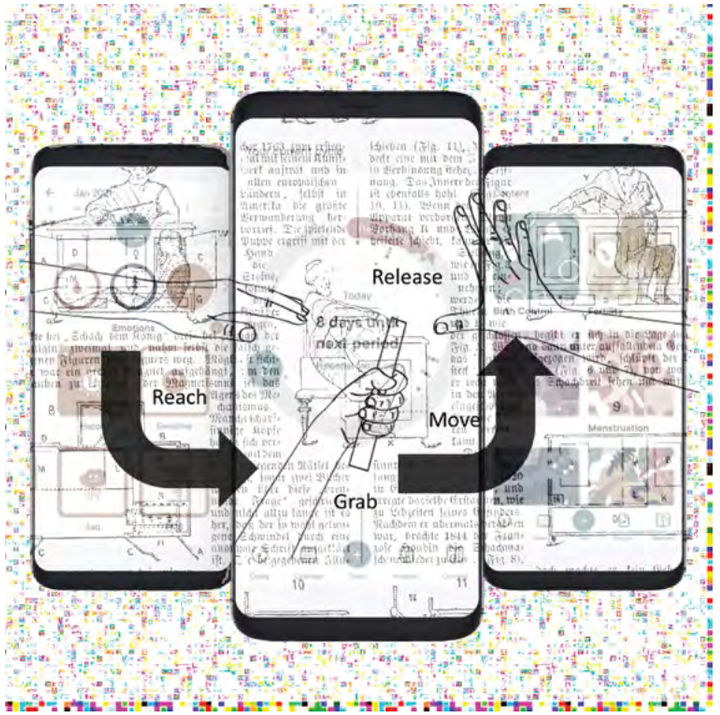


(Fig. 02)
OBOT, DialPak-opticon.

A similar logic is found in menstrual apps, mobile device software designed to self-regulate cycles and ovulation. These apps can be interpreted as digital versions of the pillbox, where the dimension of synchronization and disciplining the body is just as present. Body data are digitized by users themselves and are used for profit by companies that collect and own them. The management of the enormous amount of data on the reproductive cycles of the population guarantees their conditioning through algorithms capable of foreseeing future trends. At a given moment, let us assume that we want to promote a product, a service, or to submit a new legislative proposal to the population. Starting from the hormonal calendar of the data aggregated by the app would be enough to choose the most favorable period of the cycle, significantly increasing the probability of success. Moreover, data shared by users on their physiological, behavioral and emotional state generate metadata with which to corroborate those on biological material (such as presence and quantity of menstrual blood).

As a result, the technology of self-surveillance through menstrual apps has fuelled the hormonal surveillance of the human population by corporations and governments. These spiral consequences well represent the form of biopower in the era of the "quantified self,"[9] in which new practices emerge such as life logging, personal genomics, location tracking, and biometrics. This is the period we position the starting point of this research, and from which a bio-value emerges to be extracted. Therefore, biopower exploits the self-management of humans' bodily functions and controls possible interferences between reproduction cycles and commodity production cycles: a form of governmentality where subjective emancipation is confused with capitalism's self-emancipation. This design complicates the dichotomous relationship between domination and oppression.

9
See Gary Wolf, "What is the Quantified Self?" *quantifiedself* (3 March 2011), quantifiedself.com/blog/what-is-the-quantified-self.



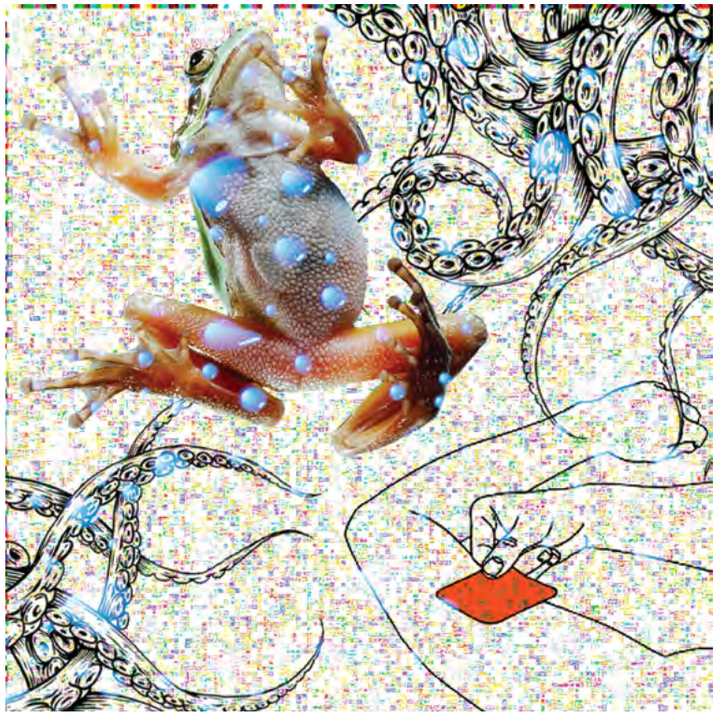
(Fig. 03)
OBOT, Ovulation Method Time Management.

In conclusion, during the twentieth century, increased productivity was achieved by transferring the capitalist methods of time management to the administration of "hormonal time": this process is guaranteed through the diffusion of *exogenous* hormones. Contrarily, the phenomenon on which we focus our analysis is the control of the population's hormonal balance through the stimulation of *endogenous* hormones.

We apologize for the digression to which we have subjected You, but it seemed necessary to outline the context and provide a brief genealogy of medical and corporate hormonal research and administration before disclosing the technical details of our research.

§

Gentle Entities of PULP, we can now present the analyses of the chemical characteristics of "digital oxytocin," that is, the intrinsic qualities of hormonal release resulting from human interaction with social networks. Our research focused on the severe lack of biological data in life digitization. We try to identify how the enhanced relationship between humans and digital technologies, from the Great Pandemic onwards,



(Fig. 04)
OBOT, Amphibian – an octopus-like skin patch.

has modified the quality of the regulatory hormones inside the human body and how this new hormonal balance has transformed intraspecies relations. To answer this question, we had to test whether there was a correlation between the abnormal presence of oxytocin in the body and the peak of interspecies' dialogic inability.

Foremost, a note on the method used. As is known, sweating is the biological mechanism for the expulsion of toxicity that is done by every human being, a symptom of an excess of affective movement. From the beginning, we considered sweat an interesting fluid to monitor the hormonal balance of humans. Firstly, because its collection is less invasive (if compared, for example, with that of blood). Secondly, the collection of samples can be delegated to subjects involved in the research. Thus, the analysis of hormones by sweat allowed us to collect a quantity of data that—even if we subtracted them from the standard percentage of "self-management error" (-3.33%)—was higher than what we could have collected, at the exact costs, with the analysis of blood samples.

For this reason, we decided to use a low-cost version of the "Wearable Skin Patch,"[10] a patch with an innovative

10
Da Wan Kim, Sangyul Baik, Hyeongho Min, Sungwoo Chun, Heon Joon Lee, Ki Hyun Kim, Jun Young Lee, and Changhyun Pang, "Highly Permeable Skin Patch with Conductive Hierarchical Architectures Inspired by Amphibians and Octopi for Omnidirectionally Enhanced Wet Adhesion," *Advanced Functional Materials* 29.13 (2019).

multi-scalar architecture that mimics the structure of the suction cups present in amphibians, allowing adequate and prolonged adhesion to skin surfaces in various conditions of humidity. The Wearable Skin Patch is composed of a layer of ultra-thin, two-dimensional metallic material that alters its electronic state when it detects the presence of hormones. Depending on the electrical signal it produces, which can be amplified and measured, the presence of hormones can be seen and analyzed. The sample of people to whom the test was carried out (10,000) was issued with six patches each. The directive was to wear them for no less than 10 minutes 2 times a day for 3 consecutive days. The double daily application coincided with two different moments of the day, one during the use of social networks, and one in inactivity conditions.

Once the nearly 60,000 Wearable Skin Patches were recollected, we analyzed the presence of the reagent. An alteration should have signaled the presence of oxytocin in the R-type electrical signal, but this was not detected. The unexpected absence of any trace of oxytocin on the totality of collected samples—except the specific cases of pregnancy and lactation—prompted us to repeat the experiment to see if other types of hormones were involved. The new attempt was performed on a smaller quantity of patches, after which 50 percent of the selected group responded positively to the S-type electrical signal, the one indicating the presence of dopamine (C8H11NO2). We re-ran the analysis on all the samples collected and found that what we were trying to analyze, the quality of the so-called "digital oxytocin," was none other than dopamine, found in about the 50 percent of the Wearable Skin Patches collected. In conclusion, according to our findings, the intensive use of social media produces an increased release of dopamine, erroneously defined by scientific studies that preceded us as "digital oxytocin."

The massive oversight of previous scientific approaches is perhaps due to focusing on only one biomarker—this does not detract from the fact that the error may also have been intentional. Unlike oxytocin, which is released by the hypothalamus, dopamine is produced in various brain parts. It is critical to several of its functions: thinking, moving, and sleeping, and regulating mood, attention, and motivation. The delicate vital functions of dopamine make us suspect that detected hormones in the interaction with social networks have been defined as "digital oxytocin"—replacing the name of the hormone and adding the lemma "digital"—so that there would be less attention to the phenomenon. Since oxytocin is commonly associated with positive factors—such as motherhood, relationships

and love—it would not seem a stretch to suppose that the detection of an unbalanced release of dopamine, capable of inducing states of addiction, alteration, and anxiety in the brain, was deliberately hidden by previous scientific research, probably under the pressure of the same social network companies.[11]

§

Gentle Entities of PULP, although the data collected were already broadly helpful in analyzing the phenomenon of human polarization, one question remained unresolved: why was there no significant trace of the oxytocin hormone on all collected Wearable Skin Patch? The absence of oxytocin, even in average amounts, led us to do further analysis through the extraction of a blood sample from a subsect of people involved in the research (100). In almost all the blood samples analyzed, we found a deficient level of oxytocin: the reason why the electronic state of the metal material inside the skin patch had not been compromised in the first experiment. This finding led us to a new hypothesis—or rather a parallel one—concerning the origin of the human polarization spike. While the presence of an imbalance of dopamine inside the human body—cause and effect of a general state of compulsive addiction—seems to explain the reasons for the reduced capacity of social interaction; what seems less reliable is the hypothesis according to which there is no correlation between physical distancing measure (yet still imposed in certain countries at the moment of writing) and human polarization. That is, the hypothesis that moved the first steps of this research. The study thus continued by focusing on the analysis of the missing hormone. Since oxytocin is released mainly from touch and low-intensity stimulation of the skin (such as caresses and contact between epidermis), we started by defining its absence in the collected blood samples as a "secondary symptom of tactile restriction," or SSTR. Therefore, it remained to verify if and how much the SSTR was co-responsible for social polarization.

For quite some time, feminist science and technology studies have brought attention back to a sense too often overlooked and deemed secondary, such as touch. In particular, some studies have emphasized reversibility as a unique quality of touching. The fact that we are touched by what we touch inevitably puts the question of reciprocity at the center. In 2017, María Puig de la Bellacasa wrote that "touch expresses a sense of material-embodied relationality that seemingly eschews abstractions and detachments that have been associated with dominant epistemologies

11
Hüseyin Bilal Macït, Gamze Macït, and Orhan Güngör, "A Research on Social Media Addiction and Dopamine Driven Feedback," *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 5.3 (2018): 882 897.

of knowledge-as-vision."[12] At the same time, she added that any attempt to reclaim touch as a neglected model of knowing must resist its idealized view.

Similarly, social studies in critical medicine have highlighted how (human) contact has become a luxury good. The raising of companies promoting digital medicine and "touch-screen care"—such as *Care.Coach*, providing personalized care for the elderly via animated kittens inside a screen—are among the most apparent effects of the social impoverishment of the population and of the culture of increasing isolation. An era in which many of the traditional gathering places and social structures have disappeared, swept away by the cuts in welfare services that began in the mid-twentieth century, mostly in high-earning areas of the world.

The desires for immanent proximity associated with touch have been progressively replaced by screens that fill a void. As early as the beginning of the second millennium, Milton Pedraza, the director of the Luxury Institute,[13] argued that "What we are seeing now is the luxurification of human engagement."[14] Pedraza has never stopped indicating to luxury companies that wealthy people want to spend their money on anything that is human contact. While the rest of the population, unable to afford it, witness the *screenification* of all their relationships and activities. Since a screen can fit in any place (classrooms, hospitals, airports, restaurants), costs can be cut, and since any action that can take place on a screen becomes cheaper, consequently the structure of life, its tactile experience, has suddenly become *smooth glass*. This is a sensation that we all know and that, well in advance, James Ballard had described in a paper published for the first time in 1982 in the collection *Myths of the Near Future*.[15]

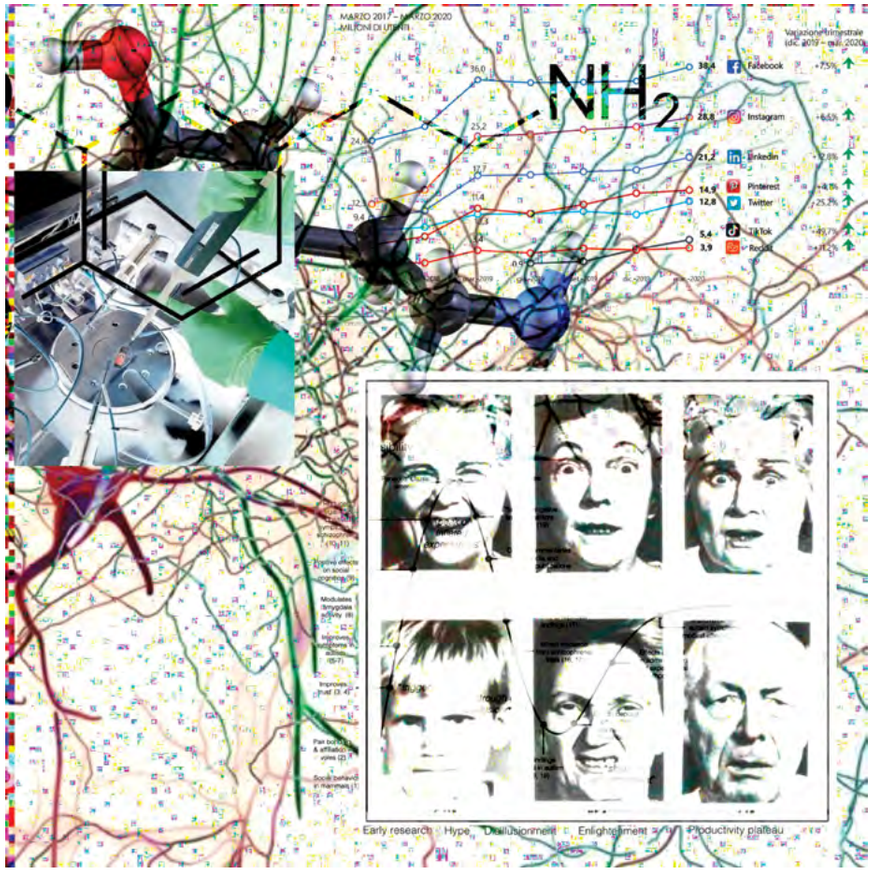
Despite its name, the touch-screen cannot compensate for the production of oxytocin resulting from touching other living bodies: to account for the intrinsic reciprocity of a caress when stroking. We believe this factor is at the root of causalities that have led to the polarization between humans. The lowering of oxytocin levels in the population, caused by months of social distancing during the GP and by the years of physical distancing that followed, has led people to the understandable research for new hormonal balances that found an answer in the compulsive use of social networks (also driven by market interests). As demonstrated in the proposed research, interaction with social platforms does not produce the release of oxytocin but of dopamine. Dopamine is a hormone that generates a mild pleasure effect in exchange for a potent addictive effect—a chemical mechanism that we can point to as the other factor at the origin of the reduced capacity for intraspecies dialogue from the Great Pandemic onwards.

12
María Puig de la Bellacasa, *Matters of Care: Speculative Ethics in More than Human Worlds* (Minneapolis: University of Minnesota Press, 2017).

13
Luxury Institute, luxury institute.com.

14
Nellie Bowles, "Human Contact Is Now a Luxury Good," *New York Times* (25 March 2019), nytimes.com/2019/03/23/sunday-review/human-contact-luxury-screens.html?utm_source=pocket_mylist.

15
J. G. Ballard, "The Intensive Care Unit," in *Myths of the Near Future* (Paladin, 1982).



(Fig. 05)
OBOT, Matterpower.

Should the research and suppositions submitted so far be verified, the control of the hormonal balance of the population through the stimulation and blocking of—or dependence on—endogenous hormones is central to the lens through which the transition from the twentieth to the twenty-first century should be read. Leaving behind disciplinary architectures and biopower, the management of time and the "hormonal time" of with-gestational-capacities-bodies, the government of the population has moved to a phase that could be called "matterpower," a form of connective control that acts directly on the bodily substance through brain stimulations that induce imbalances in the internal regulation of hormones. In an increasingly dematerialized horizon, the boundary between domination and oppression is blurred—as mentioned earlier in describing the era of the "quantified self"—but the boundary between disciplinary management and self-management is also blurred: can we define self-management as an activity that generates addiction?

To conclude, dear and gentle Entities of PULP, we would like to emphasize that the quality of the population's internal regulatory hormones is a factor profoundly linked to public health. It is no coincidence that the topic analyzed so far—the polarization of the intraspecies debate that led to the neck of the ideal of twentieth-century liberal democracy—is one of the most explicit and apparent symptoms of the lack of a satisfactory idea of public health. In 1976, in opposition to the concept of health as the "absence of disease" proposed by the WHO (what was then known as the World Health Organization), Dr. Jordi Gol defined health as "that way of life that is autonomous, supportive and joyful."[16] According to Dr. Gol, neither the concept of "absence" nor the concept of "disease" is sufficiently involved in social justice issues; instead, their juxtaposition risks hiding social justice behind a dominant, positivist ideal model of health. To this vague and abstract ideal, Dr. Gol substitutes a definition that questions joy, promoting a concept of health that addresses not the body as a re/productive workforce, but rather the body as a subject capable of experiencing joy in leisure, sexuality, relationships, and emotions. Perhaps this subject no longer exists today, or it is time to return to thinking health from the perspective of bodies with more complex needs than a "smooth glass."

Dear Pulp, ultimately with this research our attempt is to highlight how a re/productive body is not necessarily healthy and how an unproductive body is not necessarily sick.

We send the collected samples for Your investigations on the question mentioned above and cordially invite the PULP community to research these issues further.

With great care,
Your humble kin,
#Obot

16
Joan Senent-Josa, "El X congreso de médicos y biólogos de lengua catalana," *Gestión del Repositorio Documental de la Universidad de Salamanca* (1976).

LENKA VESELÁ
an art-based researcher, lecturer, organizer, and feminist thinker advocating for inclusive forms of transdisciplinary knowledge production

● **Brno, Czech Republic**

KEEPING TRACK OF ENDOCRINE DISRUPTION

How do we keep track of endocrine disruption?

How and with what effects is exposure to endocrine disrupting chemicals made (in)visible?

How do we orient ourselves in the labyrinth of indirect evidence, unreliable facts, inconclusive research results, manufactured doubt, and normative assumptions?

How can we conceive of endocrine disruption without resorting to the ableism, heterosexism, and transphobia embedded in the normative imaginary of a toxin-free futurity?

How do we navigate the territories of the unknown and uncertain indicating harms but—possibly—also potentials of becoming with hormone-disrupting chemicals?

Developmental and lifetime exposure to endocrine disrupting chemicals via environmental pathways increases susceptibility to a wide range of pathologies in humans and animals. Effects on neurodevelopment and brain function, and thus also thoughts, feelings, and motivations, are among the adverse outcomes linked to exposure to chemical endocrine disruptors. Notwithstanding these factors, disrupted emotions are not commonly examined in connection to endocrine disruption. With the assistance of the Endocrine Disruption Tracker Tool—a speculative instrument utilizing disrupted emotions as an index of endocrine disruption—this contribution examines what we can learn about endocrine disruption if we consider how our emotions are affected. What are the critical and political potentials of thinking with and acting upon our emotions caused and modulated by involuntary chemical exposure?

Keeping Track of Endocrine Disruption

INTRODUCTION: BECOMING WITH ENDOCRINE DISRUPTING CHEMICALS

Among the hundreds of thousands of synthetic chemicals in existence, approximately 800 are either suspected or known to possess endocrine disrupting properties. Endocrine disruptors are industrially manufactured chemicals capable of mimicking or interfering with the way the body's hormones work. Similar to physiologically produced hormones, chemical endocrine disruptors act as "chemical messengers" circulating through the bloodstream and informing the functions of organs and tissues. As hormone-disrupting chemicals able to "hack" the chemical information network of the body become ubiquitous in the environment, concerns have emerged regarding the extent to which humans are exposed to and affected by them. How dire a predicament have we reached? How do we keep track of endocrine disruption?

According to the *State of the Science of Endocrine Disrupting Chemicals,* a landmark review of the science of endocrine disrupting chemical agents released by the World Health Organization (WHO) and United Nations Environment Programme (UNEP), the true extent of the exposure and consequences of chemical endocrine disruptors is yet to be fully understood.[1] The report summarizes research findings evidencing that endocrine disrupting chemicals are causally implicated in adverse health outcomes in humans and wildlife, while also raising concern about the incompleteness of knowledge about the endocrine activity of environmentally ubiquitous chemicals:

> "Because only a small fraction of the hundreds of thousands of synthetic chemicals in existence have been assessed for endocrine disrupting activity, and because many chemicals in consumer products are not identified by the manufacturer, we have only looked at the tip of the iceberg."[2]

Despite the proliferation of research on endocrine disrupting chemicals, significant uncertainties remain about the true extent of risks posed to human health and wildlife. Endocrine-related diseases and disorders are on the rise,

1
Åke Bergman, Jerrold J. Heindel, Susan Jobling, Karen A. Kidd, and R. Thomas Zoeller, eds., *State of the Science of Endocrine Disrupting Chemicals 2012: Summary for Decision-Makers* (United Nations Environment Programme and World Health Organization, 2013).

2
Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012,* 18.

including hormone-sensitive cancers, lower sperm counts, infertility, endometriosis, early puberty, autoimmune diseases, diabetes, obesity, osteoporosis, cardiovascular problems, growth disorders, and neurological and learning disabilities, but is it plausible and scientifically demonstrable that chemical endocrine disruptors are among the causes? Endocrine-related effects have been observed in wildlife populations in highly contaminated environments, but what do these observed changes in wildlife development and physiological functions tell us about the consequences for the human populations suffering chronic exposure to endocrine disrupting chemicals? Numerous laboratory studies have identified adverse outcomes of chemicals with endocrine disrupting properties, but how do findings focused on the selected effects of single chemicals under laboratory conditions bear upon real life conditions of humans and nonhuman organisms exposed to complex chemical mixtures on a daily basis throughout life?[3]

"How many endocrine disrupting chemicals are there? Where do they come from? What are the human and wildlife exposures? What are their effects individually and in mixtures during development and adulthood and even across generations? What are their mechanisms of action?"[4]—these are some of the questions outlined in the WHO-UNEP report that demand urgent answers. Unfortunately, given the invisibility, penetrability, mobility, and complex interactivity of endocrine disrupting chemicals, many of these concerns remain largely unanswered. Studying chemical endocrine disruptors necessitates the examination of a plurality of interactive factors, including the net effects of complex chemical mixtures; tissue-specific responses; critical windows of exposure across lifespan; the intricate problematics of epigenetic effects, which alter susceptibility to diseases intra- and inter-generationally; and, anomalous dose-response relationships rendering even low-concentration exposure harmful. In sum, endocrine disruption is a complex, multilayered process, posing momentous challenges, not least for the gathering of scientific evidence.

The absence of irrefutable evidence makes chemical regulation both erratic and contestable. National and international legislative frameworks for the regulation of chemicals aim to ensure a high level of protection of human health and the environment. Such frameworks are developed and managed by national laws, national and international regulatory agencies, and international initiatives, agreements, and conventions. By defining policy elements, such as exposure or emission limits, and overseeing their enforcement, chemical regulators are just as influential as scientists, if not more so, in determining how the public perceives chemical pollution and its effects on the environment and human health. Under existing neoliberal governance systems, however, their regulatory decisions tend to be lax and industry-friendly, facilitating investments and economic growth rather than protecting public health and the environment. More often than not, controversies over the banning of chemical agents in industrial production are based on a utilitarian calculus of potential benefits and harms that exaggerate social and economic benefits of toxic chemicals while downplaying suspected or known costs to health of humans, nonhuman organisms, and the environment. Environmental justice researchers Reena Shadaan and Michelle Murphy refer to governance systems that justify the continued production of known toxins and "acceptable" risks to health as "permission-to-pollute regulatory systems" and point out their link to structures of settler colonialism and racial capitalism.[5] Shadaan and Murphy dispute conceptualizations of endocrine disrupting chemicals that frame them as an issue of consumer products and plastic packaging and characterize their effects in terms of individual bodily damage and argue for strengthening decolonial feminist frameworks for understanding endocrine disruption. Such move demands suspending damage-cantered research—bringing our attention from the brokenness and suffering of the victims of pollution to the perpetrators of violence who must be made accountable for their action.[6] Shadaan and Murphy also make a compelling case for investigating the infrastructures of settler colonialism and racial capitalism associated with oil extraction and refining, industrial emissions to air, and releases of water pollutants. Building on their argument, this essay contributes a systemic analysis of the interactions, power relations, and modes of governance that structure and sustain chemical violence. How are the flows of man-made chemicals managed and to what effects? What relations can we observe and analyze with regard to their production, application, and disposal?

Industry-friendly regulatory policies are predicated upon systemic asymmetries that make it easy for the financial beneficiaries of chemical manufacturing to obscure, externalize, or buy their way out of their wrongdoings, while making it difficult for those on the receiving end to demand more stringent regulations or direct compensation. Pre-existing structural inequalities are exacerbated when the burden of proof is placed on the victims of pollution rather than the perpetrator. Moreover, it is difficult to hold chemical companies accountable when only the high probability—rather than reasonable possibility—of adverse health

3
For methodological limitations in studying endocrine disrupting chemicals in human populations, see Duk-Hee Lee and David R. Jacobs, "Firm Human Evidence on Harms of Endocrine-Disrupting Chemicals Was Unlikely to Be Obtainable for Methodological Reasons," *Journal of Clinical Epidemiology* 107 (2018): 107–15.

4
Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012,* 18.

5
Reena Shadaan and Michelle Murphy, "Endocrine-Disrupting Chemicals (EDCs) as Industrial and Settler Colonial Structures: Towards a Decolonial Feminist Approach," *Catalyst: Feminism, Theory, Technoscience* 6.1 (Spring 2020): 1–36.

6
Indigenous studies scholar Eve Tuck uses the term "damage--centered research" to refer to research that documents people's pain, brokenness, and suffering to hold those in power accountable for the oppression they have perpetrated. According to Tuck, the possible gains of research that describes people, communities, or environments as "toxic," "polluted," or "damaged" do not warrant the cost of thinking about ourselves or others in reference to these terms. Tuck urges communities, researchers, and educators to reconsider how research is framed and conducted and to rethink how research findings could be used by, for, and with communities. See Eve Tuck, "Suspending Damage:

outcomes warrants regulatory action, and when the evidence bar is raised impossibly high relative to applicable scientific methodologies. As the immensely profitable chemical industry increasingly encroaches upon the territory of scientific research, chemical industry executives not only exploit but actively manufacture dubiety by hiring reputable experts to publicly contest the findings of independent researchers.[7] Since current legislation requires substantial evidence for the banning or restriction of chemicals suspected of causing harm, manufactured skepticism pays off as a strategy; chemical companies succeed at querying the evidential basis of the health hazards and ultimately manage to keep their products on the market.[8]

Following the uncertainty about the true extent of chemical damage, reinforced by industry sponsored campaigns of denial and doubt, members of the pubic are encouraged to take preventive and protective action. Sociologist Norah MacKendrick introduced the term "precautionary consumption" to describe the practice of reducing exposures to chemicals found in everyday consumer products by making responsible and informed consumer choices.[9] Precautionary consumption, MacKendrick shows, shifts the responsibility for reducing toxic burdens from manufacturers and distributors of toxic products to individuals, especially the child-bearers and caretakers of young children. Individualized tactics invoking consumer caution called for by neoliberal governance fail to the extent that the presence of chemicals is not limited to consumer products but also encompasses industrial processes. Even more crucially, chemicals cannot be contained but infiltrate the environment. Ubiquitous endocrine disruptors include Bisphenol A (BPA) in plastic bottles, food containers, and the liners of metal food cans; phthalates and parabens in cosmetics; detergents in household cleaners; and flame retardants in furniture and electronics. Besides their ubiquity in everyday consumer products, endocrine disrupting chemicals prevalently occur in a wide range of industrial processes, including polychlorinated biphenyls used as industrial lubricants and coolants; chemicals discharged during oil and gas extraction by hydraulic fracturing technologies; and pesticides for protecting crops from weeds, insects, rodents, and fungi. Additionally, industrial wastewaters and livestock waste are major sources of endocrine disruptors. Once released from their multiple outlets, endocrine disrupting chemicals circulate through the ground, water, and air, eventually diffusing throughout the entire environment. While disadvantaged workers suffer the consequences of occupational exposure, and communities built in areas around chemical production

A Letter to Communities," *Harvard Educational Review* 79.3 (2009): 409–28.

7
See Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2011). In the context of the science of endocrine disruption, the issue is addressed in Åke Bergman et al., "Manufacturing Doubt About Endocrine Disrupter Science—A Rebuttal of Industry-Sponsored Critical Comments on the UNEP/WHO Report 'State of the Science of Endocrine Disrupting Chemicals 2012,'" *Regulatory Toxicology and Pharmacology* 73.1 (December 2015): 1007–17.

8
This was the case when Syngenta, the producer of the common herbicide atrazine, managed to keep it on the US market by successfully challenging the evidence of the health hazard it poses, even though it had been banned in other parts of the world. In 2016, the US Environmental Protection Agency found reproductive risks to wildlife and, in 2018, concluded that combined exposure to atrazine from its different sources poses developmental risks to children but reapproved it for use in lowered amounts in 2020. See Britt E. Erickson, "US EPA Reapproves Atrazine: Agency Allows Continued Use of Common Herbicide with New Requirements," *Chemical & Engineering News* (21 September 2020), cen.acs.org/environment/pesticides/US-EPA-reapproves-atrazine/98/web/2020/09.

9
Norah MacKendrick, *Better Safe Than Sorry: How Consumers Navigate Exposure to Everyday Toxics* (Oakland: University of California Press, 2018).

10
Giovanna Di Chiro, "Polluted Politics? Confronting Toxic Discourse, Sex Panic, and Eco-Normativity," in *Queer Ecologies: Sex, Nature, Politics, Desire,* eds. Catriona Mortimer-Sandilands and Bruce Erickson (Bloomington: Indiana University Press, 2010), 199–230.

and dumping sites are disproportionately affected, a truly effective wider prevention of exposure is infeasible—not even by the expensive and onerous practices of shielding, filtering, and distancing elaborated by MacKendrick.

In contrast to the neoliberal prescription for individuals to maintain control by avoiding chemicals through consumer choices, environmental activists demand structural changes and responsibility on the part of those accountable. International environmental organizations, such as Greenpeace, World Wildlife Fund, Sierra Club, and Friends of the Earth, as well as other NGOs and community groups, campaign for a toxic-free future where hazardous chemicals are no longer produced, used, and dumped into the environment. Environmental activists insist that chemical industry manufacturers and regulators must be held accountable for the multifarious impact of toxic chemicals, especially on immediately affected communities, and that decisive steps must be taken to achieve a global toxic-free environment. However, the agenda of a zero-pollution and toxicity-free future for all that is utilized to promote the ban of toxic chemicals and the transition to what are considered safe and sustainable alternatives is underpinned by problematic assumptions. Fantasies about a clean, chemical-free body, environment, and future foster anxieties about impurity, contamination, and pollution and are prone to what environmental justice researcher Giovanna Di Chiro terms "eco-normativity," that is, often ableist and normative ideas harnessed by environmental discourse to conceptualize chemical exposure and its effects.[10]

This uncritical rhetoric—labelling bodies as "impure," "unhealthy," or "unnatural"—becomes increasingly problematic in the context of endocrine disrupting chemicals and their effects on sexual and reproductive development and functions. Eco-normativity becomes eco-heterosexism once queer bodies and behaviors are put forth as the main evidentiary focus of documenting harms. When studies concerned with effects of endocrine disrupting chemicals on sexual and reproductive systems published in acclaimed scientific journals use normative expressions and catchphrases such as "chemical castration" and "gender-bending chemicals," or describe animal physiology and behaviors as "feminized," "homosexual," or "transgender," they make chemical harms visible in ways that promote heterosexist and transphobic views.

So, how do we keep track of endocrine disruption and orient ourselves in the labyrinth of indirect evidence, unreliable facts, inconclusive research results, manufactured

doubt, and normative assumptions? How do we conceive of endocrine disruption without resorting to the ableism, heterosexism, and transphobia embedded in the normative imaginary of a toxin-free futurity? How do we identify and study endocrine disrupting chemicals in ways that facilitate caring relations and allow us to envision and enact hopeful futures with and despite them? How do we navigate the territories of the unknown and uncertain indicating harms but—possibly—also potentials of becoming with hormone-mimicking chemicals?

The representation of chemical violence is key to effective resistance against it, but how it is represented is also significant because the ways in which chemical harms are made visible can become a source of violence in their own right. Some queer ecological researchers have developed an alternative vocabulary to conceptualize chemical exposure—with care and in a hopeful manner, yet critically and without glossing over the ongoing violence owing to the profitable chemicals being produced, used, and dumped into the environment.[11] Artists, activists, and scholars adopting a queer ecological approach not only point out the bio-social nature of endocrine-related toxicity, critiquing the heterosexist articulations of sexuality and nature predicated on socially constructed binaries of the "natural" and "cultural," "pure" and "polluted," or "healthy" and "damaged," but also offer feasible alternatives to the discourse and practices grounded in static, essentialist, and normative understandings of bodies, sexualities, and environments. Rather than addressing environmental chemicals with "concern" (about "purity" and "health"), the queer ecological approach conceives of them through the notions of indeterminacy, becoming, and care—looking for, experimenting with, and inventing ways forward that facilitate caring relations and allow us to live well with these chemicals in spite of their potential for harm. My proposal for attending to how endocrine disrupting chemicals affect our emotions is inspired and informed by these experimental, affective, and caring engagements (both scholarly and artistic) that a queer ecological thinking and sensibility have helped give rise to.

11
See, for example, Malin Ah-King and Eva Hayward, "Toxic Sexes: Perverting Pollution and Queering Hormone Disruption," *O-Zone: A Journal of Object-Oriented Studies* 1 (2013): 2–12; Lynda Birke, "Sitting on the Fence: Biology, Feminism and Gender-Bending Environments," *Women's Studies International Forum* 23.5 (2000): 587–99; Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham: Duke University Press, 2012); Heather Davis, "Toxic Progeny: The Plastisphere and Other Queer Futures," *PhiloSOPHIA* 5.2 (2015): 231–50; Giovanna Di Chiro, "Polluted politics?"; Eva Hayward, "Transxenoestrogenesis," *Transgender Studies Quarterly* 1.1–2 (2014): 255–58; Bailey Kier, "Interdependent Ecological Transsex: Notes on Re/production, 'Transgender' Fish, and the Management of Populations, Species, and Resources," *Women & Performance: A Journal of Feminist Theory* 20.3 (2010): 299–319; Robyn Lee and Roxanne Mykitiuk "Surviving Difference: Endocrine-Disrupting Chemicals, Intergenerational Justice and the Future of Human Reproduction," *Feminist Theory* 19.2 (2018): 205–21; Logan Natalie O'Laughlin, "Interrogating Ecofeminisms: Reading Endocrine Disruptor Panics as Assemblages," *Green Theory and Praxis* 9.6 (2016): 25–38; Logan Natalie O'Laughlin, "Troubling Figures: Endocrine Disruptors, Intersex Frogs, and the Logics of Environmental Science," *Catalyst: Feminism, Theory, Technoscience* 6.1 (2020): 1–28; Serpil Oppermann, "Toxic Bodies and Alien Agencies: Ecocritical Perspectives on Ecological Others," in *The Postcolonial World,* eds. Jyotsna G. Singh and David D. Kim (London: Routledge, 2016), 432–44; Anne Pollock, "Queering Endocrine Disruption," in *Object-Oriented Feminism,* ed. Katherine Behar (Minneapolis: University of Minnesota Press, 2016), 183–99; Dayna Nadine Scott, "'Gender-Benders': Sex and Law in the Constitution of Polluted Bodies," *Feminist Legal Studies* 17.3 (2009): 241–65, link.springer.com/article/10.1007/s10691009-9127-4; and, Alexis Shotwell, *Against Purity: Living Ethically in Compromised Times* (Minneapolis: University of Minnesota Press, 2016).

12
See Figs. 01–03.

INTERVENTION: ENDOCRINE DISRUPTION TRACKER TOOL

The Endocrine Disruption Tracker Tool (EDTT) is a speculative instrument utilizing disrupted emotions as an index of endocrine disruption.[12]

Developmental and lifetime exposure to endocrine disrupting chemicals via environmental pathways increases susceptibility to a wide range of pathologies in humans and animals. Effects on neurodevelopment and brain function, and thus also thoughts, feelings, and motivations, are among the adverse outcomes linked to exposure to chemical endocrine disruptors. Notwithstanding these factors, disrupted emotions are not commonly examined in connection to endocrine disruption. So why does EDTT seek to identify the presence of endocrine disrupting chemicals by focusing on their effects on our emotions? What can we learn about endocrine disruption if we consider how our emotions are affected?

Whereas the impact on emotions is overlooked in the research on endocrine disruption, examination of emotional symptoms takes center stage in considering the effects of endogenous (physiologically produced) hormones. Fluctuation of these hormones during puberty, pregnancy, menopause, and over the course of menstrual cycle has long been associated with cognitive, emotional, and sensory changes, with symptoms such as anxiety, irritability, mood swings, difficulty to concentrate, fatigue, lethargy, insomnia, social withdrawal, depressed mood, feeling overwhelmed and out of control, or paranoia attributed to hormonal changes in female (and to a much lesser extent male) bodies. Adverse influences on emotions and cognitive and sensory capacities have also been associated with uses of hormonal medicines and listed as common side effects of hormonal contraception, hormone replacement therapy, or fertility-stimulating treatments and assisted reproductive technologies that make use of synthetic hormones. To the extent that endocrine disrupting chemicals increasingly enter and co-constitute our bodies, they are also part of the hormonal make up shaping our cognitive performance, emotional well-being, and subjective experience.

Premenstrual syndrome and premenstrual dysphoric disorder are medical conditions caused by changes in hormonal levels in the second half of the menstrual cycle and the first few days of menstruation leading to a range of physical and emotional symptoms, with the emotional symptoms resulting in greater impairment than the purely physical changes. EDTT is modelled on a tool for diagnosing these

conditions that cannot currently be detected via a blood or saliva test. A Premenstrual Symptom Tracker is a self-tracking tool comprising a set of symptoms whose severity is monitored over the course of the menstrual cycle. EDTT is adapted from the 2021 variant of a Premenstrual Symptom Tracker, developed by the International Association for Premenstrual Disorders, which is based on Jean Endicott's and Wilma Harrison's version of this tool.[13] EDTT uses the same set of ten emotional symptoms, while leaving out the eleventh symptom (the only physical symptom on the list).[14] Significantly, EDTT adapts the design by expanding the functional range to cover emotional symptoms caused by the production and interplay of both hormones and hormone-disrupting chemicals.

EDTT invites participants to complete a ten-day review by examining the list of emotional symptoms and paying attention to emotions both as experienced in person and as shared with or observed in others.[15] Participants are asked to describe the emotional symptom and the situation in which they experienced it, as well as to reflect on how it impacted their daily life and well-being. Additionally, they are encouraged to think about the possible influence of exposure to chemical disrupting chemicals on the onset of the emotion and the degree to which it was felt.

Is it possible to identify when chemical endocrine disruptors are involved, rather than just physiologically produced hormones? How can we distinguish the influence of chemical endocrine disruptors from the action of physiological hormones and other hormonally active agents, such as self-administered synthetic hormones and medication, or naturally occurring phytohormones absorbed from one's diet? How can we distinguish their influence from multiple other non-hormonal influences (biochemical and social) that also affect our emotional make up? The answer is that we cannot do so with a high degree of confidence. Environmentally ubiquitous endocrine disrupting chemicals penetrate our bodies and interfere with the normal function of the endocrine system to a degree unbeknownst to ourselves. Accordingly, it is not possible to determine the precise extent to which chemical endocrine disruptors affect our emotions. Given their ubiquity, endocrine disrupting chemicals are likely, even certain, to influence our emotions; yet how extensive this influence is and whether it is always detrimental—resulting in emotions considered "negative," "unpleasant," or "unhappy"—cannot be determined.

It follows that EDTT cannot provide conclusive answers about the state of endocrine disruption. Rather, EDTT is designed to raise awareness of how closely interwoven we have become with planetary-wide infrastructures of man-made chemicals. Locating the effects of endocrine disruption in our anxiety, sadness, sleeplessness, irritability, and inability to concentrate foregrounds our shared—albeit unevenly—fragility and vulnerability vis-à-vis the chemical transformation of the planet. Reflecting upon the mobility and interactivity of chemical endocrine disruptors, and the porosity of the body as it absorbs and excretes them, unsettles the atomistic conception of humans as bounded individuals, who are divorced from the broader collectivity of non-human life in a shared environment. Contemplating, reflecting upon, and experiencing the far-reaching effects of endocrine disrupting chemicals on our emotions enable us to address endocrine disruption from a situated point of view, in highly subjective and deeply personal ways. Emotionally charged and personally engaged perspectives on endocrine disruption open space for cross-species solidarities and action rooted in interconnectedness, interdependency, and mutual becoming in an ever-changing yet diminishing world.

Inasmuch as the EDTT mimics the format of a medical brochure, it also disrupts a common narrative these brochures convey. EDDT neither provides an individual diagnosis and prognosis, nor it offers a solution in a form of an individualized preventive or therapeutical intervention. If it offers a solution, it is a political one—an affective politics for anti-toxic action fostering and exercising solidarities to oppose the non-consensual chronic exposure to environmentally ubiquitous endocrine disrupting chemicals—collectively and affectively.

PROPOSITION: AFFECTIVE POLITICS FOR THE CHEMICAL ANTHROPOCENE

The term "Anthropocene" originates in geology, but has gained wider currency in the social sciences, humanities, and the arts, while also capturing the popular imagination and gaining media attention—acting as shorthand for a deterioration of living conditions on Earth owing to anthropogenic activity. Although it now serves as a framework for coming to terms with a variety of temporally extended and vastly distributed anthropogenic disruptions, the common representations of the Anthropocene observe its original geological reference and foreground the impacts of mass extraction and consumption of fossil fuels. Ecocultural researcher Stacy Alaimo critically examines the ways in which prevalent depictions of the Anthropocene exaggerate the significance of geology as a determining

13
*Premenstrual Symptom Tracker (*International Association for Premenstrual Disorders, 2021), iapmd.org/symptom-tracker.

14
For a comparison, see Figs. 04–05.

15
See Fig. 05.

factor at the expense of disruptions to biological processes and human and non-human life. "The geological origins of the term 'Anthropocene' have spawned stark terrestrial figurations of man and rock in which other lifeforms and biological processes are strangely absent,"[16] writes Alaimo, noting that "the focus on geology, rather than, say, chemistry or biology may segregate the human from the anthropogenic alterations of the planet, by focusing on an externalized and inhuman sense of materiality."[17] Responding to her observation, we may consider the notion of the Chemical Anthropocene. What kind of Anthropocene emerges if we shift our focus to the hidden, slow-moving, and emerging realities of chemicalized life? What might be the critical and political potentials of thinking and feeling the Anthropocene with far-reaching effects of anthropogenic chemicals?

The Chemical Anthropocene designates an epoch in which every corner of the planet and every part of the body are exposed to, and affected by, industrially manufactured chemicals. It marks an era of absolute and permanent exposure where nothing is safe or pure, and the only way forward is with and despite toxic anthropogenic chemicals. The Chemical Anthropocene thus calls for effective forms of resistance, not merely in demanding the accountable production, use, and disposal of chemicals but also in cultivating forms of resilience attuned to the experience and needs of a life already altered by exposure to man-made chemicals.

In their introduction to *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environments and Epistemologies*,[18] co-editors Heather Davis and Etienne Turpin argue that the Anthropocene is primarily an aesthetic phenomenon. The Anthropocene as a "sensorial phenomenon," or an "aesthetic event," reorganizes our sensorial and perceptive systems around our projections of the environmental collapse and thus impacts our capacity to grasp the world we are living in. When Davis and Turpin claim that the Anthropocene has emerged as an aesthetic device framing our experience of the world, they invoke the original Greek meaning of the word αἰσθητικός [aisthetikos] as pertaining to the sense of perception—the ability to perceive through the senses. Given that endocrine disrupting chemicals affect brain chemistry and implicitly our thoughts and feelings, their argument takes on a literal and material interpretation. Through the material effects of anthropogenic chemicals, the very physiology of our perception, cognition, and emotions—the ways in which we encounter and interpret the world around us—is being reassembled.

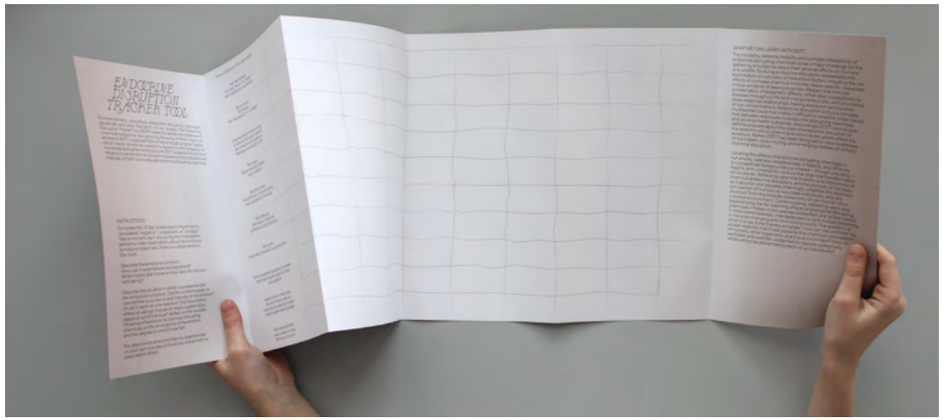
Attending to endocrine disrupting chemicals as they interfere with our emotions can help us address the exigencies of our chemically altered lives and construct responsive care relations. Thinking with, and acting upon, the anger, irritability, anxiety, or depression caused and modulated by involuntary chemical exposure paves the way for an embodied, experientially and materially grounded politics of anti-toxic action. Affective politics for the Chemical Anthropocene takes its point of departure in acknowledging endocrine disruption as expressing and reflecting conditions of life on Earth in the Anthropocene. It is a platform for a politics that attends to our emotions as affected by endocrine disrupting chemicals, recognizing them as a matter of collective concern: caring for and affirming them, while also seizing and mobilizing them, for action. When experienced and expressed collectively and publicly, our anger, frustration, and sadness can motivate and energize action opposing the violence that systematically impairs life in all its forms. "Pollution is colonialism," claims plastic pollution researcher Max Liboiron.[19] To build on this basic idea is to stand up to regimes of extraction and exploitation and decolonize our chemical relations. The collective practice of *getting angry with endocrine disrupting chemicals* gives initial bearings to such a project.

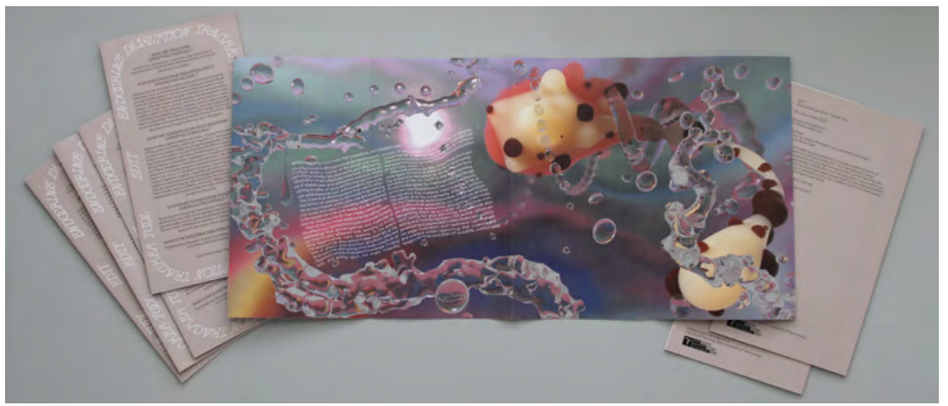
16
Stacy Alaimo, *Exposed: Environmental Politics and Pleasures in Posthuman Times* (Minneapolis and London: University of Minnesota Press, 2016), 143.

17
Alaimo, *Exposed,* 148.

18
Heather Davis and Etienne Turpin, eds., *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environments and Epistemologies* (London: Open Humanities Press, 2015), 3–29.

19
Max Liboiron, *Pollution is Colonialism* (Durham: Duke University Press, 2021).





(Figs. 01–03)
Lenka Veselá, *Endocrine Disruption Tracker Tool* (Brno: Faculty of Fine Arts, Brno University of Technology, 2022).

PREMENSTRUAL SYMPTOM TRACKER
(DAILY RECORD OF SEVERITY OF PROBLEMS)

Name:

Month:

INSTRUCTIONS

Print off as many copies as you need to complete a **full two months** worth of tracking. Begin tracking your premenstrual symptoms with this chart today. Fill it out **daily** (preferably at the end of your day). Two full months of menstrual cycle charting will allow for a more accurate assessment.

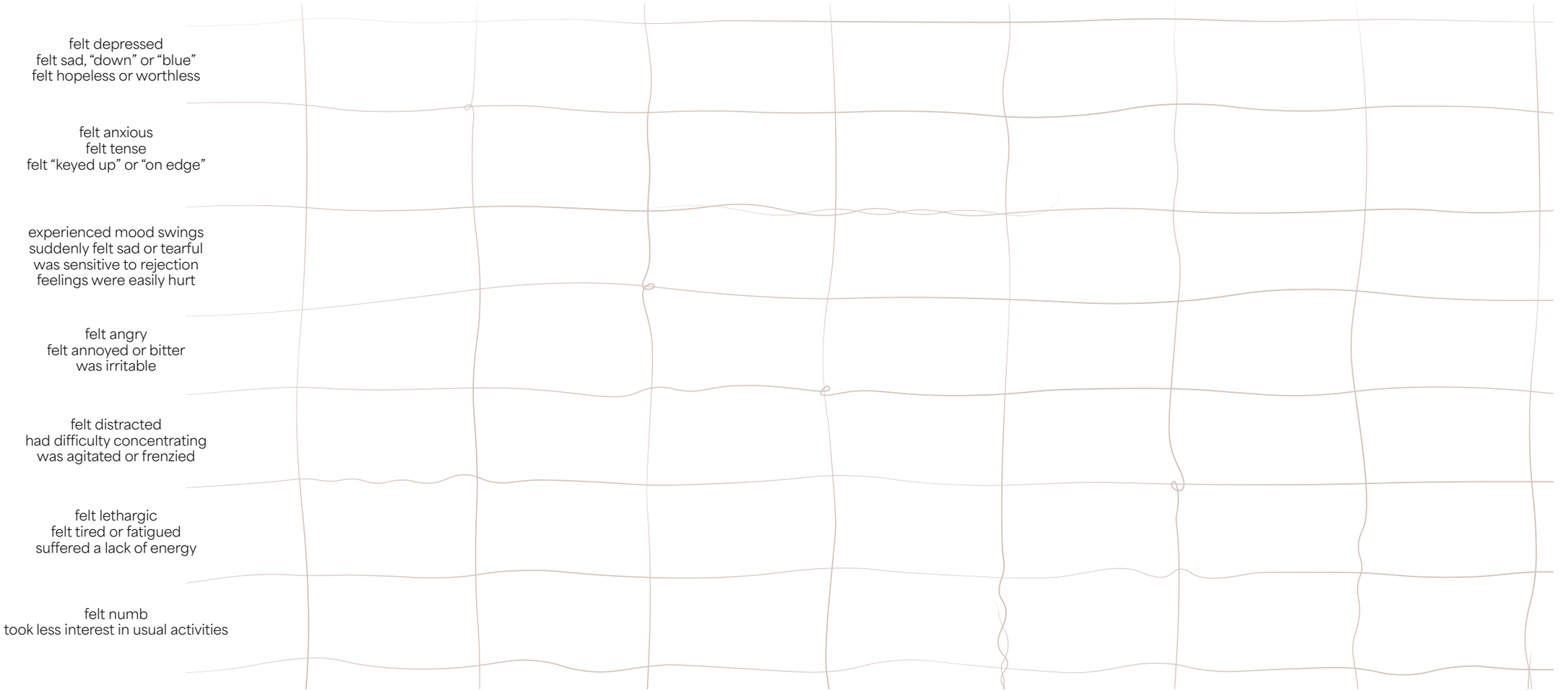
Each evening note the degree to which you experienced each of the problems listed below. Put an "x" in the box which corresponds to the severity:
1 - not at all **2 - minimal** 3 - mild **4 - moderate** 5 - severe **6 - extreme**

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Enter day of the week (e.g. Monday = 'M')																															
	Note any spotting by entering 'S'																															
	Note menstrual bleeding by entering 'M'																															
	Date (i.e. 1 = 1st of the month)																															
SYMPTOMS	1. Felt depressed, sad, "down,", or "blue" or felt hopeless; or felt worthless or guilty	6 5 4 3 2 1																														
	2. Felt anxious, tense, "keyed up" or "on edge"	6 5 4 3 2 1																														
	3. Had mood swings (i.e., suddenly feeling sad or tearful) or was sensitive to rejection or feelings were easily hurt	6 5 4 3 2 1																														
	4. Felt angry, or irritable	6 5 4 3 2 1																														
	5. Had less interest in usual activities (work, school, friends, hobbies)	6 5 4 3 2 1																														
	6. Had difficulty concentrating	6 5 4 3 2 1																														
	7. Felt lethargic, tired, or fatigued; or had lack of energy	6 5 4 3 2 1																														
	8. Had increased appetite or overate; or had cravings for specific foods	6 5 4 3 2 1																														
	9. Slept more, took naps, found it hard to get up when intended; or had trouble getting to sleep or staying asleep	6 5 4 3 2 1																														
	10. Felt overwhelmed or unable to cope; or felt out of control	6 5 4 3 2 1																														
	11. Had breast tenderness, breast swelling, bloated sensation, weight gain, headache, joint or muscle pain, or other physical symptoms	6 5 4 3 2 1																														
IMPACT	At work, school, home, or in daily routine, at least one of the problems noted above caused reduction of production of efficiency	6 5 4 3 2 1																														
	At least one of the problems noted above caused avoidance of or less participation in hobbies or social activities	6 5 4 3 2 1																														
	At least one of the problems noted above interfered with relationships with others	6 5 4 3 2 1																														

iapmd.org/steps-to-diagnosis for more information on gaining a PMD diagnosis

Adapted from Jean Endicott, Ph.D. and Wilma Harrison, M.D, version

(Fig. 04)
Premenstrual Symptom Tracker (International Association for Premenstrual Disorders, 2021), iapmd.org/symptom-tracker.



(Fig. 05)
Veselá, *Endocrine Disruption Tracker Tool.*

MARY MAGGIC
an artist and researcher working at the intersection of hormones, body and gender politics, and ecological alienations

● **Vienna, Austria and Los Angeles, USA**

TO STAND IN THE FIRE AND FEAR

What does it mean to find belonging in the molecular semiosphere?

How do current regimes of truth and purity act antagonistically toward this form of collectivization?

How can performative approaches towards biohacking open up new subjectivities for living in a toxic world that go beyond prescribed notions of normal and natural?

Through years of research through public workshopologies on the project *Open Source Estrogen*, biohacking methodologies have proven to serve far more than spreading didactic knowledge. These protocols that produce an existential knowing in our bodies and environments inevitably lead to a form of collective worlding and knowledging, strategies that may help us find a way out of ecological ruin. Combining biohacking with performative methods in a new dramaturgical workshop, "Performing the Sublime Sea of Co-Mattering," participants embody the very agency of toxic molecules and their ongoing process of worlding, emerging on the other side with a radical breakage from the past.

To Stand in the Fire and Fear

PART ONE:
An Existential Knowing

In the summer of 2015, during the Ars Bioarctica Residency in Kilpisjarvi Biological Station in the subarctic regions of Finland, I had the pleasure of meeting Canadian artist and professor, Byron Rich, who talked about the possibility of creating an open source recipe for the birth control pill. While this was a purely speculative conversation about extracting cholesterol from chicken eggs and chemically converting this pre-starter into its final estrogenic form, it opened my eyes to a disruptive potential of biohacking that exceeded its techno-utopian narratives in US mainstream media. I became aware of a kind of potential that re-established relationships between molecules and bodies. For the next two years or so, Byron and I, along with Hackteria members Špela Petrič and Transhackfeminists Paula Pin and Gaia Leandra among many others, collaborated on the recipes of *Open Source Estrogen*, which aimed at developing protocols for hacking hormonal molecules through detection and extraction, first as a scientific contestation against the institutional gatekeeping of knowledge and basic healthcare, then later as a collective strategy for revealing the bio-political presence of these molecules as capitalist industrial toxicities.

When we disseminated *Open Source Estrogen* and its "freak-science" iteration *Estrofem! Lab* in the form of public participatory workshops, we initially took a very didactic approach. Using mobile laboratories outfitted into suitcases, we performed workshops for transgenic yeast bio-sensing, solid phase extraction with peristaltic pumps, and column chromatography with urinary hormones. Unsurprisingly, our protocols held a very practical, almost utilitarian promise for our participants who all wanted to increase their endocrino-logical knowledge. But what struck me most incisively in these workshops was the elephant in the room, the stone left unturned—the unaddressed emotional affect of the participants. What sense do you get when you realize for the first time in your life how irreversibly contaminated the planet is, how every moment since you first gestated in your mother's womb your body has been silently queering? What if you were someone who spent their whole life in the comfort of heteronormative existence only to find out that heteronormativity never existed in the first place? Most reactions I've received are panic, fear, and the dystopic feeling that one's body has been stolen. I knew there was another battlefield ahead, one that dealt with the molecular traumas of an emotional and immaterial kind.

Anyone who has performed any type of biohacking, whether it is fermenting in the kitchen, tending to a garden, or co-existing with a non-human in a shared space, will know that biohacking eventually moves from the utilitarian into the subjective like the inevitable force of marbles gliding off an inclined surface. This is simply because hacking the black box of the material eventually leads to the hacking of its symbolic representations. When we hack hormonal molecules, we equally hack their codified definitions of masculinity, femininity, and reproductive futurism, no matter how socially entrenched they are. So, if biohacking remains in the purely utilitarian and techno-utopian realm, this disruptive practice would be falling short of its true potential. Media scholar Maria Rogg describes existential ways of knowing as a cultivation of knowledge that comes with the immeasurable lived experiences of embodiment, relationality and vulnerability. From experiential ways of learning and being together, biohacking must be framed as a socio-material practice of knowledging, one that activates through accidents and mishaps, co-generative play and jamming, public amateurism, and collective world-making. It is in this space of radical unknowingness that old ideas can be extinguished in service of new subjectivities to be generated.

Through years of researching *Open Source Estrogen*, the contestational ground on which the project performs its resistance has evolved, like peeling back layers of a fruit to get to the core essence of its flavor. It started first in experimenting with the ways an artist can gain access to scientific spaces and resources and confronting the institutional barriers along the way. *First layer gone*. Then came the ways an artist could open up critical spaces of knowledge production for the public engagement and performance of science. *Second layer gone*. Then came the protocols themselves and what new discoveries emerge once we reveal the molecules that were previously invisible to us. *Third layer gone*. Finally, we come to the critical threshold: what do we do now, knowing that these scandalous levels of estrogen are in the water supply? Or now that what we find in our bodies is actually an unruly composition of both natural and synthetic compounds? After this existential knowing is produced in these biohacking workshops, what are the next strategies that allow us to live, cope, and care in this permanently polluted world? How must these strategies extend beyond the scientific and the technical, and involve the work of ideologically, philosophically, and spiritually purging what no longer serves the public imaginary? What if the real work of biohacking was showing others how to stand directly in the fire and fear and say, “I’m here.”

1
Maria Rogg, “Biohacks of Biometric Existence,” paper presented at the 11th EFRC conference Social Change in a Feminist Perspective: Situating Gender Research in Times of Political Contention, Milano, 15–18 June 2022.

PART TWO:
Alien Tendencies I Wish to No Longer Hide

Whatever it is we discover collectively in these hormone hacking workshops, one truth always remains: our bodies and our environments are much more alien than we suspected. The micro-plastics in our urine, breastmilk, and rivers, the occurrence of intersex frogs and fish, the decreasing distance between the anus and genitals, and all the mainstream stories of reproductive disruption and threats to species propagation are evidence of our malleable bodies. While there is undoubtedly the physical threat of mutation, disease, and death, there exists alongside it the toxic shame, the anti-disability sentiments, and all the various phobias associated with those labeled pathological and un-categorizable. In order to address this double trauma, I felt the need to create a fictional corporate brand, the *Estroworld* and its company slogan “We Are All Living in the *Estroworld*.” Living in the *Estroworld* means that, first, we all live under unprecedented levels of pollution and, second, that the all-too-common phobia-riddled response to this alienation freezes us in a state of panic that is both paralyzing and de-collectivizing.

(Fig. 01)
Digital illustration from the interactive web project Estroworld Now, 2021.
Image courtesy of the artist.

Most of us are taught to run away from the alien, barricade ourselves from it, silence it, or deny it ever existed. Most of white, privileged Western cosmology believes in what feminist scholar Alexis Shotwell calls an illusory state of "corporeal exceptionalism," where individually bounded bodies avoid the complexity and complicity that comes with being in a contaminated world.[1] This xenophobic and prophylactic tendency is historically rooted in the same systems responsible for the destructive binary divisions we see today: female and male, nature and culture, animal and human, abnormal and normal. It is rooted in the way national borders are defined and enforced, the way lands become corporate resources, the way white supremacists justify the denial of a racist-colonial past, the way the Democratic Gen Z's indulge in "cancel culture," or the way we respond to media stories of birth control in the water supply with the fear of men feminizing or suddenly becoming gay. It is rooted in the way we witnessed the world's reaction to the COVID-19 pandemic and the disaster capitalism that profited from the vaccines, masks, and hand sanitizers that promised to wall us off from the threat of viral infections. These are the purity ideologies that make up the *Estroworld*, and we are all caught in its trap.

However, as we discover through the existential knowing of biohacking, not only is it impossible to not be alien, but *we are already alien*. All of our capitalist-colonial desires for ontological separation simply fall apart when we consider the queering ability of toxic molecules to permeate bodies and environments across spatial and temporal scales. Things change faster than we can comprehend. That's why the socio-material work of biohacking must go beyond the scientific and the technical—it is hacking the dominant imaginaries that have long served the agenda of the powerful, those who have historically excluded or denied this inter-permeability by preserving binary divisions. It is hacking whatever system that upholds a politics of purity, so that we may find a sense of belonging in an ever-changing world.

What forms can this belonging take? If the motivation behind individualistic and categorizable claims to purity are nested in the fear of acknowledging the magnitude of our inter-connectedness, how do we resist collapsing in the face of complexity? How do we negotiate contradicting ways of being, allowing the alienation of this world to be both beautiful and horrible all at the same time? And how do we embody these theories and understandings of toxic interdependence through the socio-material work of biohacking? How do we collectively claim this *Estroworld* as *our Estroworld*?

2
Alexis Shotwell, *Against Purity: Living Ethically in Compromised Times* (Minneapolis: University of Minnesota Press, 2016), 85.

I first began exploring the combined potential of biohacking and performative strategies when I collaborated with the Aliens in Green from 2016-18. A mobile laboratory and tactical theater collective who acts as a contra-analogous entity to the fictional Hollywood characters, the Men in Black, the Aliens in Green host highly orchestrated and durational participatory performances about toxicities and the industrial capitalism that situates our planet as an ongoing laboratory. Appropriating spaces like the kitchen, the laboratory, and the clinic, we tasked participants with cutting, shredding, and slicing foods of contaminated origins, liquidating and boiling micro-plastic-containing products such as toys, cosmetics, and plastic bottles, and extracting hormonal samples from participants' urine. All of this menial labor represented a remixing of an alien bio-commons, one that ceaselessly mutates and creates new combinations and therefore new subjectivities, cutting through pre-existing lines of purity ideologies. These performances then culminated in a final climactic and collective action of ingesting our extracted urinary hormones mixed as a cocktail, acting as a form of affirmation that lays claim to an alien existence on an alien planet.

From working with the Aliens in Green, it became clear to me that biohacking, when used as a kind of intentional witchcraft, will always inevitably lead to some form of *worlding* through the re-articulation of present and past ontologies. This re-articulation can even produce an emotional rescue, where the existential crisis of the body is brought to a point of neutrality. Participants can be led into the radical unknown so that they may emerge on the other side with an entirely new and embodied perspective. They may emerge on the other side feeling safer in their alien becoming.

PART THREE:
The Genesis of Caressing Oceans

It is no simple task to neutralize the fear of people you haven't previously met, but an embodied approach towards biohacking was worth interrogation. In July 2021, the participatory performance *Molecular Queering Agency* was re-commissioned by the curatorial team Perrrformat to act as a ten-person trauma-releasing ritual. Wearing uniforms remade out of hospital gowns and protective garments sold on Aliexpress that promise anti-bacterial and anti-UV radiation, participants acted as representatives of the agency, whose logo repeats the words of Anna Tsing in *The Mushroom at the End of the World*, "Purity is not an option."[2] During this choreographed and meditative ritual,

3
Anna Lowenhaupt Tsing, *The Mushroom at the End of the World* (Princeton: Princeton University Press, 2019).

participants go through a series of movements and exercises borrowed from yoga, kinesiology, and breath work that are designed to strengthen somatic awareness. Then, encircling a large aluminum sculpture, participants put on oxygen masks connected to urinary hormones that have been extracted in previous performances, giving the participants the choice to inhale foreign molecules. This action plays with the idea of offered consent as a form of trauma healing. The performance continues with participants pouring their urine through a glass extraction column, a synchronized action that resembles a cult-like worship. Lastly, participants join a one hour group discussion to collectively process the strangeness together.

(Fig. 02)
Image still from the video, Perrrformat Presents: Molecular Queering Agency, performed at Schindlergut Park, Zurich in 2021.

The *Molecular Queering Agency* is an exercise in releasing the molecular traumas of living in the *Estroworld*, and accepting the alien qualities within and all around us. As the ten of us move through the ritual, we move as one hybrid organism that morphs and shape-shifts, similar to a team of synchronized swimmers when seen from the bird's eye perspective. As participants mimic my choreography, I facilitate their entry into an unknown territory, similar to entering into the conscious awareness of our profound toxicity. We perform the urine hormone extraction protocol that is taken outside of its scientific realm and into a performance space of intentional witchcraft. We worship urine as the

evidence of our contaminated bodies. This is where biohacking begins to embody the practice of care, allowing us to reckon with invisible molecules that we never consented to ingest and imbibe. We reckon with our very otherness, knowing and trusting that through these invisible contaminations we will only continue to become more and more altered the longer we live on this planet.

If this combined strategy of biohacking and collective embodiment initiates a new somatic awareness of the molecules all around us, then how do we also become aware of their collaboration with us? How do we also embody this process of co-mattering rather than just the matter itself? In the book *Vibrant Matter: A Political Ecology of Things*, theorist Jane Bennet writes about the agency of assemblages and their capacity to produce emergent properties larger than the sum total of the individual parts alone[3]. In essence, we are all co-produced by molecules. Molecules morph us as much as we morph them, in an endless and disobedient way. So, engaging in the co-creative process of performance allows us to re-tell the story of our biochemical becoming without the predetermined notions of fixity, naturalism, and biological essentialism. It allows us to go beyond the trap of the *Estroworld* that has placed us in a simulation of desired purity. Because, whether we are aware or not, synthetic molecules become our willful collaborators in our process of "world-genesis" or world-making. Even in our sea of toxic industrial molecules, *it is still a sublime sea of co-mattering*.

In my six years as an artist, researcher, and workshopologist, "Performing the Sublime Sea of Co-Mattering" is the newest form of workshop-performance that draws upon previous participatory experiments in biohacking (*Open Source Estrogen* and *Estrofem! Lab*), theater-based interventions (*Aliens in Green*), and somatic awareness (*Molecular Queering Agency*). In this exercise, the various detritus of late capitalism and toxic relations are re-articulated through a dramaturgy that adapts the story of our biochemical becoming into actable form. Using performative methodologies, we attempt to collectively divest from present and past ontologies in favor of new ways of being and relating. This multiple day workshop-performance is divided into four core steps:

4
Jane Bennet, *Vibrant Matter: A Political Ecology of Things* (Durham: Duke University Press, 2010), 24.

Step One: The Encounter

We arrive at a polluted and terraformed site where industrial toxicities have leaked across bodies, space and time. As Heather Davies describes in her book *Plastic Matter*, plastic is a deliberately alienated material that embodies all of the colonial logics of dissociation and dislocation[4]. In its synthetic and sterile form, its origin is indeterminable because it has been intentionally non-localized, seeming to appear out of nowhere yet existing everywhere. Working within this spatial and temporal alienation, we scavenge the ruined site for organic and synthetic materials, or hybrid entities, allowing these materials and their physical environment to become the starting point for the new world we seek to build.

5
Heather Davis, *Plastic Matter* (Durham: Duke University Press, 2021), 5.

Step Two: Other Sensing Regimes

We bring our alienated materials into a large central pile, gather around it in a circle, and put on blindfolds. In the pitch darkness, we give up the ocular centrism that has long built western bodily constructs of matter and mattering. Moving towards our materials, we use hearing as a form of tasting as a form touching as a form of smelling as a form of seeing. In this new familiarity that we gain with the alien, we allow our intimacy to spill over into the "extra-human." We find kinship in petrochemical leftovers and leakages.

Step Three: New World Disorder

Using this newfound intimacy, we build the scenography for our collective performance. First, they are not allowed to speak, so that all negotiations in spatial design must be done silently and somatically. Second, their urine-hormone extractive devices that were constructed days prior must be embedded in the scenography itself. After about an hour of scenography building, the space resembles a combination of a shelter, a garden, and a shrine—all elements that would signify a home or sense of belonging. This newly constructed world represents a new *hyperspecificity*, a pleasurable breakage from the old world paradigms.

Step Four: Performing the Sublime Sea of Co-Mattering

We collectively decide how we want to perform in our new *hyperspecificity*. An audience arrives and sits around and in the scenography. In a performance lasting twenty to thirty minutes, we sonify the space with contact microphones, we read aloud our sci-fi writings from days before, we perform contact improvisation with our bodies and the materials, and we hold the hands of audience members to bring them into the new world we have just constructed. Then, in sync, we perform the urine-hormone extraction as a final climactic ritual. Through this extraction we capture the tiniest toxic snapshot in a macro cosmos of space and time. But perhaps this is all we need to transmute the traumas of our old world into the new.

In conclusion, biohacking reveals the *Estroworld* to us, and it also sends us on our way out. Through a collective interrogation of our socio-material reality, we re-articulate the purity ideologies of the *Estroworld*. We accept that all borders, even the barriers of our own skin, are really just transient spaces, ultimately unable to wall off the leakiness of our toxic interrelations. We accept that generative worlds emerge with molecules even if they have been deemed invasive and harmful. We accept that living in an endlessly shapeshifting world means co-mattering in its accidents and mishaps, over and over again. We release notions of dystopia and catastrophe that paralyze our ability to collectivize and belong. Instead, we choose to stand in the fire and fear. We choose to stay entangled in order to transform.

(Fig. 03)
Blind-sensing exercise for "Performing the Sublime Sea of Co-Mattering" at Leilija sewing factory in Vilnius, Lithuania, part of the Rupert Residency alternative education program. Image taken by Medeina Usinavičiūtė, 2022.

ALIENS IN GREEN
with the participation of Léonore Bonaccini, Ewen Chardronnet, Xavier Fourt, Špela Petrič, and Mary Maggic

a mobile investigation laboratory and tactical theater group developing inquiries into the alien agents of anthropocenic xenopower — reaching out and opening a critical public space by implementing intermedia processes that connect open-science, DIY practices, speculative narration, serious games, cultural intelligence, and science-fiction

BECOMING NON–ALIEN

"Do queers and our alien kin have no future in our increasingly toxic landscape?"

Exposure to synthetic chemicals interferes with human and nonhuman hormonal systems. Despite all the warnings about the toxic impacts of endocrine disruptors, the lobbying of the petro-chemical, agricultural, and pharmaceutical industries continue to influence regulatory institutions. These actors can be viewed as xeno-powers that both regulate and pollute our bodies and environment. At the same time, terms like "abnormal" or "disruptor" are at the center of most environmental and critical discourses, focusing the main arguments on sex-panic, gender ambiguity, and threats to reproductive futurism. These arguments reinforce a politics of purity that reflects our prescribed eco-hetero-normative value system. What is "normal" and "natural"? Do queers and our alien kin have no future in our increasingly toxic landscape? The Aliens in Green want to generate "a crisis of the body" that leads to non-prescriptive subjectivities, offering a kind of alien resilience called xeno-solidarity. In their provisional manifesto, we are invited to learn about their non-alien laboratory of commons—a place-in-becoming in which interspecific communities meet and form and that which does not yet exist comes into existence and materializes.

Becoming Non-Alien: Provisional Manifesto for a Laboratory of Recombinant Commons

RE-QUALIFYING THE LABORATORY

Aliens in Green is an agent from a planet-turned-laboratory. The laboratory is the place where that which does not yet exist comes into existence and materializes. With the laboratory-planet, the biosphere is itself transformed into a laboratory, affecting what we from the Cenozoic have known up until now.

The future, however, has not yet been created; the images coming from the future are materializing in various ways. Some of these images show a xeno-power that elicits the emergence of radically new entities forcing the evolution of living beings in unconcerted directions among species.

In the xeno-laboratory, we are witnessing and anticipating the emergence of the systems of our future subordination or extermination based on our alienation. Against this xeno-laboratory, Aliens in Green is positing the idea of a non-alien laboratory. This laboratory of commons, a place where interspecific communities meet and form, is a continuation of, rather than a break with, the community of beings we have been experiencing throughout the Cenozoic. This laboratory is a place-in-becoming, a place where the combination of living forms—their composition and articulation—is elaborated.

CULTIVATING AN ART OF COMBINATIONS

The art of combinations is aimed primarily at recomposing the commons in an odd world. The art of combinations is the art of symbiosis, a common thrust towards phusis, or the "self-giving-of-a-common-form." Genetic recombination as well as genetic, hormonal, and chemical communication between species is multi-facetted and ongoing. Whereas sex was the pivotal issue of traditional biopolitics, connecting individuals and populations as well as citizens and states, the non-genealogical and lateral transfer of genes, molecules, and signals is what may enable us to better understand the making of new biopolitical connections—between persons and licenses, between human and non-human user communities, between polymorphisms and policies. These recombinations, which are immanent in society, must emancipate themselves from the specific standards of the bio-, chemo- and porno-industrial complex in order to bring forth

bodies and habitats that adapt to the beings living in them. This is why the critique of xeno-hormones, xeno-molecules, xeno-genes and xeno-(eco- or bio-)systems, and the critique of the xeno-powers that define their present and future orientations, are the necessary correlates of a recombinant common policy.

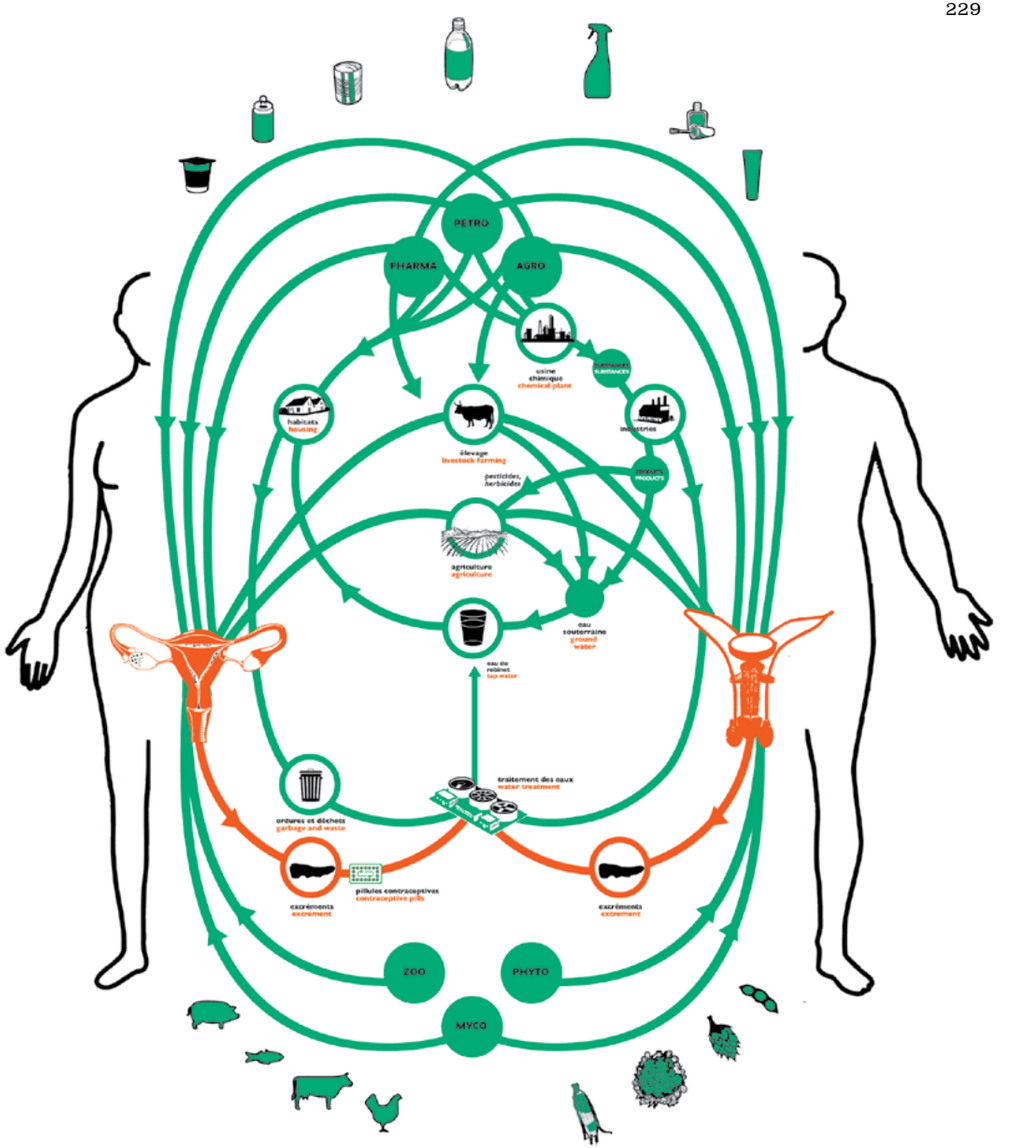
CULTIVATING AN ART OF COMPOSITION

A non-anthropomorphic approach to intelligence opens up new spaces of social composition. If we leave behind the anthropomorphic and cerebro-centric conceptions of intelligence and acknowledge instead that intelligence is distributed across all biotic flows—across all plant, animal, fungal and bacterial species—then the social and political compositions change radically. The phyto-oriented approach reconfigures our modes of operation by aiming to connect the reflexivity and the theoretical models inherited from western anthropoid culture with concrete modes of action generated by other biotic species and flows. Reflexivity, through its ability to render alien and create distance, can subvert the process of meaning and enable us to represent the unrepresentable. The non-anthropomorphic approach of affects also allows us to rethink the mediations between bodies and signifiers beyond identities and species, and to apprehend the flow of affects interconnecting and co-constituting bodies of different kinds.

CULTIVATING AN ART OF ARTICULATION

Articulation is a key concept in approaching the laboratorisation of the living and the ecosystem in capitalism if we do not want to limit our critique to economic approaches or class relations alone. The concepts of becoming-alien and becoming-non-alien enable us to articulate worlds in such a way that their potential antagonisms are neutralized. Their aim is to articulate or coordinate the various narratives revealing the anti-terrestrial spirit of capitalism and implementing the biospheric commons.

In short, they allow us to build counter-hegemonic narratives and devices as well as trans-specific solidarities that are simultaneously political, epistemological, technical, and strategic, and which in turn enable the convergence of anti-systemic struggles.



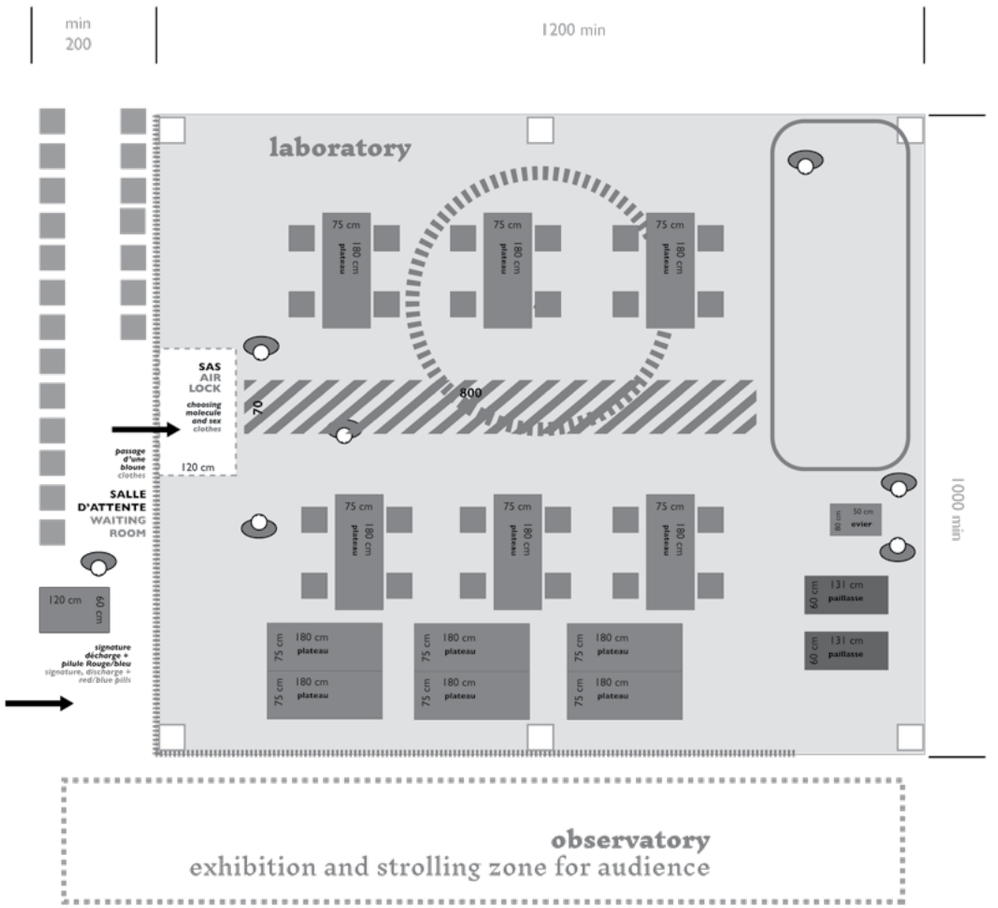
(Fig. 01)
Aliens in Green, *Petro-Bodies and Geopolitics of Hormones*, 2018.
This diagram and all subsequent images courtesy of Aliens in Green.

Laboratory of Recombinant Commons

Act 1 • Consenting to the Authority of Science

(0) Prelude: Consent

Twenty participants gather in the “waiting hall” (or in front of the room where the action takes place) where they are requested to sign a consent form. One by one they are led into the space.



(Fig. 02)
Aliens in Green, Laboratory, 2019.

(1) Impregnation

1
Aliens in Green, performance Xenopolitics#1, Antre Peaux, Human Tech Days festival, Bourges, France, 26 January 2019.

(Figs. 03–04)
Choosing a pill that assigns a Xeno or Bio category corresponding respectively to the Petro, Pharma, Agro subcategories on the one hand, and Phyto, Myco, Zoo, on the other hand. A tag is attached to the abductee's chest, indicating its category Agro, Pharma, Petro or Myco, Zoo, Phyto.[1]

(Figs. 05–06)
A water bottle labeled with an endocrine disrupting molecule must be imbibed at the entrance.

(2) Elaboration

Abductees settle at a table corresponding to the category they have received (Petro, Agro, Pharma, Phyto, Zoo, Myco). They prepare a food corresponding to their category, according to a directive.

■ Petro
Plastic bottle (phtalates): Cut in small parts.
Can (bisphenol A): Empty the content of the can. Scrape off the thin layer that protects the inner surface of the can.
Gastropods (tributyltin, TBT): Remove the body from its shell.

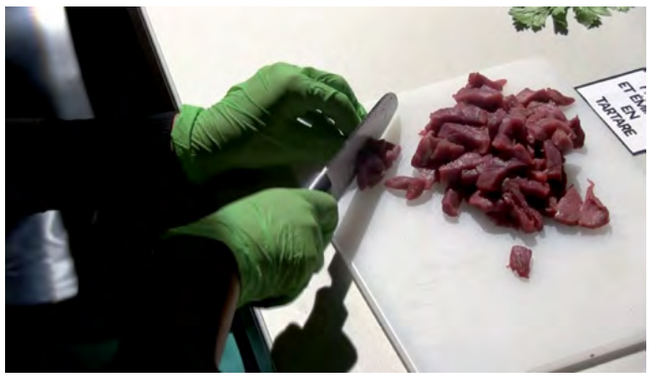
■ Agro
Beetroot: Peel. Grate.
Grapes: Remove the grapes from the bunch.
Banana (chlordecone): Cut into slices.
Strawberries (parabens): Cut into quarters.

■ Pharma
Salmon: Cut into sashimis (parts).
Trout: Cut into sashimis.
Egg: Break the eggs in a dish. Separate the white from the yellow.

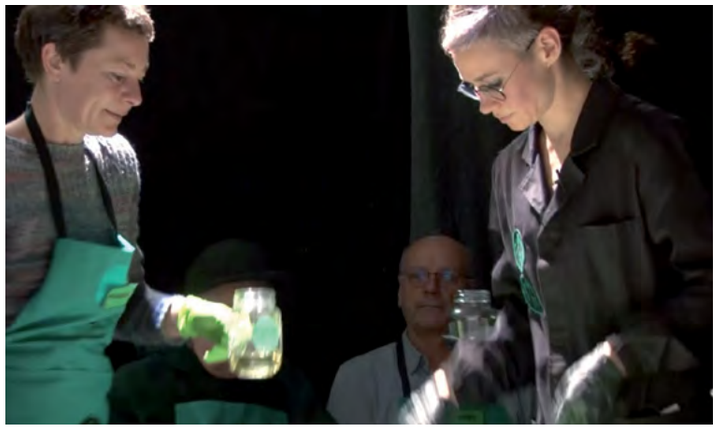
■ Phyto
Soybeans (phytoestrogens): Pound until you get a dough.
Linseed, nuts (phytoestrogens).
Grapefruits (aromatase inhibitors): Peel.
Orange (hesperidin): Peel. Separate into quarters. Remove the skins.
Green beans (isoflavones): Shell.
Parsley (apigenin): Chop.

■ Zoo
Steak (clenbuterol): Mince and chop in tartare.
Celery (androsterone stimulant): Cut into small pieces.
Tuna: Cut into sashimi.

(Figs. 07–09)
Abductees prepare food corresponding to their category, according to the instructions.

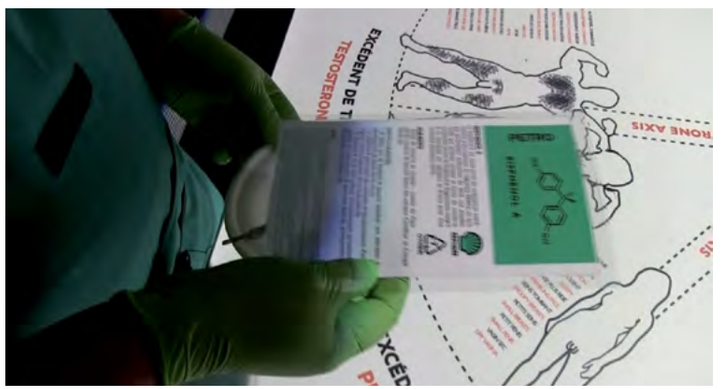


(3) Harvest



(Fig. 10)
The abductees are called one by one for a collection of their urine. They go to the toilet and give their jar to the laboratory assistant who will classify the bottle for the purpose of extracting hormones.

(4) Evaluation



(Fig. 11)
Abductees receive a card about the molecule chosen at the beginning (i.e. the molecule on the bottle at the entrance). They learn about the molecule and can connect the food they prepare to the molecule.

Act 2 • Subjectivation

(5) Extraction

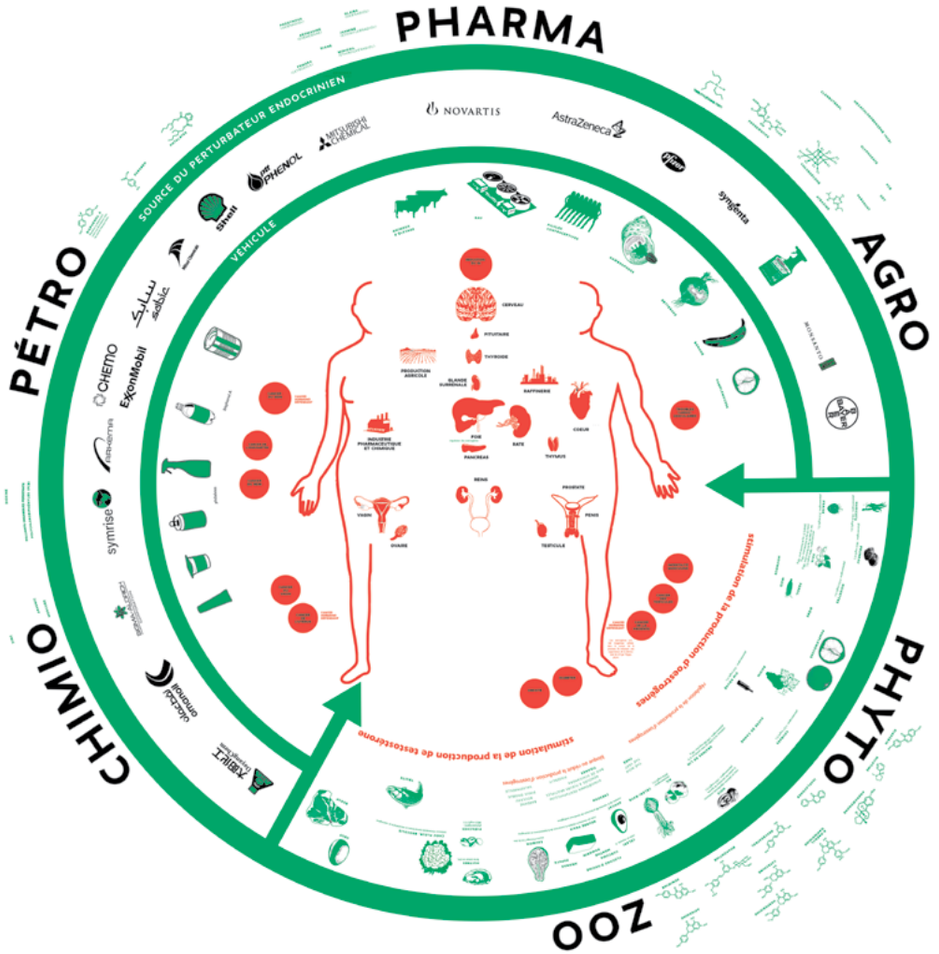
Using DIY biotech tools and provocative discussion, hormonal disruptors are extracted from urine, food, plastics, cans, magazines, thoughts, preconceptions, and sentiments.

Act 3 • Recombination

(6) Recombination

Abductees discuss phytoestrogens, mycoestrogens, aromatase inhibitors, estrogen & androsterone production stimulants, metabolization, hormonal balance, diets related to hormone dependent cancers, diets related to fitness, use and abuse, menopause, andropause, hormone therapies, veganism, vegetarianism, etc.

(Fig. 12)
Abductees discuss endocrine disruption. Abductees imagine a recipe they will make for the final banquet.

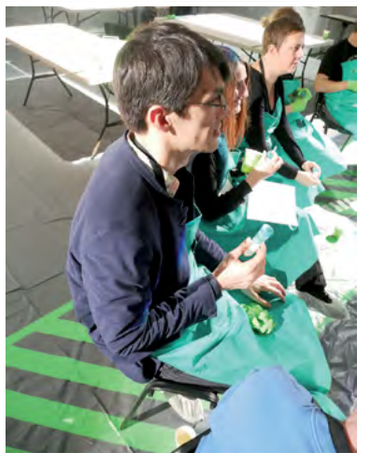


(Fig. 13)
Aliens in Green, *Hormonal Dietetics Chart*, 2017.

Abductees detect endocrine disruptors using a self-administered chemically mediated colorimetric test. The test will reveal the presence and concentration of disruptors, producing a collection of vials on the yellow-green-blue-violet-brown spectrum. This is done in several stages. During the first stage, each abductee measures in the toilet with a mirror and meter their anogenital distance, which is supposed to distinguish between men and women. This distance may vary under the influence of endocrine disruptors. As such, it claims to “prove” the distinction between man and woman, establishing the difference scientifically. In the second stage, participants coalesce vegetables, bottles, birth control pills, antidepressants, fertilizers, and so on, based on the color of the detection test into categories. Drawing inspiration from the concepts of flat ontology, participants are invited to narrate the connections in monochromatic categories.

(7) Queering Toast

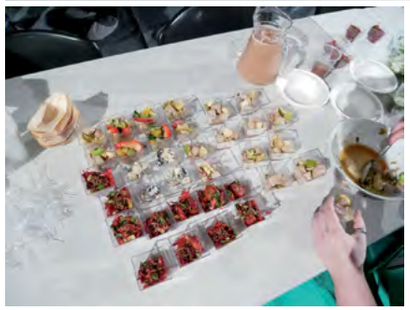
Each abductee receives their residue of hormones/pheromones extracted from the urine. Abductees smell their pheromones and compare them with those of other abductees. The hormone residues of all abductees are then diluted in the same bottle of vodka. Participants share and mix the disruptors until they achieve a liquid perfectly balanced in hue, intensity, and volume, thus creating a special xeno-vodka which is subsequently distributed to all abductees to carry toasts. Toasts are then worn, according to the inspiration of the moment, toast to the recombinant common, to the queerization, etcetera.



(Figs. 14–17)
Abductees create their queering toast.

(8) Recombinant Commons

Starting from the recipes they imagined, the abductees prepare dishes. The dishes are then shared during the final banquet.



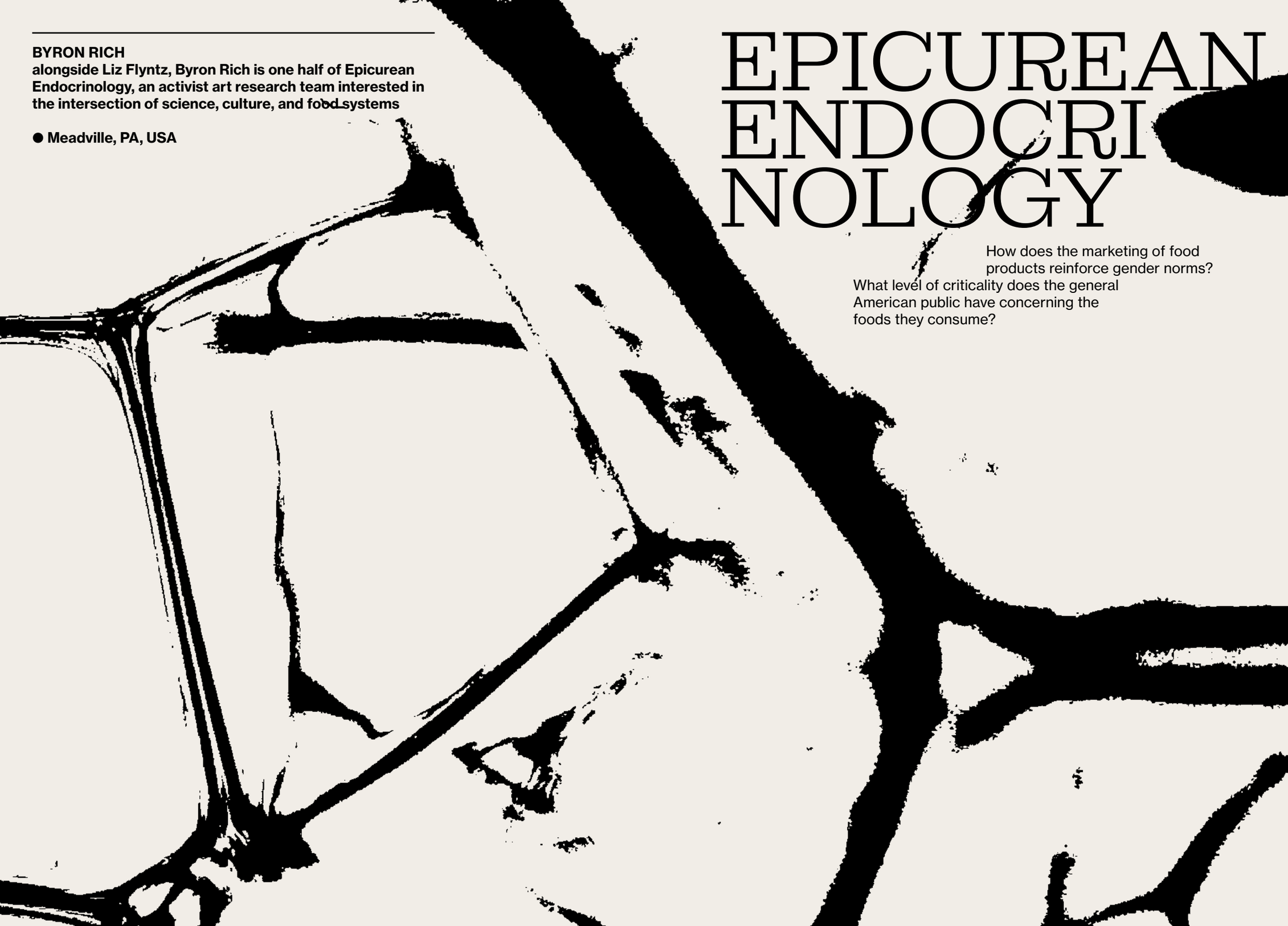
(Figs. 18–20)
Dishes at the final banquet prepared by individuals and small groups.

BYRON RICH
alongside Liz Flyntz, Byron Rich is one half of Epicurean Endocrinology, an activist art research team interested in the intersection of science, culture, and food systems

● Meadville, PA, USA

EPICUREAN ENDOCRINOLOGY

How does the marketing of food products reinforce gender norms? What level of criticality does the general American public have concerning the foods they consume?



Epicurean Endocrinology: The Middle-American Grocery Store Index **is intended to be read in the context of fieldwork and research on how the American grocery store is the epicenter of obfuscation of scientific data regarding food production and of manipulation of consumers through concerted greenwashing and gender-norm reinforcement. It is a visual index of foods that are a) gendered through marketing in order to market commodity crops and enforce gendered body discipline, and b) contain notable levels of endocrine disrupting compounds.**

Commercial foods, such as packaged goods, quick meals, and shelf-stable snacks, are often produced using commodity crops that contain endocrine disrupting compounds or are packaged in endocrine disruptor-rich packaging materials. In some cases, these xenohormones are the result of biological processes that occur without human intervention, while in others they are due to methods of manufacture or packaging. Simultaneously, food manufacturers exploit gender anxiety and body shame in order to market value-added commercial food products. Gender-specific food products proliferate throughout grocery and convenience stores, promising increased and idealized feminine and masculine attributes to the buyer.

Epicurean Endocrinology: The Middle-American Grocery Store Index

Using food as a mechanism for social disruption and conversation, *Epicurean Endocrinology* occurs at the intersection of science, identity politics, and corporate interest. Through the project, we are taking a closer look at how industrial processes, specifically in industrial agriculture, introduce endocrine disruptors, particularly Atrazine and BPAs—well-known "demasculinizing" and "feminizing" compounds—into the environment, animal bodies, and human bodies in service of profitability.

Beyond the aforementioned demasculinizing and feminizing effects of endocrine disruptor proliferate in food systems, there are gendered attributes in their presentation and consumption. In many cultural contexts, certain foods are associated with masculinity and virility, or femininity and fecundity. This constellation of meanings function differently within specific spiritual and healing traditions. In the American capitalist tradition of food-as-product, foods are marketed to men (Burger King, Doritos, etc.) and women (salad, yogurt) with aspirational messages, promising to help consumers attain their culture's gender ideals.

While corporations honed these marketing strategies in the twentieth century, many new chemicals with hormone-mimicking properties—endocrine disruptors, chemicals which endocrinologists now understand can alter sex-linked physical characteristics and reproduction on an ecosystem scale—wound up in the industrial food supply. Ironically, the gendered symbolism of food products and the sexual valence of their chemical contents often do not align. *Epicurean Endocrinology* pries open the gap between consumer symbolism and the workings of our industrial food system to enable a critical and empowering shift of perspective.

American vernacular cuisine, and the ingredients that are staples in folk or "homestyle" food traditions in the United States, provide a fascinating platform to examine the aforementioned intersections of culture and bodies. "Middle-America" refers to the so-called "flyover" states that encompass the vast American interior between the northeast megalopolis of Boston-New York-Philadelphia-Washington and the southwest coastal region of Los Angeles and San Francisco. Middle America is often referred to as "Real America" by politicians vying for votes in the vast center of the country where sentiments of "coastal elitism" prevail.

(Fig. 01)
Giant Eagle grocery store shelf, Meadville, PA. This photo and all subsequent images courtesy of the author.

An example of American vernacular cuisine is “Cheesy Taco Bake,” a common middle-American dish, exemplifies the complexity of America’s relationship to its food systems. At once, it incorporates foods that are grown using endocrine disruptors as herbicides and pesticides (Atrazine, for example), foods that are packaged and processed using known endocrine disruptors (BPAs), and foods that use the tropes of American masculinity and exceptionalism in their packaging, while also appropriating elements of other cultural traditions. Cheesy Taco Bake contains many corn-based products—corn being the most widely produced crop in America, while also being the most likely to be grown using the well-known endocrine-disrupting herbicide Atrazine.

(Fig. 02)
Canned corn.

(Fig. 03)
Canned back beans.

(Fig. 04)
Corn-based processed taco shells.

(Fig. 05)
Plastic packaging of industrially grown tomatoes.

(Fig. 06)
Canned bean sprouts with cultural stereotypes depicted on the label.

(Fig. 07)
Plastic wrapped industrially raised ground beef.

Many of the regional homestyle dishes that seem the most comforting and familiar in American culture are often the most likely to contain endocrine-disrupting compounds due to agricultural, industrial, or pharmaceutical processes. These foods contain cheap, popular, broadly distributed “commodity crops,” such as seed oils, sugar, and grains which have been grown with known endocrine disruptor pesticides and herbicides. Or they may contain factory farmed and processed meats and dairy products derived from animals fed with industrially produced grains and treated with a variety of hormones. Plastics used in processing and packaging food products can also contribute detectable levels of endocrine disruptors.

Beyond the biological realities of homestyle cuisine, the ways in which these foods are marketed are often highly gendered, especially in the United States, where we are bombarded with imagery that reinforces heteronormative and patriarchal cultural constructs emblematic of the “nuclear family.” This cultural construction of family and corresponding “family values” are touted as the cornerstones of American capitalism and democracy.

Epicurean Endocrinology: The Middle-American Grocery Store Index is a visual catalog of common foods, food systems, advertising techniques, and processing techniques found in any middle-American grocery store. The selections have been broken down into three main categories:
1) Grown or produced using endocrine-disrupting compounds;
2) Gendered advertising and usage of coded language; and,
3) Packaging that includes endocrine-disrupting compounds.

(1) Produced Using Endocrine Disruptors

Endocrine disruptors like Atrazine—a “feminizing” compound—are commonly used as herbicides in the United States. Corn, the most widely produced crop in the US, is especially likely to have been grown using Atrazine. Atrazine leeches into the foodstuffs, but also into the waterways and ecosystems surrounding the farms. Below are some of the forms corn commonly takes in the American grocery store.

Besides the herbicides used to promote healthy plants, other common foods contain endocrine disruptors as part of their biology, known as phytoestrogens. Soy is the most commonly vilified food for its “feminizing” effects, but others, like flax, also contain phytoestrogens.

(Fig. 08)
Plastic wrapped, industrially grown, frozen corn on the cob.

(Fig. 09)
Industrially brown, frozen corn kernels.

(Fig. 10)
Flax seed.

(Fig. 11)
Flax seed label depicting nutrition facts and marketing text.

(Fig. 12)
Tofu-based meat substitute.

(Fig. 13)
Tofu-based dairy-free cheese substitute.

(Fig. 14)
Tofu-based dairy-free cheese substitute ingredients and nutrition facts.

(2) Coded Language & Gendered Imagery

Binary gender reinforcement is a commonplace attribute of advertising in the American food industry. Whether via language or imagery, or both, many common foods in the American grocery store perpetuate heteronormativity and a binary America predicated upon “traditional” values. These “traditional” values are often coded language for white and straight. Below are examples of such products.

(Fig. 15)
In-aisle marketing materials.

(Fig. 16)
“Homestyle” white bread.

(Fig. 17)
“Injectables” processed butter.

(Fig. 18)
“Jack Daniels” branded factory-raised pork.

(Fig. 19)
“Jack Daniels” branded factory-raised pork marketing narrative, ingredients and nutrition facts.

(Fig. 20)
“Muscle Milk” branded protein supplement.

(Fig. 21)
“Vega” branded protein supplement.

(Fig. 22)
Organic probiotic yogurt.

(Fig. 23)
“Doritos 3D” nacho chips.

(Fig. 24)
“Good Thins” crackers.

(Fig. 25)
“Oreo Thins” wafers.

(Fig. 26)
“Tombstone” factory raised pepperoni and sausage pizza.

(Fig. 27)
Processed industrially grown mashed potatoes.

(3) Endocrine Disruptors in Packaging

Bisphenol A (BPAs) is a chemical compound used in the manufacture of plastics and is commonly found in food packaging, including plastic containers, the liners in cans, and even in receipts. Although exposure to individual packaging isn't a concern, the cumulative effects of BPAs as an estrogen-mimicking compound are of potential concern. In the United States, over-processing and unnecessary packaging are commonplace, and both present environmental problems in terms of packaging waste, but also public health issues because BPAs can produce estrogen-like effects with prolonged, cumulative exposure. Below are some examples of packaging and processing that allow BPAs to proliferate in American bodies, human and non-human alike.

While the United States isn't the only country where endocrine disruptors are nearly omnipresent in the food system, the intersection of politics, advertising, food, and human and non-human bodies presents a compelling case study in intersectionality. The food system reinforces heteronormativity and "traditional" values, which belie a codification of American "normalcy" that is tied to capitalism and a unique brand of mythological individualism.

(Fig 28)
Plastic packaging of industrially grown tomatoes.

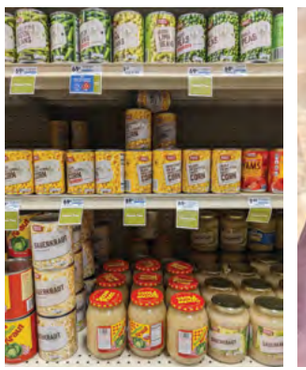
(Fig 29)
Plastic packaging of industrially grown peppers.

(Fig. 30)
Plastic packaging of industrially grown salad.

(Fig. 31)
Plastic packaging of frozen industrially grown brussel sprouts.

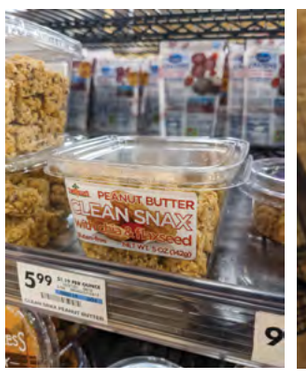
(Fig. 32)
Plastic packaging of industrially grown onions.

(Fig. 33)
Processed white sugar.



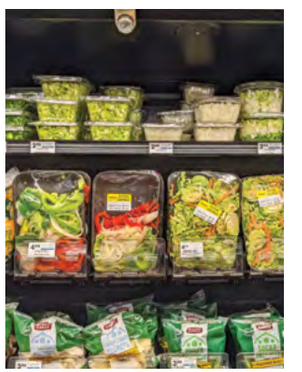
(Fig. 34)
Canned vegetable shelves at Giant Eagle in Meadville, Pennsylvania, USA.

(Fig. 35)
Processed roasted peanuts.



(Fig. 36)
Processed "Clean Snax."

(Fig. 37)
Processed carrots, celery, and onion from multiple industrially grown sources.



(Fig. 38)
Pre-packaged and processed vegetable shelf at Giant Eagle in Meadville, Pennsylvania, USA.

FRANZISKA KLAAS
being ethnographic and doing ethnography; committed to feminist politics of care, thinking, writing—curious to explore the edges of knowledge production in and beyond academia; wondering about how to do academia differently

● **Oslo, Norway**

SUSANNE BAUER
a science and technology studies (STS) scholar; grappling with science, technology and medicine as situated practices; committed to decentering Euro-American epistemic infrastructures from within—through feminist and decolonial STS

● **Oslo, Norway**

ENDOCRINE DISRUPTING SUBSTANCES

How can we historically narrate and situate different substances without retreating to stories of origin?

How can we better understand the entanglements of endocrine disrupting substances with global economies?

How do different disciplines take stock and sort these endocrine disrupting substances in specific ways and construct along the way different visions of harm and benefit that are in flux?

How have different approaches and practices, such as biochemistry and toxicology, been shaped by and co-shaped understandings of the hormonal body interlinking and engendering debates over endocrine disruptors and preconceived categories of sex/gender?

Endocrine disruptors range from industrial chemicals to pharmaceuticals, and from pesticides to phytoestrogens, many of them being persistent and ubiquitous pollutants. Others are attributed health benefits or just considered present in the manifold material world of biochemical processes in living matter. In their contribution, Franziska Klaas and Susanne Bauer take the variety, broadness, and ubiquity of endocrine disrupting substances in our everyday life as a point of departure to develop a preliminary and necessarily fragmentary inventory of endocrine disruptors. The goal is not only to take stock, compile, and order substances, but also to explore the limits of scientific practices and formats. Inspired by data safety sheets that normally provide information on chemicals and chemical mixtures, their potential hazards, and instructions for safe handling, they appropriate and mimic the format and develop it further for substances that circulate in everyday life. The sheets serve as a starting point and an exercise to examine the affordances, tensions, and troubles with classifications and capture-all inventories. In addition, it systematizes and standardizes the very substances that exceed data sheet formats, unfolding the categorizations in tension with what can and cannot be captured by the sheet.

Endocrine Disrupting Substances: A Partial Inventory

Late twentieth century technoscience has conceptualized the endocrine system as a complex network of different organs with hormones as messengers to control metabolism, reproduction, moods, and other bodily functions and developments. A range of synthetic chemicals as well as otherwise occurring substances produced by living beings, like plants or fungi, have a similar molecular structure and can thus act like or affect bodily produced hormones. These substances are called endocrine disruptors. They interfere with or alter endocrine processes creating effects, like an increase or decrease of hormone levels, the mimicking of endogenous hormones, or the alteration of the production of hormones. The effects of these interferences are complex, yet clearly associated with several adverse health effects and linked to environmental pollution. Their circulation and persistence have given rise to specific anthropogenic ecologies, chemical kinships, and queer survival—yet to be described.

Endocrine disruptors range from industrial chemicals to pharmaceuticals, and from pesticides to phytoestrogens. Surprised and amazed by the variety, broadness, and ubiquity of endocrine disrupting substances in our everyday life, this contribution develops a preliminary and partial inventory of endocrine disruptors. Many of them are persistent and ubiquitous pollutants, while others are attributed health benefits or considered simply present in the manifold material world of biochemical processes in living matter. Hormone mimicking has been a core conceptualization in debates over those substances: How can we situate what is being mimicked, disrupted, or reinforced, such as its enacted binaries and versions of the biomedical body? How can we historically narrate and situate different substances without retreating to stories of origin? And, how can we better understand the entanglements of these substances with global economies? How do different disciplines take stock and sort these substances in specific ways and construct along the way different visions of harm and benefit that are in flux? How have different approaches and practices, such as biochemistry and toxicology, been shaped by and co-shaped understandings of the hormonal body interlinking and engendering debates over endocrine disruptors and preconceived categories of sex/gender?

Often, scientific and popular environmental concerns based on ecotoxicology seem to focus on gender-specific concerns, such as the “feminization” of fish or the quality of sperm. At the same time, measurement and assessment devices are geared to generate metrics that capture altera-

tions of what is supposed as the norm, often conceived of as pre-gendered and assumed binary. Some of the substances we engage with—like phytoestrogens and myco-estrogens—trouble these categories, and prompt us to reconceptualize these binaries. Theorizing and working with them, just like tricksters, figures tied to mythologies and folklore, yet with futuristic potentials, as they shape-shift, deceive, mimic, and thus refute dichotomies, can push us toward plurality and heterogeneity. Seen in this way, they may help us reconceptualize epistemic infrastructures and reimagine modes of response-able coexisting with these matters.

The Pharmakon and Global Economies

The relationship between mimicry and metabolism has been a starting point for our inventory. The concept of pharmakon, in addition, allows us to highlight the deeply ambivalent and, as such, indeterminate natures of endocrine disrupting substances while emphasizing the past and present entanglements of endocrine disrupters with global economies. In the binary metaphysics of ancient Greek philosophy, the notion of pharmakon carries two incommensurable meanings: remedy and poison, as understood in pharmacology or toxicology. More recent accounts of thinking with and through the figuration of the pharmakon attempt to extend its meaning beyond toxicology and those binaries, attending to its ambiguity, instability and fluidity.

In a deconstructive reading, the pharmakon as an indeterminate simultaneity of remedy/poison proves to be prolific in dialogue with endocrine disrupting substances. Understood as non-binary configuration, it can seep into the molecular worlds of bodies in constant modification and change. Hormones and their disruptors, whether synthetically or endogenously produced, are in this sense more than just molecules. They become "bio-artifacts made of carbon chains, language, images, capital, and collective desires."[1]

These substances are more than their chemical composition as they are simultaneously an integral part of global economic infrastructures. Their entanglements can be traced back another hundred years, when an increasingly globalized, militarized, capitalist world simultaneously reinforced the dependence on and the emergence of substances that we can understand as pharmakon. In the course of their existence, they have shifted, transcended, and eluded dichotomous conceptions.

1
Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2013), 167.

Toward an Inventory

With our partial inventory, we intend not only to take stock, compile, and order, but also to test the limits of these practices and their respective scientific formats. In that sense, we are extending the invitation to examine knowledge infrastructures, materializing through safety data sheets and pertinent lists, data structures, collections of chemical substances, and compound summaries in chemistry databases.

Attending to chemistry's classifications and taxonomies, we experiment with mimicking (in collaboration with graphic designers) individual "sheets" for a small number of substances. We chose widespread, if not ubiquitous, substances that circulate in everyday life. The sheet serves as a starting point and an exercise to examine the affordances, tensions, and troubles with classifications and capture-all inventories. In addition, it systematizes and standardizes the very substances that exceed the data sheet formats unfolding the categorizations and affordances in tension with or not captured by the sheet.

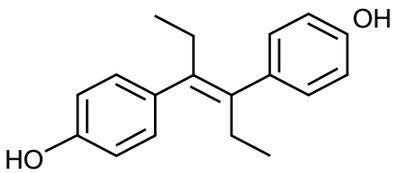
Our take can open different sensitivities, flexibilities, modifications, and disruptions that grasp these matters differently, resulting in interconnected, mixed stories of what else these substances are about. Starting from the substance itself, the sheet is a standardizing device, yet each compound brings its own transgressions and reconfiguration of the sheet.

As we intend to convey the broadness and variety of endocrine disrupting substances, we decided on the following ones:

- DES
- Paracetamol
- DDT
- PFAS
- Testosterone
- Soy
- ZEA
- BPA

This partial inventory will introduce each of these substances in terms of their elemental composition, using an expanded structural formula. These contain information on the molecular composition and structure, describing its composition and defining the compound/substance. This chemical notation contains not just the summary composition but also its molecular structure (in terms of how the elements combine and align), implying certain characteristics of the compound, for instance, with regard to solubility, binding capacity, and related metabolic pathways. We take these structural formulae as points of departure to examine the epistemic and economic entanglements each of these unruly substances.

DES



(Fig. 01)
Structural formula of diethylstilbestrol (DES).

LATENT EFFECTS

Diethylstilbestrol (DES), 4-[(E)-4-(4-hydroxyphenyl)hex-3-en-3-yl]phenol (C18H20O2), also known as stilbestrol or stilboestrol, is a nonsteroidal estrogen medication, hence a synthetic substance with estrogenic effects.[2] First synthesized in 1938, it was used for different estrogenic hormone therapies ranging from prevention of spontaneous abortion to postmenopausal breast cancer.[3] Later, it also found an application as a growth promoter for cattle and sheep. Its prescription to pregnant women was only scrutinized in 1971, as studies showed a potential relation between *in utero* exposure to DES and CCA (clear-cell adenocarcinoma of the vagina, a rare form of cancer), as well as other forms of cancer. Subsequently, it was banned from being prescribed to pregnant women and, only several years later, from its use as a growth promoter in livestock.[4] Although early knowledge of its effects was based on lab animals, it showed that DES is a potent estrogen that deviates from bodily-produced estrogen in its persistence in the body. It remained potent over unusually long periods, which made it difficult to understand its effects. In addition, it challenged the toxicological paradigm of "the danger is in dose," as it appeared to be even more effective in low doses.[5]

DES (HIS)STORIES AND DEVIANCE

Chemical castration is a technology targeting the cis-male body. Although rarely applied anymore, it was used to treat prostate cancer. Chemical castration, however, has several other effects, such as erectile dysfunction and reduction of sexual desire. With the advent of scientific discourses linking certain hormones to aggression, it appeared to be a legitimate punishment/treatment for deviancies, intersecting biopolitics, deviant bodies, and punishment. Thus, for the first time reported in 1944, DES was applied as a chemical castration substance for sex offenders, while, for a certain period, it was also combined with aversion therapy as part of a complex treatment regime for homosexual men.[6] The effectiveness of DES as part of this so-called treatment was controversial throughout, as sexual desire appeared to increase through erectile dysfunction.[7]

(Fig. 02)
Diethylstilbestrol glass prescription bottles. Image sourced from desdaughter.com/diethylstilbestrol-glass-prescription-bottles-from-1963.

DES CHILDREN

With the first studies published in the 1970s that linked certain types of cancer to *in utero* exposure to DES, the issue gained more public awareness, which gave rise to different ways of dealing with the effects of the drug. The activism that was part of an increasing number of embodied health movements pushed further investigations and was carried forward by first- and second-generation exposed women, the latter often referred to as DES daughters. Those became vocal and active in telling their stories, challenging the pharma regime and the medicalization of the female body.[8] Most active in the United States, they can also be found in other countries. However, there is another side to this alternate storytelling. DES has shifted from being part of the regime to "treat deviant bodies" to a substance under suspicion to cause "deviant desires and identities." Often formulated as concerns around the "feminization" of bodies, the impact or rather the relation between endocrine disrupting chemicals and sex/gender is under observation, and the question between "gender disorders" or "gender dysphoria" and DES is on the table. Apart from these diagnoses being flawed, problematic, and deeply rooted in binary conceptions of sex and gender, no scientific correlation was ever established. Therefore, it remains disconcerting that this problematic line of exploration is still integral to certain disciplines and contexts.[9]

2
Diethylstilbestrol, pubchem.ncbi.nlm.nih.gov/compound/448537.

3
Donna Haraway, "Awash in Urine: DES and Premarin® in Multispecies Response-Ability," *WSQ: Women's Studies Quarterly* 40.1 (2012): 301–16.

4
IARC Working Group on the Evaluation of Carcinogenic Risks to Pharmaceuticals, *A Review of Human Carcinogens, Volume 100* (Lyon: International Agency for Research on Cancer, 2012).

5
Nancy Langston, "The Retreat from Precaution: Regulating Diethylstilbestrol (DES), Endocrine Disruptors, and Environmental Health," *Environmental History* 13.1 (2008): 41–65.

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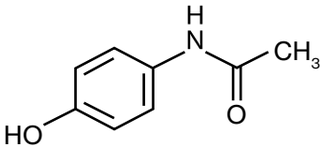
Charles Scott, Trent Holmberg, "Castration of Sex Offenders: Prisoners' Rights Versus Public Safety," *The Journal of the American Academy of Psychiatry and the Law* 31.4 (2003): 8.

7
Basil James, "Case of Homosexuality Treated by Aversion Therapy," *The British Medical Journal* 1.5280 (1962): 768–70.

8
Susan Bell, *DES Daughters, Embodied Knowledge, and the Transformation of Women's Health Politics in the Late Twentieth Century* (Philadelphia: Temple University Press, 2009); Haraway, "Awash in Urine."

9
Nicholas Neibergall, Alex Swanson, and Francisco Sánchez, "Hormones, Sexual Orientation, and Gender Identity," in *The Oxford Handbook of Evolutionary Psychology and Behavioral Endocrinology,* ed. Lisa Welling and Todd Shackelford (Oxford: Oxford University Press, 2019), 199–214; Rebecca Troisi, Julie Palmer, Elizabeth Hatch, William Strohsnitter, Dezheng Huo, Marianne Hyer, Karen Fredriksen-Goldsen, Robert Hoover, and Linda Titus, "Gender Identity and Sexual Orientation Identity in Women and Men Prenatally Exposed to Diethylstilbestrol," *Archives of Sexual Behavior* 49.2 (2020): 447–54.

Paracetamol



(Fig. 03)
Structural formula of paracetamol (acetaminophen).

UNCERTAIN EFFECTS

Paracetamol (C8H9NO2), also known as acetaminophen or N-(4-hydroxyphenyl)acetamide, is a medication used to treat fever and mild to moderate pain.[10] Although paracetamol seems to be ubiquitous in both households and pharmacies, it is associated with side effects. Most often, these side effects are discussed with concerns about liver and kidney failure in (unintentional) overdose. However, paracetamol has a more subtle and perhaps surprising ability to affect the body: studies suggest that it also acts as an endocrine disruptor.[11] However, these studies are still limited and sometimes contradictory. To date, research on these effects has focused on human fertility and potentially adverse reproductive effects targeting binary gendered bodies. The cis-male body is depicted as potentially at risk of reduced sperm quality and similar effects that could impair fertility.[12] For instance, testosterone production can be altered by exposure to paracetamol.[13] Similarly, the cis-female body is of interest during pregnancy. A growing body of experimental and epidemiologic research indicates that prenatal exposure to paracetamol and similar substances may impair fetal development and suggests a potentially increased risk for neurodevelopmental, reproductive, and urogenital disorders.[14]

A PILLAR OF THE POST-WAR ECONOMY

As the economy in Europe and the US grew following World War II, the demand for consumer goods increased as well. In Switzerland, traditional watch factories were among the beneficiaries of this economic upswing. Mostly women worked in these factories, assembling watches under restrictive regimes; putting together small pieces was a burden on the eyes and often caused headaches and fatigue.

One effective remedy for the drain of factory work was "a break, coffee and a piece of bread covered with butter and punched into the butter 'headache pills.'"[15] *Der Spiegel* reported in 1958 that Swiss and German physicians had observed the increased consumption of pain-relieving phenacetin,

10
Acetaminophen, pubchem.ncbi.nlm.nih.gov/compound/1983

11
Océane Albert, Christèle Lethimonier, Laurianne Lesne, Alain Legrand, François Guillé, Karim Bensalah, Nathalie Dejucq-Rainsford, and Bernard Jégou, "Paracetamol, Aspirin and Indomethacin Display Endocrine Disrupting Properties in the Adult Human Testis in Vitro," *Human Reproduction* 28.7 (May 2013): 1890–98.

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Saleem Ali Banihani, "Effect of Paracetamol on Semen Quality," *Andrologia* 50.1 (2018).

13
Jan-Bernd Stukenborg, Rod Mitchell, and Olle Söder, "Endocrine Disruptors and the Male Reproductive System," *Best Practice & Research Clinical Endocrinology & Metabolism, Endocrine disruptors* 35.5 (September 2021): 101567.

14
Ann Bauer, Shanna Swan, David Kriebel, Zeyan Liew, Hugh Taylor, Carl-Gustaf Bornehag, Anderson Andrade, et al., "Paracetamol Use during Pregnancy—a Call for Precautionary Action," *Nature Reviews Endocrinology* 17.12 (December 2021): 757–66.

15
Kay Brunner, B. Renner, and G. Tiegs, "Acetaminophen/Paracetamol: A History of Errors, Failures and False Decisions," *European Journal of Pain* 19.7 (2015): 953–65.

16
"Die Tablettomanen," *Der Spiegel* (1 July 1958), spiegel.de/politik/die-tablettomanen-a-8f22f165-0002-0001-0000-000041761782.

17
Brunner, Renner, and Tiegs, "Acetaminophen/Paracetamol."

which had given rise to a new condition resulting from drug consumption: phenacetin disease.[16] Phenacetin was, since its discovery, next to aspirin and phenazone, one of the major drugs on the market for relief from pain and fever alike. The newly coined phenacetin disease regularly occurred in young and middle-aged women who often worked in the watch industry. These women suffered initially from high blood pressure, later from kidney disorder and pigmentation of the skin.

In some cases, they died from heart attacks. Ultimately, as one consequence of this newly occurring issue, the drug regime changed. Paracetamol, a main metabolite of phenacetin, became the supplement drug on the market. Not only did it carry the promise of lower abuse potential, it was also thought to be less toxic for kidneys.[17] The working conditions in the factories, however, remained the same.

(Fig. 04)
Paracetamol purchased in the pharmacy next door. Photo by Franziska Klaas.

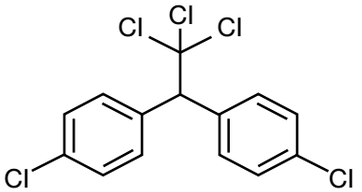
LIVING WITH PARACETAMOL

Recently, Pakistan has announced a paracetamol shortage as not only Covid-19 but cases of dengue fever also hit the country hard.[18] Before physicians and experts from different countries had advised using paracetamol instead of ibuprofen due to its anti-inflammatory effects on mild Covid-19 symptoms, India stopped the export of several drugs, among them paracetamol, to ensure the supply for their own population.[19] Paracetamol has been of global relevance on the drug market for decades. It is one of the most purchased over-the-counter drugs, common in many households and often recommended to treat all kinds of minor ailments one experiences in everyday life, from headaches to period cramps, fever, or toothaches.

During the Covid-19 pandemic, however, the situation intensified, illustrating a new height in the global success story of paracetamol while signifying a mundane, unabated dependency on low threshold meds with potentially uncertain side effects.

18
"Pakistan Faces Paracetamol Shortage Amid Rising Covid and Dengue Cases," *DNA India* (3 February 2022), dnaindia.com/world/report-pakistan-faces-paracetamol-shortage-amid-rising-covid-and-dengue-cases-drug-regulatory-authority-notice-2931972.

19
Michael Day, "Covid-19: Ibuprofen Should Not Be Used for Managing Symptoms, Say Doctors and Scientists," *BMJ* 368 (March 2020): m1086; Hannah Ellis-Petersen, "India Limits Medicine Exports After Supplies Hit By Coronavirus," *The Guardian* (4 March 2020), theguardian.com/world/2020/mar/04/india-limits-medicine-exports-coronavirus-paracetamolantibiotics.



(Fig. 05)
Structural formula of dichlorodiphenyltrichloroethane (DDT).

SLOW EFFECTS

Clofenotane, also dichlorodiphenyltrichloroethane (DDT), or 1-chloro-4-[2,2,2-trichloro-1-(4-chlorophenyl)ethyl]benzene, is a colorless, tasteless, and almost odorless crystalline chemical compound, an organochloride developed as an insecticide. It has the structural formula C14H9Cl5.[20]

While DDT had been known before, it was fully developed as an insecticide in a time of war, which comprised not only a war against humans but also against other living beings like insects. The first experiments showed it effective against some bugs, attacking the central nervous system, with no immediate effects on humans.[21] Crucially, its effects appeared to be long-lasting. This factor was initially celebrated, but later turned into a concern about persistence, also due to Rachel Carson's influential book *Silent Spring,*[22] which popularized knowledge on DDT as an insecticide with broad effects on non-human animals and the environment.

The effects of DDT on human beings became public much later, as scientific correlations are difficult to establish. Although DDT was found in breast milk and was soon after acknowledged as an accumulating substance, it is only more recently that DDT became known as an endocrine-disrupting substance that can affect the reproduction system of mammals or even cause cancer. It can, for instance, attach to and activate estrogen receptors.[23] The temporalities of DDT and its effects are still a quandary, as they are often latent, differ between acute and chronic exposure, and potentially reach far into the future, affecting lives and bodies over generations.[24]

WAR STORIES

While DDT is commonly associated with the fight against malaria, it is equally a substance intimately intertwined with techno-war infrastructures and economies targeting lice. A neglected substance until then, DDT was fully developed and recognized in its potential amid the turmoil of World War II, as insect-borne diseases in Europe and North Africa became a war determining factor. One issue was malaria, which occurred

20
Clofenotane, pubchem.ncbi.nlm.nih.gov/compound/3036.

21
Thomas Dunlap, "Science as a Guide in Regulating Technology: The Case of DDT in the United States," *Social Studies of Science* 8.3 (August 1978): 265–85.

22
Rachel Carson, *Silent Spring* (London: Penguin Books, 1962).

23
Mathilde Munier, Mohammed Ayoub, Valentine Suteau, Louis Gourdin, Daniel Henrion, Eric Reiter, and Patrice Rodien, "In Vitro Effects of the Endocrine Disruptor p,p'DDT on Human Choriogonadotropin/Luteinizing Hormone Receptor Signalling," *Archives of Toxicology* 95.5 (May 2021): 1671–81.

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Evanthia Diamanti-Kandarakis, Jean-Pierre Bourguignon, Linda Giudice, Russ Hauser, Gail Prins, Ana Soto, Thomas Zoeller, and Andrea Gore, "Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement," *Endocrine Reviews* 30.4 (June 2009): 293–342.

25
Mahmoud Boualam, Bruno Pradines, Michel Drancourt, and Rémi Barbieri, "Malaria in Europe: A Historical Perspective," *Frontiers in Medicine* 8 (2021).

in southern Europe until the mid-20th century,[25] but above all, louse-born typhus proved to be the most pressing challenge. In the US, generous funding went into establishing the "Louse Lab," a scientific unit solely responsible for tackling the typhus problem caused by the war. After the first shipment of DDT had reached the US from Switzerland in 1942, the war accelerated its development into an insecticide desired. From tests in Mexico and then Algeria, it was released into broad production and use.[26]

(Fig. 06)
A displaced person is dusted with DDT during the Rhineland Campaign (a series of Allied offensive operations at the end of World War II). Image source: Wikimedia Commons.

THE LONGUE DURÉE OF DDT

DDT was banned in many countries already in the 1970s.[27] Officially, today it is only produced in India and only used in a few countries where it is limited to fighting malaria and other vector-borne diseases.[28] Often, as a legacy chemical, DDT circulates globally, persists in the environment, and accumulates in bodies and food chains; it is due to its persistence that legacy DDT and its metabolites are globally ubiquitous and deeply entangled with bodies and environments. Still, exposure to DDT is unevenly distributed with a crucial demarcation line between the Global North and South.

In some cases, acute and long-term exposure to DDT overlap, as is the case for workers in one of the Indian factories that are still producing DDT, or for users of DDT fighting malaria.[29] In other cases, the long-term effects of legacy DDT are astonishing. For instance, Norway has banned the use of DDT in agriculture in 1970, yet DDT is still one of the two most prevalent pesticides found in Norwegian Atlantic salmon.[30] The longue durée of DDT, and its omnipresence as a residue in soil or fatty tissue, point towards the depth of its ever shifting yet enduring spatial and temporal entanglements with bodies and environments.

26
Darwin Stapleton, "A Lost Chapter in the Early History of DDT: The Development of Anti-Typhus Technologies by the Rockefeller Foundation's Louse Laboratory, 1942-1944," *Technology and Culture* 46.3 (2005): 513–40.

27
Munier et al., "In Vitro Effects of the Endocrine Disruptor p,p'DDT on Human Choriogonadotropin/Luteinizing Hormone Receptor Signalling."

28
Henk van den Berg, Gamini Manuweera, and Flemming Konradsen, "Global Trends in the Production and Use of DDT for Control of Malaria and Other Vector-Borne Diseases," *Malaria Journal* 16.1 (December 2017): 1–8.

29
van den Berg et al., "Global Trends in the Production and Use of DDT for Control of Malaria and Other Vector-Borne Diseases."

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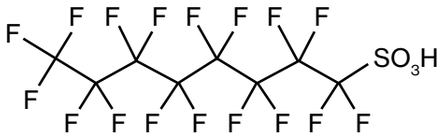
Annette Bernhard and Rita Hannisdal, "Monitor-Ing Program For Pharma-Ceuticals, Illegal Substances and Contaminants in Farmed Fish", *Annual Report for 2020*, (July 2022), hi.no/en/hi/nettrapporter/rapport-fra-havforskningen-en-2021-40.

PFAS



(Fig. 07)
Structural formula of perfluorooctanesulfonic acid.

CHEMISTRY/ MOLECULAR FORMULA

PFAS (per- and polyfluoroalkyl substances) comprise a group of thousands of chemical substances: CxFxHxSx. One example from this group is *perfluorooctanesulfonic acid* or 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluorooctane-1-sulfonic acid (PFOS), with the molecular formula of C8HF17O3S. This anthropogenic chemical is colorless, water-soluble, and has been used as a fabric protector. It is ubiquitously present in the earth's surface, including human and animal bodies, and it is also present in the products of any donor blood bank.

MIMICRY/CAMOUFLAGE

PFAS influence hormone levels in humans and other species by affecting and modifying levels of estradiol and testosterone. As endocrine disruptors, they interfere with hormone signaling and thus impact on various functions and processes in the body. The hormone mimicking property is attributed to the molecular structure of PFAS, yet the mechanisms of binding are variegated and only partially described.[31] This version of mimicry is bound to a binary understanding of the hormonal body, a legacy of epistemological binaries.

PROPERTIES AND USAGES

PFAS are, due to their persistence, also called "forever chemicals." PFAS are found in paints, lubricants, ski wax, pesticides, medicines, and fire-fighting foams, to name a few of their more well-known applications. This group of anthropogenic chemicals make industrial products resistant against lipids and water. These intended properties are precisely what is harmful to organisms and ecosystems, as they accumulate and biomagnify within food webs. Manufactured and used for decades, these chemicals do not degrade in the environment, but are transported with particles through oceans and air. With varied characteristics

31
Supratik Kar, Maria S. Sepúlveda, Kunal Roy, and Jerzy Leszczynski, "Endocrine-Disrupting Activity of Per- and Polyfluoroalkyl Substances: Exploring Combined Approaches of Ligand and Structure Based Modeling," *Chemosphere* 184 (2017): 514–23.

and industrial applications, as a substance group and chemical category PFAS emerged in the context of attempts to regulate industrial chemicals.

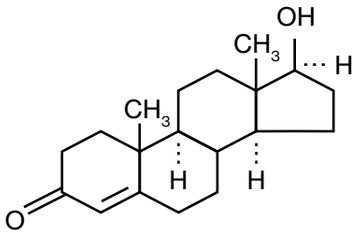
REGULATING UNCONTAINABLE UBIQUITOUS SUBSTANCES

The attempt to regulate gave rise to the name PFAS as a group category. Regulatory frameworks have been long focusing on assessments of individual chemical components. Yet, when the regulation of chemicals is based on single substances, new "replacement chemicals" can be synthesized before they are a regulatory concern.[32] Synthetic chemistry is a dynamic field that can modify and reinstate products, thereby attending to and bypassing regulation. Addressing groups of chemicals like PFAS has been a novel effort to cope with the vast amount of uncontrolled chemicals that comprise this group.

32
Carol F. Kwiatkowski, David Q. Andrews, Linda S. Birnbaum, Thomas A. Bruton, Jamie C. DeWitt, Detlef R.U. Knappe, Maricel V. Maffini, Mark F. Miller, Katherine E. Pelch, Anna Reade, Anna Soehl, Xenia Trier, Marta Venier, Charlotte C. Wagner, Zhanyun Wang, and Arlene Blum, "Scientific Basis for Managing PFAS as a Chemical Class," *Environmental Science & Technology Letters* 7.8 (2020): 532–43.

(Fig. 08)
PFAS treated stain-repellent fabric. Image from silentspring.org; reproduced with permission.

Testosterone



(Fig. 09)
Structural formula of testosterone.

CHEMISTRY/MOLECULAR FORMULA

C19H28O2 is a substance described as a “sex hormone and anabolic steroid” (aka testosterone) [Fig. 01]. In chemical classification and safety sheets, the substance is described in its purified and/or synthetic mode. The chemical safety sheet provides information on how the substance is to be handled in the lab in its pure, isolated form with its characteristics (white crystal) and toxicity labels (“irritant, health hazard, environmental hazard”) and how it is has to be disposed of safely.

DISTRIBUTION

The Human Metabolome Database describes testosterone as “the most important androgen in potency and quantity for vertebrates.”[33] It is a metabolic substance present in bodies of all genders, but at variegated and changing degrees.

ANALYTICS

Beyond medical or diagnostic usage, testosterone is among the main substances targeted in doping controls. In Norway, the logistics and routines for large scale measurement of testosterone were developed in preparation for the 1994 Olympics in Lillehammer [Fig. 02].

BORDER SUBSTANCE

Levels of the hormone testosterone in humans are used for including, excluding, and determining a range that allows a person to compete as a woman. Not only does this discriminate against trans athletes, it also redefines who is a woman. For instance, South African athlete Caster Semanya was ordered to lower her testosterone through medication in order to compete as a woman. A gender-border substance, it also

33
Human Metabolome Database, hmdb.ca.

(Fig. 10)
Hormone analytics circa 1980s: high-pressure liquid chromatography apparatus named ODIN displayed at Ahus Sykehus Hormone Lab, Oslo, 2019. Photo by Susanne Bauer.

engenders those bodily conditions as a disease in need of treatment, such as “female athletes with hyperandrogenism, a medical condition.”[34] Here, unruly bodies and the continuum of hormone levels are regulated to fit into arbitrarily set gender cutpoints. In their article on the regulation of testosterone in the US, Toby Beauchamp called testosterone “the substance of borders.”[35] Judith Butler’s writings on gender trouble have shown how biological sex is being stabilized as a result of performative enactments and practices, as is gender.[36] In biology, there are multiple ways of defining sex, even when conceptualized as a binary category, with genetic, chromosomal, hormonal, and morphological sex—and these can be divergent within individuals. Hormonal sex is just one of these biological categories and often these different sexes and the respective categories are not in agreement.

BEYOND BINARIES

Practices of entering into new conversations with these substances include modes of undoing, (non)transitioning, and experimenting differently. This includes, for instance, rethinking how datafication devices are grafted on bodies, thereby opening them up for reconceptualizing and reassembling relationships to technologies as they enter, dissolve, and become the body.[37] Such interventions trace fragments from history and engage in different futurings toward reconceptualizing deeply entrenched epistemic constraints, such as binary gender.

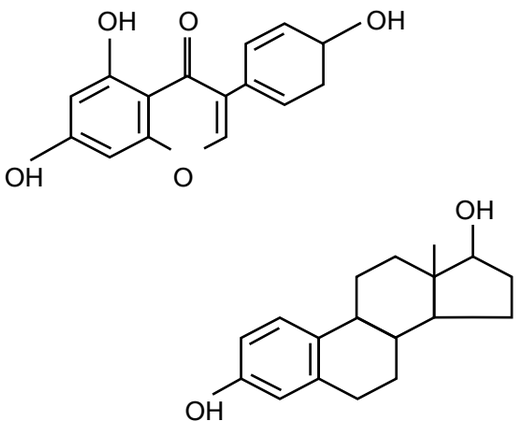
34
Martha Kelner and James Rudd, “Caster Semenya could be forced to undertake hormone therapy for future Olympics,” *Guardian* (3 July 2017) theguardian.com /sport/2017/jul/03/caster-semenya-could-be-forced-to-undertake-hormone-therapy-for-future-olympics.

35
Toby Beauchamp, “The Substance of Borders: Transgender Politics, Mobility, and US State Regulation of Testosterone,” *GLQ* 19.1 (2013): 57–78.

36
Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990).

37
Paul P. Preciado, “Pharmaco-pornographic Politics: Towards a New Gender Ecology,” *Parallax* 14:1 (2008), 105–17.

Soy



(Fig. 11)
Structural formula of soybean isoflavone genestin aglycone.

COMMERCIAL CROP, CONTAINING PHYTOESTROGENS

Soy is the plant with highest known concentrations of isoflavones [Fig. 01], a group of phytoestrogens, structurally similar to estradiol, mimicking hormones and modulating endocrine and metabolic pathways.[38] Soy has made an unparalleled career as a commercial crop. A “flex crop” with highly different sorts of harvesting and processing, it makes up an extractive industrial frontier of global agribiopolitics.[39] Soy has been intensively bred and grown as monocrop, it has taken over entire habitats and entered the global supply chains of meat production.

USAGES

Soy is a protein source to human nutrition, for instance in tofu and tofu products, catering to traditional and new markets for meat replacement. Soy also contains molecules that belong to phytoestrogens, hence are hormonally active. With a variety of mechanisms of how phytoestrogens mimic or interact with hormones, their molecular structures bind at estrogen receptors and interfere as ligands to molecules involved in these bodily processes. Soy has been marketed as part of health foods and scientists also attribute beneficial effects to these characteristics; at the same time, cautionary warnings advise survivors of breast cancer or ovarian cancer that they should avoid phytoestrogens.

38
Christopher R. Cederroth and Serge Nef, “Soy, Phytoestrogens and Metabolism: A Review,” *Molecular and Cellular Endocrinology*, 304.1–2 (2009): 30–42; Joseph V. Turner, Snezana Agatonovic-Kustrin, and Beverley D. Glass, “Molecular Aspects Of Phytoestrogen Selective Binding at Estrogen Receptors,” *Journal of Pharmaceutical Sciences* 96.8 (2007): 1879–85.

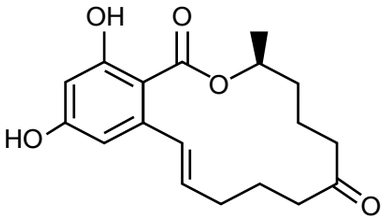
39
Kregg Hetherington, *The Government of Beans* (Durham: Duke University Press, 2020).

(Fig. 12)
Soy plant with beans.
Image source:
Wikimedia Commons.

GROWTH COMMODITY

Cheap on the world market, technoscientifically optimized soy breeds are also a major component of animal feed in the meat industry. In large-scale aquaculture, salmon is fed mostly with pellets containing soy. Commercial pellets contain soy or corn, minerals, vegetable oils, and vitamins, as well as fish oil. Salmon are predatory fish, living on other fish. Shifting to a vegetarian diet, despite the addition of fish oil, as is standard in aquaculture plants, has led to various diseases of cultured salmon. Switching to soy-based feed has not remained without consequences: diseases were met through permanent medication in fish farms, while research on genetic modification of salmon is now working toward adapting farmed fish to plant-based feed. Growth, literally, was put first.

ZEA



(Fig. 13)
Structural formula of zearalenone (ZEA).

ZEARALENONE, A MYCO-ESTROGEN

Zearalenone (ZEA) is a mycotoxin, a fungal poison, produced by different fungi species with a global distribution. ZEA or 6-(10-hydroxy-6-oxo-trans-1-undecenyl) β-resorcylic acid lactone has a molecular formula of $C_{18}H_{22}O_5$.[40]

Although it is known as a mycotoxin, some scientists refer to ZEA as a myco-estrogen because its harmful effects are due to its structural similarities to naturally occurring estrogens.[41] These similarities allow it to bind to estrogen receptors, which can have a variety of diverse effects in more-than-human bodies.[42] The total contribution of ZEA to the overall occurrence of xenoestrogens, substances that have estrogen-like properties, can only be surmised. However, it is now known that even low concentrations of ZEA can cause hyperestrogenic syndromes (increased estrogenic activities) in pigs and other domestic animals, while higher concentrations can lead to reproductive problems. Pigs appear to be the most sensitive group of animals to the effects of ZEA.[43] The effects on humans are less well known and documented. ZEA is an ambiguous substance; for a short period, due to its properties, it was considered not only a threat but also medicine, as it was used to treat postmenopausal symptoms in women and was patented as an oral contraceptive.[44] Today, the potential of ZEA points in different directions as both a potential endocrine disrupter and a substance with potential for cancer treatment.[45]

FUNGI AND MYCOTOXINS

Since the beginning of the twentieth century, a correlation between moldy grain consumption and high estrogenic activity in animals like pigs was observed. But research and knowledge only became available after mycotoxins entered the body of scientific knowledge in the 1960s with the discovery of aflatoxin and the subsequent golden era of research on mycotoxins—toxic substances produced by fungi.[46]

Fungi are a fascinating life form. Neither plant nor animal, shifting in their sexual stages, they appear as the

40
Zearalenone, pubchem.ncbi.nlm.nih.gov/compound/Zearalenone.

41
Abbas Ali Jafari-Nodoushan, "Zearalenone, an Abandoned Mycoestrogen Toxin, and Its Possible Role in Human Infertility," *International Journal of Reproductive Biomedicine* 20.2 (March 2022): 151–53.

42
Jafari-Nodoushan, "Zearalenone, an Abandoned Mycoestrogen Toxin, and Its Possible Role in Human Infertility."

43
Abdellah Zinedine, Jose Miguel Soriano, Juan Carlos Moltó, and Jordi Mañes, "Review on the Toxicity, Occurrence, Metabolism, Detoxification, Regulations and Intake of Zearalenone: An Oestrogenic Mycotoxin," *Food and Chemical Toxicology* 45.1 (January 2007): 1–18.

44
Arun Bhunia, *Foodborne Microbial Pathogens* (Berlin: Springer, 2008).

45
Karolina Kowalska, Dominika Ewa Habrowska-Górczyńska, and Agnieszka Wanda Piastowska-Ciesielska, "Zearalenone as an Endocrine Disruptor in Humans," *Environmental Toxicology and Pharmacology* 48 (December 2016): 141–49.

46
Joan Wennstrom Bennett and Maren Klich, "Mycotoxins," *Clinical Microbiology Reviews* 16.3 (July 2003): 497–516.

47
Paul Dyer and Ulrich Kück, "Sex and the Imperfect Fungi," *Microbiology Spectrum* 5.3 (June 2017).

epitome of an existence in-between. Some fungi, which scientific literature calls imperfect fungi, are commonly known as molds. Unlike other fungi, they exist only in an asexual stage and thus diverge reproductively from most other fungi. *Fusarium* is one genus of such fungi, commonly found in soil and organic remains, causing diseases in plants.[47] Like many other fungi, *Fusarium* produces several different metabolites that are toxic, which are often found in crops and grain. One of mycotoxins produced by *Fusarium* is ZEA.

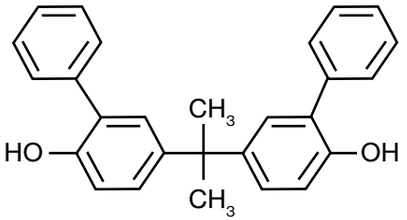
(Fig. 14)
Fusarium (a genus of fungi that produce the mycotoxin ZEA) fruit rot on a peach. Image Source: Wikimedia Commons.

ZEARALENONE AND THE AGRICULTURAL INDUSTRY

ZEA, as other mycotoxins, affect food production worldwide. Only visible as a mold that attaches itself to corn and grains, it creates concerns about food security worldwide, from small scale farming to the industrialized agrarian sector. ZEA's impact extends further into the livestock and meat production sectors. In China, for instance, the interconnectedness of the agricultural sector and the swine industry becomes most evident. China has 50 percent of the world's market for pork, making it one of the largest meat suppliers and producers. At the same time, the country is confronted with a comparatively large amount of crops contaminated with *Fusarium*, and thus with ZEA, illustrating the far reaching entanglements of fungi, endocrine disruptors, and the industrialized agrarian sector.[48]

48
X. X. Chen, C. W. Yang, L. B. Huang, Q. S. Niu, S. Z. Jiang, and F. Chi, "Zearalenone Altered the Serum Hormones, Morphologic and Apoptotic Measurements of Genital Organs in Post-Weaning Gilts," *Asian-Australasian Journal of Animal Sciences* 28.2 (February 2015), 171–79.

BPA



(Fig. 15)
Structural formula of bisphenol A (BPA).

Bisphenol A (BPA)—C15H16O2—is a synthetic plasticizer used in the production of plastics and epoxy resins that make up the inner coatings to metallic food cans. Different from other POPs, BPA is not only added to plastics in order to achieve certain characteristics, but it is used as monomer or co-monomer—hence the very building block of polycarbonate plastics. Used to make plastics, it is produced in millions of tons worldwide and released into the environment in large amounts every year. BPA is a confirmed endocrine disruptor acting on various mechanisms of the endocrine system and one of the most widespread hormone mimicking substances. Especially when heated, BPA leaches from reusable plastic containers and is then ingested via food.[49]

DISRUPTED EXPERIMENTS AND TOXICITY ASSESSMENTS

With its first synthesis in the late nineteenth century, BPA's usage in the chemical industry goes back to the 1930s and 1940s, when it was used as a plasticizer in PVC, followed by using BPA as monomer for new polycarbonate plastics in the 1950s. Controversies over endocrine disrupting effects of this "xenoestrogen" have accompanied its productions and applications. In the life sciences, some of BPA's effects have only been observed after certain phenomena could not be explained in ongoing animal experiments, as mice showed unforeseen effects within experimental environments.[50] Sometimes, those effects remained unexplained, until researchers began considering the unintended presence of endocrine disrupting chemicals in the laboratory environment, including the cages and the water bottles. Heated before usage, these plastic bottles released endocrine disruptors, which the animals ingested. Endocrine disrupters leaching from the plastics material of laboratory equipment interrupted the controlled conditions for experiments designed to assess the effects of toxic chemicals.

49
Laura N. Vandenberg, Maricel V. Maffini, Carlos Sonnenschein, Beverly S. Rubin, and Ana M. Soto, "Bisphenol-A and the Great Divide: A Review of Controversies in the Field of Endocrine Disruption." *Endocrine Reviews* 30.1 (2009): 75–95, doi.org/10.1210/er.20080021; Christopher D. Kassotis, Laura N. Vandenberg, Barbara A. Demeneix, Miquel Porta, Remy Slama, and Leonardo Trasande, "Endocrine-Disrupting Chemicals: Economic, Regulatory, and Policy Implications," *Lancet: Diabetes & Endocrinology* 8.8 (2020): 719–30.

50
Hannah Landecker, "Food as Exposure: Nutritional Epigenetics and the New Metabolism," *BioSocieties* 6.2 (2011): 167–94.

(Fig. 16)
Plastic bottle with a BPA free label. Image source: Wikimedia Commons.

DISRUPTED REGULATORY ASSUMPTIONS

BPA is structurally similar to DES. Until recently certain assumptions "the dose makes the poison" have been key in toxicity assessments.[51] These shapes, different forms, and the lower dose ranges were often controversial as to whether there was a threshold or not below which an agent was safe. Within this framework, scientists worked with extrapolating linear dose-response from higher to lower dose ranges. These practices have long guided toxicity assessments and scientific knowledges produced and used for regulation. Yet established scientific standards and assumptions on dose-response relationships do not hold for endocrine disruptors such as BPA—here toxicity studies show not only more complex interactions in mixtures, but also non-monotonic relations.[52] Findings about non-monotonic dose-response relations challenge and reshape not only toxicology and pharmacology, but also impact regulatory assumptions and the politics of proof and compensation that they have relied on.

51
Sarah A. Vogel, "The Politics Of Plastics: The Making and Unmaking of Bisphenol a 'Safety'," *American Journal of Public Health* 99.S3 (2009): S559–S566; Jane Muncke, "Tackling The Toxics In Plastics Packaging," *PLoS Biology* 19.3 (2021): e3000961.

52
Genoa R. Warner and Jodi A. Flaws, "Bisphenol A and Phthalates: How Environmental Chemicals Are Reshaping Toxicology," *Toxicological Sciences* 166.2 (2018): 246–49; Laura N. Vandenberg, Theo Colborn, Tyrone B. Hayes, Jerrold J. Heindel, David R. Jacobs Jr, Duk-Hee Lee, Toshi Shioda, Ana M. Soto, Frederick S. vom Saal, Wade V. Welshons, R. Thomas Zoeller, and John Peterson Myers, "Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses," *Endocrine Reviews* 33.3 (2012): 378–455.

Glossary of Terms

The collectively written glossary of terms offers brief definitions of key terms and conceptual ideas explored in the book. Alphabetically arranged entries in this glossary are not meant to be comprehensive, authoritative definitions of the terms but seek instead to provide accessible introductions to both technical terms and philosophical ideas that are important for our research. The entries range from informative descriptions to more subjective explanations and interpretations. Our hope is that together they may serve as building blocks for further exploration and discussion of synthetic hormones, endocrine disruptors, and emerging forms of chemical kinships, queer ecologies, earthly survival, and more-than-human resistance, care, and healing.

■ ALTERLIFE

Alterlife is a figuration of chemical exposure developed by technoscience studies scholar Michelle Murphy focused on collectivities of chemicalized existence entangled with capitalism and its colonial manifestations.[1] Working from colonial and capitalist pasts and presents and moving towards differently imagined futures, alterlife indexes not only life in its already altered state as a result of the chemical production of capitalism, but also life that is open to further alterations—life that has the potential to become something else. Alterlife embraces impure and contaminated forms of life, affirming their capacity to recompose and recombine within and against infrastructures of violence.

—LV

■ ANTHROPOCENE

The term Anthropocene, popularized by atmospheric chemist Paul Crutzen, originates in geology, but has gained wider currency in the social sciences, humanities, and the arts, while also capturing the popular imagination and gaining media attention—acting as shorthand for a deterioration of living conditions on Earth owing to anthropogenic activity.[2] Although it now serves as a framework for coming to terms with a variety of temporally extended and vastly distributed anthropogenic disruptions, including the disruption to the diversity, biology, and ecology of living organisms, the common representations of the Anthropocene observe its original geological reference and foreground the impacts of mass extraction and consumption of fossil fuels.

—LV

1
Michelle Murphy, "Alterlife and Decolonial Chemical Relations," *Cultural Anthropology* 32.4 (2017): 494–500; Michelle Murphy, "Against Population, Towards Alterlife," in *Making Kin Not Population,* eds. Adele E. Clarke and Donna J. Haraway (Chicago: Prickly Paradigm Press, 2018), 101–23.

2
Paul Crutzen, "Geology of Mankind," *Nature* 415.23 (January 2002).

■ BIO-COLONIALISM, BIO-COMMERCIALISM

Biocolonialism, intrinsically tied with bio-commercialism, is a one-way power dynamic of biological information and data being extracted from disenfranchised, disempowered peoples or communities or groups for the benefit of the people doing the extraction or the people that hold the power in that relationship. This could be, for example, scientists entering Indigenous communities and taking biological data and information for their own scientific purposes. It could be for-profit companies entering into disenfranchised communities or groups and seeing data for their own commercial profit and benefit. But generally, it's a description of the one-way extraction of data and biological information to support the colonizers in whatever power imbalance.

—KT

■ BIOHACKING

Biohacking refers to performance of non-institutional science with origins from the DIY and computer hacking movement. While there are several sub-genres of biohacking that point to modern uses of technology (e.g., transhumanism, quantified self, etc.), this book emphasizes the democratizing and collectivizing potential of biohacking and recognizes that there is nothing inherently futuristic nor utopian about the practice. To quote from the Center for Genomic Gastronomy and the global Hackteria network, "We have always been biohackers."[3]

—MM

■ BIOPOLITICS

Biopolitics refers to the intersection of economic, political, and cultural influence over the bodily autonomy of human and non-human species.

—BR

■ BIOPOWER

Biopower is a term coined by French philosopher Michel Foucault to describe the techniques for the subjugation of individuals and the control of populations adopted by modern nation states. Returning to Foucault's analysis, transfeminist theorist Paul B. Preciado points out how disciplinary management of bodies persists but its logic is now discrete, privatized, individualized, and—with the administration of population through pharmacological control—also diffuse and molecular.[4] With the new technologies of pharmacological self-management and self-surveillance, such as hormonal surveillance through menstrual apps designed to self-regulate cycles and ovulation, bodies are disciplined and

3
The Center for Genomic Gastronomy, genomic-gastronomy.com; Hackteria, hackteria.org.

4
Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2017).

their biodata exploited for profit by companies that collect, own, and extract value out of them.

—MF, ZR

■ BIRTH CONTROL PILL, CONTRACEPTIVE PILL, THE PILL

A hormonal contraceptive method that consists in the daily ingestion of a pill containing a varying mix of estrogens and progestins, which prevents pregnancy by inhibiting ovulation. "The Pill" was developed in the United States in the 1950s, first tested in animals and then in Puerto Rican women, mirroring colonial relations between the two countries, and then quickly adopted by millions of women in the Western, industrialized world.[5] Although short-term contraceptive methods, such as the birth control pill or condoms, come only second to long-term contraceptives such as intra-uterine devices (IUDs) and female sterilization worldwide, there is no other method used in as many countries as the birth control pill. Its use, however, concentrates in Africa and Europe, being the main contraceptive method in many European countries.[6] The birth control pill has a fascinating and versatile history. In the 1960s and 1970s, it was mobilized by feminist movements around the world for the advancement of women's right to decide if and when to bear children.[7] The Pill has also, at different and numerous times, been criticized for asymmetrically placing the burden of contraceptive work and side effects, that reportedly range from weight gain to cancer, solely on women and people with ovaries. More recently, the synthetic hormones contained in the contraceptive pill have been associated with concerns with environmental pollution and endocrine disruption.

—MRS

■ BISPHENOL A (BPA)

A synthetic plasticizer used in the production of plastics and epoxy resins that make up the inner coatings to metallic food cans. BPA is a confirmed endocrine disruptor and one of the most widespread hormone-mimicking substances. Especially when heated, BPA can leach from plastic containers into food.

—SB, FK

■ BODIES OF WATER

To conceptualize our bodies as watery beings, as hydrofeminist Astrida Neimanis proposes, is to acknowledge that our existence is situated in myriad relations with other human, nonhuman, and more-than-human bodies.[8] For Neimanis, water—more than any other element—entangles human

5
Nelly Oudshoorn, *Beyond the Natural Body: An Archaeology of Sex Hormones* (London: Routledge, 1994).

6
"Trends in Contraceptive Use Worldwide," *Economic & Social Affairs* (New York: United Nations, 2015).

7
Bibia Pavard, *Si je veux, quand je veux: Contraception et avortement dans la société française* (Rennes: PU Rennes, 2012).

8
Astrida Neimanis, *Bodies of Water: Posthuman Feminist Phenomenology* (London: Bloomsbury Academic, 2016).

bodies with more-than-human worlds. As two-thirds of the human body are composed of water, we come to be and live in watery milieus: in many ways, we are water, and we depend on water for our survival. Examining the philosophical and ethical implications of where our water comes from, where it goes, and what happens to it along the way is key to hydrofeminism—a posthuman feminist phenomenology (and ethics) developed by Neimanis. Hydrofeminism considers the stakes of the intense interdependency of bodily and planetary waters, investigating what it means to be connected, indebted, and accountable to other planetary bodies of water with which we come into contact.

—LV

■ CHEMICAL ANTHROPOCENE

The Chemical Anthropocene designates an epoch in which every corner of the planet and every part of the body are exposed to, and affected by, industrially manufactured chemicals. It marks an era of absolute and permanent exposure where nothing is safe or pure, and the only way forward is with and despite toxic anthropogenic chemicals. The Chemical Anthropocene thus calls for effective forms of resistance, not merely by demanding the accountable production, use, and disposal of chemicals, but also by cultivating forms of resilience and care attuned to the experience and needs of a life already altered by exposure to man-made chemicals.

—LV

■ CHEMICAL KINSHIP

With the notion of chemical kinship, interdisciplinary scholars Angeliki Balayannis and Emma Garnett probe what finding good kinship with "bad" chemicals might involve.[9] Building on decolonial feminist research on chemicals, Balayannis and Garnett encourage collaborative, interdisciplinary, and inventive ways of attending to environmental chemicals that are never entirely "good" nor "bad"—being, to some extent, always both enabling and harmful. Rather than investing in purity politics, the concept of chemical kinship invites an expansive, open-minded approach to researching chemicals and learning to live well with them, extending the relationships of care and responsibility to potentially harmful and hazardous material entities.

—LV

■ CHEMICAL REGULATION

National and international legislative frameworks for regulating chemicals aim to ensure high levels of protection for human health and the environment. Such frameworks are

9
Angeliki Balayannis and Emma Garnett, "Chemical Kinship: Interdisciplinary Experiments with Pollution," *Catalyst: Feminism, Theory, Technoscience* 6.1 (Spring 2020): 1–10.

developed and managed by means of national laws, national and international regulatory agencies, and international initiatives, agreements, and conventions. Under the currently existing neoliberal governance systems, though, many regulatory decisions tend to be lax and industry-friendly, facilitating investment and economic growth instead of protecting public health and the environment. More often than not, decisions about the banning of chemical agents for use in industrial production are based on a utilitarian calculation of the potential benefits and harms, which exaggerates the social and economic benefits of toxic chemicals, while downplaying the suspected or known costs in terms of the health of humans, nonhuman organisms, and the environment. Environmental justice researchers Reena Shadaan and Michelle Murphy refer to governance systems that justify the continued production of known toxins and "acceptable" risks to health as "permission-to-pollute regulatory systems," while pointing out the links between such systems and the structures of settler colonialism and racial capitalism.[10]

—LV

■ CORPOREAL EXCEPTIONALISM

Drawing on Mel Y. Chen's *Animacies,* philosopher Alexis Shotwell describes corporeal exceptionalism in her book *Against Purity* as the idea that bounded bodies can exist in conditions of individual purity and therefore resist being shaped or altered by the world.[11] The belief that bodies can be ontologically separable serves a politics of purity that removes the complexity and complicity of living on a contaminated planet. However, Chen argues that it is only with the recognition of our interdependence that we can truly claim toxicity as the way things already are.

—MM

■ CYBORG

The figure of the cyborg was introduced by Donna J. Haraway, a multispecies feminist theorist, in her landmark essay titled "A Cyborg Manifesto," published in 1985.[12] Her essay sparked a paradigm shift in feminist theory that paved the way for the emergence of material/posthuman feminisms. The concept of the cyborg challenges static, essentialist notions of identity and dismisses rigid boundaries that are used to separate human from animal and human from machine. The cyborg is a hybrid creature—half machine, half biological organism. By collapsing the divide between human and animal, as well as between organism and machine, the figure of the cyborg marks the breakdown of troubling dichotomies that have been perpetuated by Western human-

10
Reena Shadaan and Michelle Murphy, "Endocrine-Disrupting Chemicals (EDCs) as Industrial and Settler Colonial Structures: Towards a Decolonial Feminist Approach," *Catalyst: Feminism, Theory, Technoscience* 6.1 (Spring 2020): 1–36.

11
Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham: Duke University Press, 2012); Alexis Shotwell, *Against Purity: Living Ethically in Compromised Times* (Minneapolis: University of Minnesota Press, 2016).

12
Donna J. Haraway, "A Cyborg Manifesto: Science, Technology and Socialist-Feminism in the Late Twentieth Century," in *Manifestly Haraway,* eds. Donna J. Haraway and Carry Wolfe (Minneapolis and London: University of Minnesota Press, 2016), 3–90.

ist tradition—namely, those of nature/culture, self/other, mind/body, male/female, civilized/primitive, agent/resource, active/passive, right/wrong, total/partial, and God/man. As a being that is uncoupled from organic reproduction and from the idea of the community based on the model of the organic family, the cyborg rejects connections established by genealogical origin in favor of coalitions formed through affinity. The world of cyborgs described by Haraway is a vibrant place populated by cyborg monsters and chimeras in which kin-making replaces reproduction and cyborgs are engendered and engaged in unruly and unexpected multispecies collaborations and fusions.

—LV

■ DAMAGE-CENTERED RESEARCH

The representation of chemical violence is crucial in ensuring that we can develop an effective resistance against it. But how such violence is represented is also significant: the ways in which chemical harms are made visible can become a source of violence in their own right. Indigenous studies scholar Eve Tuck uses the term "damage-centered research" to refer to research that documents people's pain, brokenness, and suffering to hold those in power accountable for the oppression they have perpetrated.[13] According to Tuck, the possible gains of research that describes people, communities, or environments as "toxic," "polluted," or "damaged" do not warrant the cost of thinking about ourselves or others in reference to these terms. Tuck urges communities, researchers, and educators to reconsider how research is framed and conducted and to rethink how research findings could be used by, for, and with communities.

—LV

■ DECOLONIAL FEMINIST APPROACH

A decolonial feminist approach is a feminist mode of inquiry invested in the critical analysis of hierarchical structures of oppression and domination sustained by modern capitalist colonial system.[14] Informed by intersectional perspectives, a decolonial feminist approach seeks to gain a nuanced and layered understanding of the power matrix of overlapping oppressions—critiquing Western capitalist modernity because it is not only androcentric, misogynist, and heterosexist but also intrinsically racist and Eurocentrist, with ties to coloniality. Decolonial feminist approach examines the possibilities of decolonizing uncaring, colonial relations, and restituting eradicated onto-epistomologies offering alternative models of communal life.

—LV

13
Eve Tuck, "Suspending Damage: A Letter to Communities," *Harvard Educational Review* 79.3 (2009): 409–428.

14
Françoise Vergès, A Decolonial Feminism, trans. Ashley J. Bohrer (London: Pluto Press, 2021).

■ DES MOTHERS, DES DAUGHTERS, DES SONS, DES TRANS

The term "DES mothers" is used to refer to individuals who took diethylstilbestrol (DES) while pregnant. "DES Daughters" and "DES Sons" came to be used widely by those exposed to diethylstilbestrol *in utero*, as well as consumer advocacy organizations and public health initiatives, establishing kin connections and community among those exposed and highlighting the transgenerational impact of exposure. In 2008, Dana Beyer published a blog entitled DES's Other Daughters, drawing attention to the experiences of transwomen who were exposed to DES. The title of the piece shifts the emphasis from the gendered subject roles of those exposed, their kin configurations of and through exposure (mother, daughter, son), and connections to each other to invoke the generative role of DES itself, rendering the synthetic estrogen a parent. While there was a growing demand from some individuals in the 1990s and 2000s to examine the impact of DES on queer and trans identity and expression, as well as the emergence of a DES Trans support listserv, DES Daughter and DES Son are often understood as referring to assigned sex at birth identities, remaining a stable point of identification even if one's sex/gender identity changes in life (i.e. one might identify as a transwoman and DES Son).

—JL

■ DICHLORODIPHENYLTRICHLOROETHANE (DDT)

A colorless, tasteless, and nearly odorless insecticide that was first synthetized in the late nineteenth century. Initial experiments showed it was effective against some insects by attacking their central nervous system, yet had no immediate effects on humans. Crucially, its effects appeared to be long-lasting. This factor was originally celebrated, but later turned into a concern about persistence, due in part to Rachel Carson's influential book *Silent Spring*, which popularized knowledge about DDT as an insecticide with broad effects on non-human animals and the environment. The effects of DDT on human beings came into the picture much later because scientific correlations were difficult to establish. Although DDT was found in breast milk and was soon after acknowledged as an accumulating substance, it is more recently that DDT became known as an endocrine disruptor that can affect the reproduction system of mammals and cause cancer. The temporalities of DDT and its effects are still a quandary, as they are often latent, differ between acute and chronic exposure, and potentially reach in the far future, affecting lives and bodies over generations.

—SB, FK

■ DIETHYLSTILBESTROL (DES)

A nonsteroidal synthetic substance with estrogenic effects, DES was first synthesized in the late 1930s, when it was used for different estrogenic hormone therapies, ranging from prevention of spontaneous abortion to postmenopausal breast cancer. Later, it also found application as a growth promoter for cattle and sheep. Its prescription to pregnant women was only scrutinized in the 1970s, as studies indicated a potential relation between *in utero* exposure to DES and clear-cell adenocarcinoma of the vagina, a rare form of cancer, as well as other forms of cancer. Subsequently, it was banned from being prescribed to pregnant women and only several years later from its use as a growth promoter in livestock. Although early knowledge of its effects was based on test on laboratory animals, it showed that DES was a potent estrogen that deviated from bodily produced estrogen in its persistence in bodies. It remains effective over unusually long periods, which makes it difficult to understand its impact on humans and animals. In addition, it challenges the toxicological paradigm of "the dose makes the poison," as it appears to be even more effective in low doses.

—SB, FK

■ ECO-NORMATIVITY

The agenda of zero-pollution and toxic-free future utilized by environmental activists to promote the ban of toxic chemicals and the transition to safe and sustainable alternatives is underpinned by problematic assumptions. Fantasies about the clean, chemical-free body, environment, and future foster anxieties about impurity, contamination, and pollution and are prone to what environmental justice researcher Giovanna Di Chiro terms "eco-normativity"—ableist and normative ideas harnessed by environmental discourse to conceptualize chemical exposure and its effects.[15] This uncritical rhetoric—labelling bodies as "impure," "unhealthy," or "unnatural"—becomes increasingly problematic in the context of endocrine disrupting chemicals exerting effects on sexual and reproductive development and functions. Eco-normativity becomes eco-heterosexism once queer bodies and behaviors are put forth as the main evidentiary focus of documenting harms. Both popular media and studies concerned with effects of endocrine disrupting chemicals on sexual and reproductive systems published in acclaimed scientific journals tend to use normative expressions and catchphrases such as "chemical castration" and "gender-bending chemicals," or describe animal physiology and behaviors as "feminized," "homosexual," or "transgender."

15
Giovanna Di Chiro, "Polluted politics? Confronting toxic discourse, sex panic, and eco-normativity," in *Queer ecologies: Sex, nature, politics, desire*, eds. Catriona Mortimer-Sandilands and Bruce Erickson (Bloomington: Indiana University Press, 2010), 199–230.

In so doing, they make chemical harms visible in ways that promote heterosexist and transphobic views.

—LV

■ ENDOCRINE DISRUPTORS

Endocrine disruptors range from industrial chemicals to pharmaceuticals, and from pesticides to phytoestrogens, many of them being persistent and ubiquitous pollutants. Others are attributed health benefits or just considered present in the manifold material world of biochemical processes in living matter. These substances interfere with or alter endocrine processes creating effects, like an increase or decrease of hormone levels, the mimicking of endogenous hormones, or the alteration of the production of hormones. The effects of these interferences are complex, yet clearly associated with several adverse health effects and linked to environmental pollution. Their circulation and persistence have given rise to specific anthropogenic ecologies, chemical kinships, and queer survival, yet to be described.

—SB, FK

■ ESTROGEN

A steroid hormone produced in the bodies of vertebrates, including humans, and some insects.[16] At the beginning of the twentieth century, estrogens were conceptualized as one of the two main sex hormones, the other being testosterone, by the nascent Western science of sex endocrinology. This categorization drew on prevalent cultural understandings of femininity and masculinity, as well as on previous ideas of the gonads, ovaries, and testes, which secrete estrogens and testosterone respectively, as the bodily basis for the existence of two, antagonistic sexes: male and female.[17] Estrogens are better known for their role in reproduction (pregnancy, menstruation) and the development of secondary sexual characters; however, they intervene in all sorts of metabolic processes. Synthetic estrogens are used as contraceptive method, in hormonal replacement therapy (HRT) during menopause, and in gender-affirming care for transgender people.

—MRS

■ FEMINIZING/DEMASCULINIZING EFFECTS OF ENDOCRINE DISRUPTORS

In a culture where gender binaries are reinforced, endocrine disruptors are often cited as having “feminizing” or “masculinizing” effects. For example, bodily response to hypothalmic gonadotropin (GnRH), which triggers the release of estradiol triggers breast development, among other effects.

16
Raphael Mechoulam, Robert W. Bruegge-meier, and David L. Denlinger, “Estrogens in Insects,” *Experientia* 40. 9 (1 September 1984): 942–44.

17
Oudshoorn, *Beyond the Natural Body.*

Examples of “masculinizing” effects might be increased muscle mass and bone density.

—BR

■ FUNGI

An ambiguous lifeform. Neither plant nor animal, shifting in their sexual stages, they appear as the epitome of an existence in-between. Some fungi are commonly known as molds. Since the beginning of the twentieth century, a correlation between moldy grain consumption and high estrogenic activity in animals like pigs has been observed. Additional research was initiated as mycotoxins—toxic substances produced by fungi, some of them functioning as endocrine disruptors—entered the body of scientific knowledge in the 1960s.

—SB, FK

■ HERBALISM

A body of knowledge and practices aimed at maintaining and restoring health by using plants. Synthetic endocrine disruptors have a direct link to practices of herbalism because they are found everywhere in the environment. Because soil and groundwater have been contaminated by highly toxic products, it is difficult (if possible at all) to find unpolluted places to harvest healthy medicinal plants. In France, 200 years of industrial activity have left their mark. According to the French Agency for Ecological Transition (Ademe), there are between 300,000 and 400,000 potentially polluted sites, or approximately 100,000 hectares.[18] The question of where medicinal plants are harvested or cultivated is therefore of primary importance. However, it is very difficult to access data on the state of soil pollution. One can look for isolated places to avoid over-contamination of collected plants, but it is never certain that there have not been industries upstream or aggressive agricultural practices not far away contaminating the waterways.

—MLR

■ HORMONAL SEX

Judith Butler’s writings on gender trouble have shown how biological sex is stabilized by performative enactments and practices, as is gender.[19] In biology, there are multiple ways of defining sex, even when conceptualized as a binary category, with genetic, chromosomal, hormonal, morphological sex; these can also be divergent within individuals. Hormonal sex is just one of these biological categories and often these different sexes and the respective categories are not in agreement. Practices of entering into new conversations with these substances include modes of undoing, (non)tran-

18
“Des plantes dépolluantes guérissent les sols,” *Mon Quotidien Autrement* (25 August 2021), monquotidienautrement.com/dossiers/plantes-depolluantes-phytorestauration.

19
Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990).

sitioning, and experimenting differently. Such interventions trace fragments and scraps from history and engage in different futurings toward reconceptualizing deeply entrenched epistemic constraints, such as binary gender.

—SB, FK

■ HORMONES

Hormones are “chemical messengers” that circulate through the bloodstream and inform functions of organs and tissues.[20] Hormones can be synthesized in and released from endocrine cells of animals (including humans), synthesized within the bodies of plants and fungi (called phytohormones and mycohormones), or synthesized in laboratories and manufactured at industrial sites. Hormones have wide-ranging effects on our bodies, including effects on blood sugar, lipid metabolism, bone density, growth and development, fat distribution, cardiovascular system, sleep, mood, cognition, and stress levels. Notwithstanding that, it is their effects on sexual development and reproduction that most occupies scientists` attention and popular imagination, especially when it comes to endocrine disrupting compounds with the ability to interfere with the biosynthesis, metabolism, and functions of bodily produced hormones. Gender studies scholar Celia Roberts coined the term “messengers of sex” to critically analyze how hormones as bio-social agents act to produce sexed bodies and behaviors.[21] Ultimately, hormones are not fixed objectifiable entities but carry social and cultural ideas as they emerge within a particular situatedness and through certain infrastructures of knowledge.

—LV

■ HORMONE-MIMICKING CHEMICALS

Hormone-mimicking chemicals include a broad range of substances that can interfere with, re-route, or disrupt hormonal processes in the body. In a world irreversibly and permanently marked by pollution, they comprise not only components in plants and other organisms, but also many industrial chemicals. Through their chemical composition, these substances mimic hormones and interfere with and alter human and nonhuman metabolisms. Endocrine disrupting chemicals have been shown to be potentially harmful to reproductive health. Pertinent scientific debates remain deeply entrenched in biomedical orderings that enact binary gender logics. Even though certain synthetic hormones act as support for the coming into existence of non-binary and non-cisgender positions, debates on pollutants tend to reify binary gender borders.

—SB, FK

20
Ernest H. Starling, “The Croonian Lectures. I. On the chemical correlation of the functions of the body,” *Lancet* 166.4276 (August 1905): 423–25.

21
Celia Roberts, *Messengers of Sex: Hormones, Biomedicine and Feminism* (Cambridge: Cambridge University Press, 2007).

■ HORMONE PATENTING

In the 1930s, with the discovery of steroid hormones, the world was ignited with desire for scientific promises of life extension, heightened sexual prowess, the maintenance of colonized populations through the application of birth control, and elimination of queer, transgender, and intersex people who were seen as polluting imperfections. Hormones had set the historic precedent in court cases that overturned previous rulings that “natural substances” could not be privately owned. With the isolation, classification, and synthesis of steroid hormones, courts began ruling on the side of European pharmaceutical and chemical companies that would eventually come to be known as the European hormone cartel. The patenting of steroid hormones opened the door for the patenting of genes, cells, microbes, plants, and animals.

—RCH

■ HORMONE REPLACEMENT THERAPY (HRT)

Hormone replacement therapy (HRT) is a form of hormone therapy to treat physical and psychological symptoms associated with menopause or andropause caused by the natural decline of sex hormones in aging women or men. HRT is also used to transition a person’s gender towards their preferred secondary sex characteristics.

—ML

■ INTRA-ACTION

Feminist theorist Karen Barad developed the concept of intra-action in her reconceptualization of the conventional notion of “interaction.”[22] Whereas interaction relies on the existence of pre-established bodies that engage in action with each other, the neologism “intra-action” signifies the mutual co-constitution of entangled agencies. It is the process of intra-action that enables distinct agencies to emerge. The boundaries and properties of intra-acting agents become determinate and meaningful via their intra-actions, and these agents come into existence and are reconstituted in each intra-action that occurs. It is through intra-actions that the boundaries between humans and nonhumans, between culture and nature, are constituted. This makes clear that these causal (but nondeterministic) intra-actions need not involve humans. Additionally, we must recognize that human bodies, like all other bodies, are not entities with inherent boundaries and properties, rather they acquire their boundaries and properties via the dynamic and open-ended process of intra-activity.

—LV

22
Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007).

■ MANUFACTURING DOUBT ABOUT CHEMICAL HARMS

As the immensely profitable chemical industry increasingly encroaches upon the domain of scientific research, chemical industry executives not only exploit but actively manufacture dubiety by hiring reputable experts to controvert the findings of independent researchers.[23] Exemplifying this strategy is an article by a collective of industry-sponsored scientists published in the acclaimed scientific journal *Regulatory Toxicology and Pharmacology* that undermined the influential *State of the Science of Endocrine Disrupting Chemicals* report by contesting its conclusions, suggesting that they were drawn without sufficient evidence, lacking in scientific rigor, and provided an unbalanced and misleading view of endocrine disruption.[24] The authors of the report responded to the article to defend the credibility of their claims and accused their opponents of deliberately manufacturing doubt about the harmful effects of endocrine-disrupting chemicals with the aim of confusing both the public and decision makers rather than attempting to convince scientific researchers.[25] Since current legislation requires substantial evidence in order to ban or restrict chemicals that are suspected of causing harm, such a strategy of manufactured skepticism can pay off: the chemical companies succeed in their querying of the evidential basis of health hazards, which ultimately enables them to keep their products on the market.

—LV

■ MYCO-ESTROGENS

A mycotoxin that shares structural similarities with naturally occurring estrogens, zearalenone (ZEA) is an estrogenic compound produced by fungi species. ZEA can bind to estrogen receptors which can have a variety of diverse effects

23
For an argument about the spreading of doubt and confusion as a strategy for undermining scientific consensus, see Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2011).

24
James C. Lamb, Paolo Boffetta, Warren G. Foster, Julie E. Goodman, Karyn L. Hentz, Lorenz R. Rhomberg, Jane Staveley, Gerard Swaen, Glen Van Der Kraak, and Amy L. Williams, "Critical Comments on the WHO–UNEP State of the Science of Endocrine Disrupting Chemicals – 2012," *Regulatory Toxicology and Pharmacology* 69.1 (2014): 22–40.

25
Åke Bergman, Georg Becher, Bruce Blumberg, Poul Bjerregaard, Riana Bornman, Ingvar Brandt, Stephanie C. Casey, Heloise Frouin, Linda C. Giudice, Jerrold J. Heindel, Taisen Iguchi, Susan Jobling, Karen A. Kidd, Andreas Kortenkamp, P. Monica Lind, Derek Muir, Roseline Ochieng, Erik Ropstad, Peter S. Ross, Niels Erik Skakkebaek, Jorma Toppari, Laura N. Vandenberg, Tracey J. Woodruff, and R. Thomas Zoeller, "Manufacturing Doubt About Endocrine Disrupter Science – A Rebuttal of Industry-Sponsored Critical Comments on the UNEP/WHO Report 'State of the Science of Endocrine Disrupting Chemicals 2012,'" *Regulatory Toxicology and Pharmacology* 73.1 (December 2015): 1007–17.

26
Abbas Ali Jafari-Nodoushan, "Zearalenone, an Abandoned Mycoestrogen Toxin, and Its Possible Role in Human Infertility," *International Journal of Reproductive Biomedicine* 20.2 (March 2022): 151–53.

27
Arun Bhunia, *Foodborne Microbial Pathogens* (Berlin: Springer, 2008).

28
Océane Albert, Christèle Lethimonier, Laurianne Lesne, Alain Legrand, François Guillé, Karim Bensalah, Nathalie Dejucq-Rainsford, and Bernard Jégou, "Paracetamol, Aspirin and Indomethacin Display Endocrine Disrupting Properties in the Adult Human Testis in Vitro," *Human Reproduction* 28.7 (May 2013): 1890–98.

in more-than-human bodies.[26] The total contribution of ZEA to the overall occurrence of xenoestrogens—substances that have estrogen-like properties—can only be surmised. However, it is now known that even low concentrations of ZEA can cause hyperestrogenic syndromes (increased estrogenic activities) in pigs and other domestic animals, while higher concentrations can lead to reproductive problems. The effects on humans are less well known. Yet, ZEA is an ambiguous substance. For a short period, due to its properties, it was considered not only a threat but also medicine and was used to treat postmenopausal symptoms in women. It was even patented as an oral contraceptive.[27] Additionally, ZEA, similar to other mycotoxins, affects food production worldwide. Only visible as a mold that attaches itself to corn and grains, it creates concerns about food security from small scale farming to the industrialized agrarian sector.

—SB, FK

■ OXYTOCIN

Oxytocin is an attachment hormone produced in the hypothalamus and released into the bloodstream by the pituitary gland during labor and in response to sexual activity, which is why it is also called the "love drug" or "love hormone." The primary function of oxytocin is considered to be the facilitation of childbirth by stimulating uterine contractions. Oxytocin also plays a role in bonding with the child and promotion of milk production in the breasts for an infant.

—MM

■ PARACETAMOL

A medication used to treat fever and mild to moderate pain. It is one of the most commonly purchased over-the-counter drugs and is often recommended to treat all kinds of minor ailments, from headaches to period cramps, fever, or toothaches. Although paracetamol seems to be ubiquitous in both households and pharmacies, it is associated with certain side effects. Most often, these side effects are discussed with concerns about liver and kidney failure in (unintentional) overdose. However, paracetamol has a more subtle and perhaps surprising ability to affect the body. Studies suggest that it also acts as an endocrine disruptor.[28] These studies are still limited and sometimes contradicting. To date, research on these effects has focused on human fertility and potentially adverse reproductive effects.

—SB, FK

■ PERSISTENT ORGANIC POLLUTANTS (POPS)

Persistent Organic Pollutants (POPs) is an umbrella term that conflates different substances, all of them globally regulated under one UN agreement, the Stockholm Convention, that was signed in 2001. The idea behind the Convention was to develop an instrument that would allow the international regulation of substances based on their behavior in the environment, their characteristics. Thousands of different toxicants and anthropogenic pollutants are POPs, which all belong to similar chemical families.

As they are organic substances, they all contain carbon-hydrogen or carbon-carbon bonds. They persist in the environment and in more-than-human bodies; they are toxic and therefore have potentially harmful effects on humans and animals. Moreover, they biomagnify and bioaccumulate (i.e., they accumulate in individual bodies and in food webs) and they can travel over long distances via air or water.

—SB, FK

■ PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

PFAS (per- and polyfluoroalkyl substances) comprise a group of thousands of chemical substances. Due to their persistence, they have been called “forever chemicals” and some of them are ubiquitously present in the environment. As endocrine disruptors, these chemicals interfere with hormone signaling and thus impact on various functions and processes in the body.

—SB, FK

■ PHARMAKON

In ancient Greek philosophy, the notion of pharmakon carried two incommensurate meanings: remedy and poison, as understood in pharmacology or toxicology. More recent accounts of thinking with and through the figuration of the pharmakon attempt to extend its meaning beyond toxicology, attending to its ambiguity, instability, and fluidity. The pharmakon as an indeterminate simultaneity of remedy/poison can help to think through and with endocrine disrupting substances. Understood as non-binary configuration, the pharmakon can seep into the molecular worlds of bodies in constant modification and change. The concept of pharmakon allows us to highlight the deeply ambivalent and, as such, indeterminate nature of endocrine disrupting substances while emphasizing the past and present entanglements of endocrine disruptors with global economies.

—SB, FK

■ PHYTOHORMONES

Phytohormonal plants contain chemical substances of natural origin called phytoestrogens, precursors to human estrogens. Phytoestrogens can be used as a natural therapy to replace synthetic hormone therapy (HRT) for perimenopause and menopause. The consumption of these plants allows the body to produce more estrogens than it would by itself, which attenuates the effects of a decrease in their production. The three most important phytoestrogens are isoflavones (found in over seventy plants), coumestans (young legumes such as soybean, clover, alfalfa), and lignans (found in flax). As each person is different, it is advisable to consult a professional in natural medicine who can propose a personalized treatment. The phytoestrogenic plants are contraindicated, for example, in the cases of gynecological and hormone-dependent cancers, thromboembolic accidents (phlebitis, embolism, stroke), and hyperthyroidism. Plants containing isoflavones (soy, oats, alfalfa, flax) can cause interactions with anticoagulants.

—MLR

■ POLLUTION IS COLONIALISM

Pollution is a form of colonialism (and neo-colonialism) inasmuch as the processes and products of Western capitalism disproportionately affect the “global south” or emerging economies. Common examples are plastic waste and electronic waste, which often end up in places like Mexico or Ghana, where the laws and regulations around their safe disposal are often non-existant or inadequately monitored, allowing for unsafe conditions to proliferate that affect local ecosystems and human/non-human inhabitants.

—BR

■ THE POSTHUMAN

Philosopher and feminist theorist Rosi Braidotti describes the figure of the posthuman as representative of the convergence of posthumanism and postanthropocentrism.[29] The posthuman challenges the centrality of the humanist ideal of Man as the measure of all things and the centrality of anthropos as the privileged species. The posthuman subject blurs traditional distinctions between humans and nonhuman others—being no longer a singular, self-governing individual but rather an assemblage of organic matter and technological artifacts. Braidotti develops the concept of the posthuman as a navigational tool that might be used to grasp and address the complexities, challenges, and crises of contemporary existence marked by accelerated technological development, climate change, environmental

29
Rosi Braidotti, *The Posthuman* (Cambridge: Polity Press, 2013); Rosi Braidotti and Maria Hlavajova, eds., *Posthuman Glossary* (London: Bloomsbury, 2018); Rosi Braidotti, *Posthuman Knowledge* (Cambridge: Polity Press, 2019).

degradation, and capitalist extractivism. The concept of the posthuman calls for the creation of new ways of knowing and being in the world; it requires the old system predicated on hierarchies and sovereign individualities to be replaced with a more inclusive, all-embracing approach to existence that favors heterogenous more-than-human multiplicities and transversal convergences.

—LV

■ PRECAUTIONARY CONSUMPTION

The sociologist Norah MacKendrick has introduced the term "precautionary consumption" to describe a practice of reducing personal exposure to the chemicals that are found in everyday consumer products by making responsible and informed consumer choices.[30] As MacKendrick has shown, precautionary consumption shifts the responsibility for reducing toxic burdens away from the manufacturers and distributors of toxic products and instead places it upon individuals, especially child-bearers and those caring for young children. However, such individualized tactics, which invoke the consumer caution, tend to fail to the extent that the surrounding presence of chemicals is not limited to consumer products, but also encompasses various industrial processes. Even more crucially, these chemicals cannot be contained because they infiltrate the environment. Once they have been released from their multiple outlets, endocrine-disrupting chemicals circulate through the ground, water, and air, eventually being diffused throughout the whole environment. A truly effective means of preventing wider exposure to chemicals is therefore infeasible and cannot be achieved even by way of the expensive and onerous practices of shielding, filtering, and distancing (that MacKendrick elaborates). Individualized—and largely feminized—tactics for managing environmental toxicities have been subjected to feminist critiques not only because they spread the misguided belief that effective protection from environmentally ubiquitous chemicals is possible, but also because, in doing so, they shift our focus from protecting the environment to protecting ourselves individually, with the result that we will be less likely to engage in public debates about how to address the problem of chemical pollution via systemic arrangements relating to chemical manufacturers, industrial lobbying practices, and poor regulation by the state.[31]

—LV

■ REPRODUCTIVE FUTURISM

In his book *No Future: Queer Theory and the Death Drive*, Lee Edelman defines reproductive futurism as a deeply entrenched socio-cultural belief that heteronormativity ensures a positive future for our children and is therefore instituted as a political agenda.[32] The ideology of reproductive futurism eliminates other queer, alternative ways of being and kinship from the participation in such restricted futures.

—MM

■ QUEER ECOLOGIES

Queer ecologies refer to ideas, practices, and sensibilities that acknowledge the richness, diversity, and complexity of the natural world. Queer ecologies oppose generalizing and essentializing interpretations of nature from human assumptions, especially the heterosexist notions of nature that associate "natural" with "heterosexual," and examine both through the normative lens of "purity." In *Queer Ecologies: Sex, Nature, Politics, Desire,* editors Catriona Mortimer-Sandilands and Bruce Erickson define the task of queer ecologies: "to probe the intersections of sex and nature with an eye to developing a sexual politics that more clearly includes considerations of the natural world and its biosocial constitution, and an environmental politics that demonstrates an understanding of the ways in which sexual relations organize and influence both the material world of nature and our perceptions, conceptions, experiences, and constitutions of that world."[33]

—LV

■ SCIENCE OF ENDOCRINE DISRUPTION

According to the report *State of the Science of Endocrine Disrupting Chemicals,*[34] a landmark review of the science of endocrine-disrupting chemical agents released by the World Health Organization and the United Nations Environment Programme, the true extent of our exposure to chemical endocrine disruptors (as well as the consequences of such exposure) have yet to be fully understood. The report summarizes research findings that provide evidence that endocrine disrupting chemicals are causally implicated in adverse health outcomes in both humans and wildlife, while also raising concerns about the significant uncertainties and incompleteness of our knowledge about the endocrine activity that results from the presence of environmentally ubiquitous chemicals. The study of chemical endocrine disruptors requires the examination of a plurality of interactive factors, including the net effects of complex chemical mixtures; tissue-specific responses; critical windows of exposure across lifespans; the intricate problematics of epigenetic effects, which alter susceptibility to diseases both intra- and inter-generationally; and, anomalous dose–response relationships, which mean that even low-concentration exposures

30
Norah MacKendrick, "Media Framing of Body Burdens: Precautionary Consumption and the Individualization of Risk," *Sociological Inquiry* 80.1 (2010): 126–49; Norah MacKendrick, *Better Safe Than Sorry: How Consumers Navigate Exposure to Everyday Toxics* (Oakland: University of California Press, 2018).

31
See Robyn Lee and Roxanne Mykitiuk, "Surviving Difference: Endocrine-Disrupting Chemicals, Intergenerational Justice and the Future of Human Reproduction," *Feminist Theory* 19.2 (2018): 205–21; Dayna Nadine Scott, Jennie Haw, and Robyn Lee, "Wannabe Toxic-Free? From Precautionary Consumption to Corporeal Citizenship," *Environmental Politics* 26.2 (2017): 322–42; Shadaan and Murphy, "Endocrine-Disrupting Chemicals (EDCs) as Industrial and Settler Colonial Structures;" Andrew Szasz, *Shopping Our Way to Safety: How We Changed from Protecting the Environment to Protecting Ourselves* (Minneapolis: University of Minnesota Press, 2007).

32
Lee Edelman, *No Future: Queer Theory and the Death Drive* (Durham: Duke University Press, 2004).

33
Catriona Mortimer-Sandilands and Bruce Erickson, eds., *Queer Ecologies: Sex, Nature, Politics, Desire* (Bloomington: Indiana University Press, 2010), 5.

34
Åke Bergman, Jerrold J. Heindel, Susan Jobling, Karen A. Kidd, and R. Thomas Zoeller, eds., *State of the Science of Endocrine Disrupting Chemicals 2012: Summary for Decision-Makers* (United Nations Environment Programme and World Health Organization, 2013).

can be harmful. In sum, endocrine disruption is a complex and multilayered process that poses momentous challenges, not least in terms of the gathering of scientific evidence.

—LV

■ SEX AS A REACTION NORM

A model of sex described by Malin Ah-King and Sören Nylin that emphasizes sex as a dynamic process in which organisms have more or less "open potentials" of sex, sex related characteristics, and behavior.[35] Instead of thinking of sex as a nature-given dichotomy, or an essentially discrete characteristic, sex is better understood as a responsive potential, changing over an individual's lifetime, in interaction with environmental factors, as well as over evolutionary time. Sex potential is an opening out—a responsiveness that is ontologically more dynamic than static. While some organisms have a narrow regular range of sex possibilities—their potential is more delimited—the effects of endocrine disruption provide a reworking of even these limits. In other words, while some species, such as fish, more easily shift from female to male as an environmental response to pollution, others, such as polar bears, may with the same level of endocrine disruption endure more subtle changes in sexual appearance.

—MAK, EH

■ SEXING, PROCESSES OF SEXING

Hormone levels change over an individual's lifetime and are affected by lifestyle (stress, physical activity), and exogenous hormones.[36] Even natural plant substances like phytoestrogens interact with endocrine systems of various animals.[37] Our material culture—as expressed by what objects we encircle ourselves with, the food we eat, the water we drink, the hormones we and our food industries gush into our surroundings, the air we breathe, the perfumes, soaps, shampoos and lotions we use, how we utilize our bodies—becomes part of the process of sexing. Malin Ah-King's and Sören Nylin's ontological view of sex as a dynamic process proffers an interpretation of sex that includes endocrine disruptive pollution, just as other environmental influences, into the process of sexing.[38] In this way, emerging sexual characteristics (whether transgressing boundaries of sex or not) can be understood as showing a range of potentials rather than aberrations from a norm of "pure" sexual difference.

—MAK, EH

■ SOY

Soy is the plant with highest known concentrations of isoflavones, a group of phytoestrogens, structurally similar to

35
Malin Ah-King and Sören Nylin, "Sex in an Evolutionary Perspective: Just Another Reaction Norm," *Evolutionary Biology* 37.4 (November 2010): 234–46.

36
Roberts, *Messengers of Sex.*

37
Herman Adlercreutz, "Phyto-Oestrogens and Cancer," *Lancet Oncology* 3.6 (June 2002): 364–73.

38
Ah-King and Nylin, "Sex in an Evolutionary Perspective."

estradiol, mimicking hormones and modulating endocrine and metabolic pathways. Soy is an important protein source for human nutrition, for instance, in tofu and tofu products. It also contains molecules that belong to phytoestrogens, and thus are hormonally active.

—SB, FK

■ SYMPOIESIS

Sympoiesis is a concept developed by feminist science and technology scholar Donna J. Haraway meaning "making-with" or "becoming-with."[39] Sympoiesis unsettles the atomistic conception of humans as bounded individuals, who are divorced from the broader collectivity of non-human life in a shared environment. In Haraway's words, "Nothing makes itself; nothing is really autopoietic or self-organizing [...] earthlings are never alone. That is the radical implication of sympoiesis. Sympoiesis is a word proper to complex, dynamic, responsive, situated, historical systems. It is a word for worlding-with, in company. Sympoiesis enfolds autopoiesis and generatively unfurls and extends it."[40] Sympoiesis means to be entangled with others and initiating cross-species solidarities and action rooted in interconnectedness, interdependency, and mutual becoming in the world.

—LV

■ SYNTHETIC HORMONES

Medical and corporate attention to hormone management has a long tradition. In the twentieth century, technoscientific hormone research focused on regulating with-gestational-capacities-bodies: (human and non-human) reproductive bodies have been controlled and regulated to accelerate the production cycles. One thinks of the farming sector and its increased relation to hormones' research and administration to increase and intensify the re/productive cycle of involved animals. But also, as researcher Nora Heidorn points out, "hormonal time"—such as menstrual cycles, mood swings, energy levels, reproductive capabilities and aging processes—became a biopolitical tool for managing human populations' productivity around 1960.[41] One thinks of the biotechnologies developed through synthetic hormones—i.e., the technology of hormone self-regulation such as birth control pills—and how these did not merely free bodies from their biological constraints. On the contrary, their development and application have planned and policed the reproductive role of those same bodies. As health and technology theorist Nelly Oudshoorn explains, the extraction, synthesis, and application of hormones have linked the reproductive functions of with-gestational-capacities-bodies to laboratory practice

39
Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).

40
Haraway, *Staying with the Trouble,* 58.

41
Nora Heidorn, "Lavorare un turno doppio: la biopolitica del tempo ormonale," in *Coming soon,* ed. Mira Asriningtyas et al. (Roma: Nero Edizioni, 2018), 64–70.

and techniques, highlighting and emphasizing the reproductive role of such bodies and designating them as a "natural site of intervention."[42]

—MF, ZR

■ TECHNOSCIENCE

Technoscience refers to the intersection of the scientific process and technological development, with a particular focus on human interactions with technologies, especially, but not limited to, emerging technologies. More specifically, technoscience or technoscientific criticism examines how technologies, emergent or existing, play a role in the production and diffusion of knowledge.

—BR

■ TESTOSTERONE

A substance described as a sex hormone and anabolic steroid. Testosterone is a metabolic substance present in bodies of all genders, but at variegated and changing degrees.

—SB, FK

■ TRANSCORPOREALITY

Transcorporeality is a concept developed by ecocultural researcher Stacy Alaimo to acknowledge that all creatures, both human and nonhuman, are entangled with the material world, which in turn crosses through them, transforms them, and is transformed by them.[43] Transcorporeal bodies emerge from this movement across human and nonhuman nature. The boundary between humans and the environment is dissolved by transcorporeality, drawing attention to the environment inside us—the environment as the very fabric of ourselves. Transcorporeal subjects are generated from multiple horizontal crossings, transits, and transformations across biological, technological, economic, social, and political processes and systems. Mapping these interchanges across bodies and environments informs transcorporeal ethics and politics, encouraging us to rethink the nature of the permeable surfaces between human bodies, environmental systems, and political action.

—LV

■ WILD YAM

Dioscorea species, commonly known as wild yam, Barbasco, Cabeza de Negro, and Caparazón de Tortuga, among other names, are twining vines whose tuberous roots contain diosgenin: a steroidal compound used for the commercial synthesis of cortisone, progesterone, estrogens, and androgens. Historically, wild yams were the main feedstock

42
Nelly Oudshoorn, *The Male Pill: A Biography of a Technology in the Making* (Durham: Duke University Press, 2003).

43
Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010); Stacy Alaimo, *Exposed: Environmental Politics and Pleasures in Posthuman Times* (Minneapolis: University of Minnesota Press, 2016).

globally for the production of steroid hormone pharmaceuticals. Wild yams—used by many different Indigenous peoples of Turtle Island to ease birth pains, assist abortions, and catch river fish—were found to have the highest levels of the molecules needed for producing steroid hormones. In the mid-1900s, the US government funded expeditions to other settler colonies where yams containing these molecules in abundance were collected and shipped to Federal Experiment Stations in Puerto Rico, Florida, Georgia, Maryland, and New Jersey. On these occupied lands, as well as on plantations of the Firestone Company, US Sugar Company, and Merck and Company, yams were replanted as monocrops. In these new environments, however, the levels of steroidal molecules plummeted. After years of failed efforts, US researchers were unable to reproduce the molecular abundance of those yams they had stolen, and pharmaceutical corporations were forced to continue working with campesinos in Mexico to harvest tubers for hormone production. The richness of the yams was not something unique to their individual bodies, but something more distributed and networked through the land. Something about their relationship with a particular soil, enmeshed in the vibrant web of lives that they had grown alongside, was essential to the gifts they offered.

—RCH

■ XENOHORMONES, XENOESTROGENS

Xenohormones, or environmental hormones, are exogenous hormones produced outside of the human body, whether synthetically produced or naturally occurring. Xenoestrogens are xenohormones that mimic estrogen. Examples of synthetic xenoestrogens are bisphenol A (BPA) and phthalates. These xenoestrogens trigger the effects of endogenous estrogen and are often cited as the source of various disorders or unintended consequences, such as "intersex" frogs.

—BR

Unconclusion

In the book, we have articulated research concerns pertaining to the effects of industrial, pharmaceutical, and more-than-human production and the interplay of hormonally active molecules, raising several key questions, including: What does life re-assembled by hormonally active substances look and feel like? Who are we becoming with them? How can we live well with them despite their potential for harm? Rather than providing straightforward answers, we have mapped out the complex nature of these questions and problematized the assumptions that lead us too quickly to easy answers.

Therefore, there is no conclusion or closure—the investigations continue. We leave the lines of inquiry open and encourage you, dear reader, to keep looking for answers with an open mind. Open to what synthetic hormones and endocrine disrupting compounds are and what living a good life with them might entail. And, open to not only new ideas, but also feelings, sensations, and desires that might emerge in the process. After all, if answers are to be found, they will be disclosed not in the world out there, but within these synthetic bodies we are becoming; these bodies—and the answers within them—being a perpetually shifting horizon.

Synthetic Becoming

Malin Ah-King and Eva Hayward; Aliens in Green (Léonore Bonaccini, Ewen Chardronnet, Xavier Fourt, Špela Petrič, Mary Maggic); Adham Faramawy; Feminist Technoscience Governance Collaboratory (Jacquelyne Luce with Vrisha Ahmad, April Albrecht, Sarah Hyde, Amanda Kearney, Lainie LaRonde, Alek Meyer, Cassie Pawlikowski, Karisa Poedjirahardjo, Emily Pollack, Anjali Rao-Herel, and Ella Sevier); Annabel Guérédrat, Rian Ciela Hammond and Krystal Tsosie; Franziska Klaas and Susanne Bauer; Marne Lucas; Mary Maggic; OBOT (Maddalena Fragnito and Zoe Romano); Byron Rich; Mariana Rios Sandoval and the Rosæ Canine Collective (Bethsabée Elharar-Lemberg, Maïwenn Le Roux, Elena Souvannavong); Lenka Veselá; and, Ker Wallwork

Editor
Lenka Veselá

Consulting Editor
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Editorial Assistant
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BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF FINE ARTS

Brno University of Technology
Faculty of Fine Arts
Údolní 244/53
602 00 Brno
Czech Republic
favu.vut.cz

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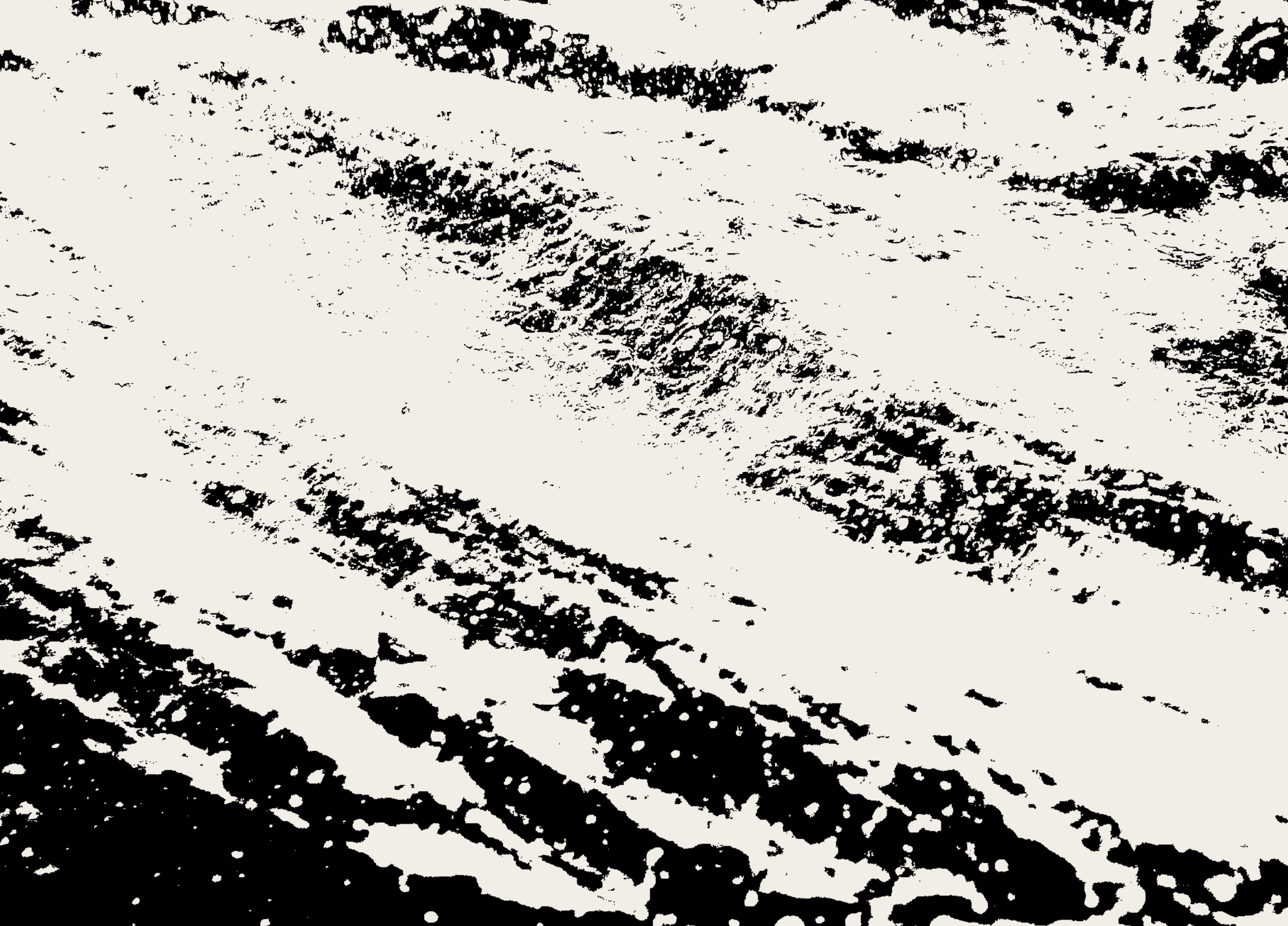

Contributors

■ MALIN AH-KING is an evolutionary biologist (PhD) and Associate Professor in gender studies at the Department of Ethnology, History of Religions and Gender Studies, Stockholm University. Her research aims to problematize the portrayal of biological sex as stable, make visible stereotypic gender notions in theory and research, to develop a theoretical framework for understanding biological sex as variable and constantly changing, as well as to study the scientific process within sexual selection research. Her current project investigates a controversy over sex differences in evolutionary biology. She has published in *European Journal of Women's Studies*, *Evolutionary Biology*, *Trends in Ecology and Evolution*, *Lambda Nordica*, *PLOS Biology*, and the *International Journal of Gender, Science, and Technology*; her forthcoming monograph, *The Female Turn: How Evolutionary Science Shifted Perceptions About Females*, is published by Palgrave Macmillan.

■ ALIENS IN GREEN (Léonore Bonaccini, Ewen Chardronnet, Xavier Fourt, Špela Petrič, and Mary Maggic) is an investigative laboratory and tactical theater group combating the alien agents of anthropogenic xeno-power. Using media communication, open-science philosophy, and speculative fiction, the collective generates critical discourse and interventions in the public sphere. One may understand the Aliens in Green as both a symmetrical and antagonist entity to the "Men in Black." They act as discursive agents dealing with human relations and life forms of a third type. But unlike the "Men in Black" who operate secretly and erase people's memories, the Aliens in Green operate openly and tactically, allowing earthlings to identify the numerous collusions between capitalist and xeno-political forces.

■ SUSANNE BAUER is a professor in Science and Technology Studies at the TIK Centre for Technology, Innovation, and Culture, University of Oslo. Her research seeks to examine and decenter technoscientific knowledge making by analyzing processes of datafication, risk assessment, and infrastructuring. Recent open access publications include: S. Bauer and T. Penter, eds., *Tracing the Atom: Nuclear Legacies in Russia and Central Asia* (Routledge, 2022); and, S. Bauer, M. Schlünder, and M. Rentetzi, eds., *Boxes: A Field Guide* (Mattering Press, 2020).

■ ADHAM FARAMAWY is an Egyptian artist based in London. Their work spans media including moving image, sculptural installation, and print, thinking through issues of materiality, touch, and toxic embodiment to question ideas of the natural in relation to marginalized communities. They lecture at both Goldsmiths University and Ruskin School of Art. In 2018 they presented a show on the body and VR for BBC Radio 4, in 2019 they premiered their video work *Skin Flick* at a screening at Tate Britain dedicated to their work. They were shortlisted for the Jarman Award in both 2017 and 2021. Their work has been exhibited in group shows at Whitechapel Gallery, Somerset House, and Serpentine Gallery. In 2022 they exhibited their first live performance as part of the Serpentine Ecologies program *Back to Earth*.

■ FEMINIST TECHNOSCIENCE GOVERNANCE COLLABORATORY is a dynamic space for inter and transdisciplinary scholarship through collective and collaborative feminist and queer methodologies. The Collaboratory comprises an ever-shifting team of undergraduate students from Mount Holyoke College and other Five College Consortium campuses and Jacquelyne Luce, a medical anthropologist, feminist science studies scholar, and Senior Lecturer in Gender Studies at Mount Holyoke College. The Collaboratory is designed around temporalities of chronicity, care, and activism, supporting participation in knowledge-making outside the boundaries of normative academic time. Formed in 2017 to explore contemporary DES-exposure narratives, the Collaboratory's work currently encompasses a range of topics at the intersections of environmental, reproductive, and social justice.

■ MADDALENA FRAGNITO is an artist and activist. At the moment, she is a doctoral student at Coventry University's Centre for Postdigital Cultures. She co-founded MACAO (2012), an autonomous cultural center in Milan; SopraSotto (2013), a self-managed kindergarten by parents; and KINlab (2021), an interdisciplinary lab in Milan and headquarter of OBOT project. She is part of the research groups Pirate Care and Institute of Radical Imagination. Her last publication is *Ecologie della cura: Prospettive transfemministe* (Orthotes, 2021).

■ ANNABEL GUÉRÉDRAT is a choreographer, a performance artist, and a certified practitioner in a bodymind centering technique release. Born in Noumea, New Caledonia (a French territory in the Pacific), she lives and works in Martinique, where she founded Artincidence dance company in 2003. She also co-founded and co-curated, with Henri Tauliaut, the FIAP Martinique (Festival International de l'Art de la Performance), the first international festival of performance art in Martinique. Initiated to various practices reaching from Afro-Brazilian dances, to breathing and yoga techniques, her artistic work addresses African heritage and ecofeminism, inspired by the movements of Afro-punk and techno-shamanism. She shares her practice with discriminated groups such as victims of violence, prostitutes or detained teenage mothers.

■ RIAN CIELA HAMMOND is an artist and biologist creating media-expansive artworks that invite people to examine the interactions between technology, power, and ways of knowing and being a body. Their recent body of work has focused on the technoscientific production of the "sex hormone" as a portal into unraveling the colonial technology of binary gender. Their co-created workshops, transgenic choreographies, and transmedia installations have fermented at the Baltimore Underground Science Space, in residence at Hangar Barcelona, at Coalesce Bioart Lab, and at Medialab MX. Most recently, Hammond's work has been exhibited at SOLU Space (Helsinki), Bas Fisher Invitational (Miami), Albright-Know Art Gallery (Buffalo), and Vox Populi (Philadelphia) in the United States.

■ EVA HAYWARD is an anti-disciplinary scholar coming out of the History of Consciousness tradition of the University of California at Santa Cruz (PhD, 2008). Her training is in the history of science, film and art history, and psychoanalytic semiotics, and is attentive to the persistence of sexuality and aesthetics in the structuring of knowledge, subjectivity, and power. She is an assistant professor in the Department of Media and Culture Studies at Utrecht University. Her research focuses on aesthetics, ecology, and trans/sexuality studies. She has written field-defining essays in both transgender and science studies, published in journals such as *Cultural Anthropology* and *Women's Studies Quarterly*. Her recent publications include a co-edited special issue (with Dr. Che Gossett), "Trans in the Time of HIV/AIDS" (*Transgender Studies Quarterly*, 2021) and "Painted Camera, Her" (*e-flux*, 2021). Hayward's forthcoming book *SymbioSeas* looks at underwater representations of marine organisms to think about the interplay of sexuality and captivity in animal sciences, specifically how the unknowability of "the Animal" is sexually oriented in laboratory research and display technology.

■ FRANZISKA KLAAS is a doctoral research fellow at the Department of Social Anthropology at the University of Oslo. In her research at the intersection of social anthropology and science and technology studies (STS), Franziska explores the lives of persistent organic pollutants (POPs), a group of diverse substances that are toxic, persistent, and accumulate in the body, many of them acting as endocrine disruptors. Her work is part of AnthroTox, an interdisciplinary research project on anthropogenetic pollutants.

■ MARNE LUCAS is a multidisciplinary artist based in New York, USA whose work spans photography, video, sculpture, and social practice. Lucas works at the intersection of art, feminism, and health, using conceptual overlaps: life's energy, the body, mortality, and transformation. An infrared thermal video (IRT) pioneer, Lucas uses heat-sensitive imaging technology to explore the magic and fragility of human existence and conceptualize mortality and the spiritual world. The *Bardo ∞ Project* explores creativity as a form of spiritual care in collaborations with terminally ill artists to establish their legacy. Lucas has exhibited at Plaxall Gallery (NYC), The Brand Library (Los Angeles), Fremantle Arts Centre (Perth, AU), Peltz Gallery (London) and Taboo-Transgression-Transcendence in Art and Science.

■ MARY MAGGIC is a Chinese-American artist and researcher working within the fuzzy intersections of body and gender politics and capitalist ecological alienations. Based in Vienna since 2017, Maggic frequently uses biohacking as a xeno-feminist practice of care that serves to demystify invisible lines of molecular biopower. After completing their Masters at MIT Media Lab (Design Fiction), their project "Open Source Estrogen" was awarded Honorary Mention at the Prix Ars Electronica 2017 in Hybrid Arts, and in 2019 they completed a ten-month Fulbright residency in Yogyakarta, Indonesia investigating the relationship between Javanese mysticism and the plastic pollution crisis. Maggic is a recipient of the 2022 Knight Arts + Tech Fellowship, and they are a current member of the online network Hackteria: Open Source Biological Art, the laboratory theater group Aliens in Green, the Asian feminist collective Mai Ling, as well as a contributor to the radical syllabus project Pirate Care and to the online Cyberfeminism Index.

■ BYRON RICH is an artist, professor, and lecturer born in Calgary, Canada. His work exploring speculative design, biology futures, and tactical media has been widely shown and discussed internationally. He pursued a degree in New-Media at The University of Calgary before relocating to Buffalo, New York, where he obtained an MFA in Emerging Practices at The University at Buffalo. Alongside his former collaborator, Mary Maggic, he was the runner up for the 2016 BioArt & Design Award, and the recipient of an Honorary Mention at the 2017 Prix Ars Electronica. He now serves as Director of Academic Innovation Partnerships, Chair of the Art Department, and Associate Professor of Art at Allegheny College in Meadville, Pennsylvania.

■ ZOE ROMANO is an independent researcher, craftivist focused on social innovation, open technologies, and speculative design. She graduated in philosophy at the University of Milan, worked for several years in digital communication and tech, and developed her social skills as media hacktivist in various collectives on precarity and material and immaterial labor in the creative industries. She co-founded WeMake Makerspace in 2014 and is now working in KINlab – an interdisciplinary lab in the San Siro neighbourhood in Milan and headquarter of OBOT project.

■ ROSÆ CANINE is a collective of activist and feminist herbalists fighting for the reappropriation of bodies. At the convergence of sciences, empirical knowledge, and intuitions, since 2017 they have organized gatherings around the use of medicinal plants, in particular plants of the gynecological and urological sphere. Their uprising is anti-capitalist, libertarian, and queer. They contest any form of oppression and advocate for the free circulation of people and knowledge. Through walks and hybrid workshops, they try to address in the most inclusive possible way our sexualities or asexualities, to question together our feelings and our bodily states.

■ MARIANA RIOS SANDOVAL is a researcher working at the intersection of anthropology and science and technology studies. She is interested in the study of chemicals as ethnographic objects, on the affective and embodied apprehension of the environmental crisis, and on the intersections of environmental and reproductive justice. She loves to make films and soundscapes, and to engage in collaborative experiments as a research methodology, and as way of rendering research insights accessible to people beyond academia.

■ KRYSTAL TSOSIE (Diné/Navajo Nation), PhD, MPH, MA is an Indigenous geneticist-bioethicist at Arizona State University in the School of Life Sciences. As an advocate for Indigenous genomic data sovereignty, she co-founded the first U.S. Indigenous-led biobank, a 501c3 nonprofit research institution called the Native BioData Consortium. Her research centers on ethical engagement with Indigenous communities in precision health and genomic medicine. She also incorporates biostatistics, genetic epidemiology, public health, and, increasingly, environmental data science and stewardship. At the laboratory bench, she patented a targeted ultrasound imaging and chemotherapeutic drug delivery device for treating early cancer metastases. Krystal's endeavors have received international media attention in outlets such as *New York Times*, PBS NOVA, *Washington Post*, NPR, *The Atlantic*, and *Forbes*, among others.

■ LENKA VESELÁ is a PhD candidate at the Department of Theory and History of Art at the Faculty of Fine Arts (FFA), Brno University of Technology (BUT) in Brno, Czech Republic. Her art-based research practice concerns "synthetic bodies" (bodies emerging by synthesis—interconnected with and dependent on the broader collectivity of human and nonhuman life that exists within a shared environment) and "synthetic bodies of knowledges" (knowledges synthesized across multiple sites). She is a lecturer, organizer, and feminist thinker advocating for inclusive forms of transdisciplinary knowledge production. She has previously published in contexts such as the *Journal for Artistic Research* and is presently the initiator of this book, *Synthetic Becoming,* as well as the attendant exhibition and symposium at FFA BUT in December 2022.

■ KER WALLWORK is a London-based artist with a multidisciplinary practice spanning moving-image, drawing, text, and sculpture. Recurrent themes are language, queerness, sickness, and the welfare state. They have worked with writers, scientists, academics, and actors to develop work that explores materiality in relation to specific social and historic contexts. They are also part of a long-term collaboration with the Survivors History Group to preserve, digitize, and disseminate key items from the archives of the activist organization Mental Patients Union, who formed in London in 1973 before forming branches across the UK.

The collective monograph *Synthetic Becoming* brings together research by artists, activists, and feminist technoscience practitioners concerned with sympoietic becoming with hormones and hormonally-active chemicals. The contributors examine effects of industrial, pharmaceutical, and more-than-human production and interplay of hormonally active molecules, asking: What does life re-assembled by hormones and hormone-mimicking chemicals look and feel like? Who are we becoming with them and how can we possibly be with them otherwise? Adopting a decolonial feminist, posthumanist, and new materialist approach, the book embraces queer ecological sensibilities and responds with a series of critical but hopeful provocations that embrace posthuman mutability and articulate our "synthetic becoming" in ways that facilitate caring relations and allow us to envision and enact hopeful futures with and despite these peculiar chemical agents.