Duelling Epistemologies

How Artists Hack Laboratories and Alter the Futures of Science

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On bio art and the living

Bio Art challenges a number of western pre-conceptions about what art is and what art is supposed to do. By its nature ephemeral, and in a constant state of flux, the use of living materials runs contrary to centuries of art preservation and the ideal of art as eternal. But an art that goes hand in hand with science now ends two centuries in which the arts and science were seen as separate (and increasingly distant) disciplines. Moreover, Bio Art does not aim to 'illustrate' science (something which often confuses novice scientific collaborators) but to place the life sciences, and the organisms, cells and complex molecules studied, in a new focus. Many Bio Art works question whether Biology is, or can ever be, truly objective; and also seek to uncover the cultural and ideological baggage that the natural sciences carry with them, making clear that this baggage hinders both any true sense of objectivity – if this is even possible – and a deeper understanding of the living world. Bio Art has left the artist's studio, as it ventures into new terrain, but it is also something more than "art made in the laboratory". Along with new "post-humanities", such as Science and Technology Studies (STS), the philosophy and history of science, and the new directions in Anthropology, Bio Art examines our civilisation's cleft between scientists (and all humans) and the more than human world. But unlike those academic disciplines, Bio

Art is about practice. After all the theory has been included, the artwork still has to function. It is a uniquely difficult practice that has to bridge both the 'laws of nature' and the debates of humankind. This essay was first published in *Proceedings of Politics of the machines – Rogue Research 2021*, in 2021.

Introduction

Donna Haraway's concept of 'Situated Knowledge' can be understood as feminist critique of scientific 'objectivity', but there are more factors to critically challenge knowledge production – from the perspectives of race, gender, and class, as well as contemporary economic ideologies. Looking specifically at the interaction of Hybrid Art and the life sciences in the late 20th and early 21st century science we would like to formulate two lines of critical approach: 1) How can Hybrid Art, and specifically artistic research – in lab – criticize the effect that the market logic has on determining what is researched and what is not. Research funding can also be seen as a means of shaping and disciplining scientific research and knowledge, to ensure it follows the desires of the market. Can cross-disciplinary exchange between scientists and artists be a catalyst for liberation from market constraints and obligations? 2) What are the effects of 'engineering' as ideology on both science and Hybrid Art? Especially in the case of the life sciences, where money and attention are focussed on bioengineering, the ideal of efficiency creates an obstacle in the pursuit of knowledge. Efficiency, mandated by the market, plays a major role in bioengineering. But this is in contradiction to nature and life, where complexity and redundancy play a very important role in evolutionary success. Further, we live in an era where the 'hype' surrounding biotechnology creates a platonic mirage of the actual state of science. We propose, for example, that the CRISPR genetic engineering technique is not going to radically change nature as we know it and sustainable biomaterials are unlikely to replace plastics. Are both artists and scientists capable of sifting the hype from their research and practice, and if so, how?

Many hybrid artists do challenge the epistemology of natural sciences. They bring in questions of epistemology, ontology, ethics, and politics, yet remain true to principles of science. Instead of a 'pure research' which, despite its pretension for purity, in reality exists to provide marketable products, their hybrid artistic research seeks to (re)contextualize both knowledge and our species within a planetary ecology. In the long run (as opposed to market economy short-term profit goals) the approach of these artists asks questions about the survival of *Homo sapiens*. Also, their engagement with a diverse public, through their work but also new forms of media such as DIY science workshops ("do it yourself"), talks and inter-species performance broadens both knowledge and debate, as well as offering lay persons tools and knowledge for scientific literacy within a broader ethical, ontological, epistemological and political framework.

Reflecting situated knowledges

In her 1988 essay *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective* Donna Haraway places natural science's claim toward 'objectivity' under a wider scope of investigation. She claims that historically, science has been carried out in tandem with militarism, capitalism, colonialism, and male supremacy (Haraway 1988: 581). While the purpose of Haraway's essay was to propose a 'feminist science' which would acknowledge and locate its bias, we think the power of the essay itself is in this initial questioning of the possibility of an objective science, and the locating of this so called 'objectivity' within the realm of power – gender power, racial power, and above all economic power. The point here is not to overturn 'science' as some sort of belief system, but indeed to create a stronger, more accurate concept of science, by examining and acknowledging the innate biases that are part of every action. In fact, it might be better to understand science from the get go as 'scientific method', or as a verb 'to science' – or 'do science', or carry out research by scientific method – rather than as a noun which, in the public imagination at least, occupies territory.

That said, doing science still takes place within a world controlled and regulated by political and economic powers, whose desires support, hinder and shape most of the research actually taking place. Funding is probably the most important determinant of what is actually investigated – or on the contrary, what knowledge is left undiscovered. There is no simple formula here though, but rather a complex set of constantly re-aligning currents that determine what resources go where. In the last three decades since Haraway wrote her essay there has been an additional point of input into this complex system: calls for inter- and transdisciplinary practice, first within academia, and more recently from several generations of artists who have sought access to laboratories and research institutions with the goal of following their own hybrid practice.

While the numbers of artists actually participating in research in scientific institutions and their influence upon these institutions is rather small – perhaps minuscule – we think it is interesting to ask here what role they might play, now or in the future, in challenging existing biases in the science, as well as opening up currently closed avenues of inquiry. But first we want to explore some of the biases in our current world that determine what is researched and how that research is carried out.

Looking specifically into late 20th and early 21st century science, we would like to formulate two lines of critical approach:

- How does scientific research take neoliberal mechanisms as fact instead of ideology? Not only taking this questionable economic theory as fact, but how funding and 'ambition for success' determine what is researched, but negate outcomes that might contradict capitalism. And how is funding used to discipline science into following the market, and often with a lack of logic?
- Understanding engineering as ideology: This is the case especially in life sciences, where the money and the attention are on bio engineering. The ideal of efficiency plays a major role in engineering – and in capitalism. This is often in contradiction to living systems, where complexity and redundancy play a very important role in evolutionary success. Given the limited space allowed here, we will only briefly touch on a few points.

How neoliberal mechanisms form research

Bias in research is often finessed through the framing of the research: which questions are asked, how comparisons are made. For instance, research on the effect of perchlorates (used, for example, in pyrotechnics industry) on thyroid iodine uptake (by humans and rats) differed markedly when carried out by a National Academy of Sciences panel as opposed to researchers working for companies that had the responsibility to clean up perchlorates (Michaels 2008). All too often "tricks of the trade" are used, for example in comparative studies, such as drug trials, where "testing your drug against too low or too high a dose of the comparison drug because this will make your drug appear more effective or less toxic" (Michaels 2008). In corporate-sponsored systematic reviews of pharmaceutics, the use of "inappropriate comparators to the product being investigated" was a major factor in outcomes favouring the sponsor (Lexchin 2003).

Bioethicist David B. Resnick states from the start that scientific research is a form of business: "The business of science is to produce new discoveries and innovations that advance human knowledge and society." He also notes that scientists and their sponsors and institutions have financial interests related to the outcome of research. Additionally, decisions made outside the scope of research (such as those made by journal editors) also influence what research is published and indirectly influence both what is researched and the outcomes of that research (Resnick 2014).

Beyond these direct influences from the capitalist system in which scientific research is embedded, there are more issues, intrinsic to scientific research such as institutional structures and dominant paradigms, inevitably influencing and constraining scientists' thinking and causing bias. In *Philosophy of Biology: Philosophical bias is the one bias that science cannot avoid*, Fredrik Andersen, Rani Lill Anjum, and Elena Rocca mention, as an example, a default position in molecular biology claiming that entities (such as proteins) are more fundamental than processes. They point out recent research that takes the opposite approach, and explore the tension between these two ontological positions. They inter-

pret this phase of tension within Thomas Kuhn's concept of paradigms and paradigm shifts. In *The Structure of Scientific Revolutions* (Kuhn 1962), Kuhn had labelled this phase 'normal science', and argued that

> "[…] the role of the scientist was to fill in the gaps in our knowledge within the paradigm. Therefore, in times of normal science, there is little need for or interest in philosophical discussions on the foundations of a subject. However, according to Kuhn, when scientists start engaging in philosophical debates about their subject, a paradigm shift might be imminent." (Anderson/Anjum/Rocca 2019)

Certainly, as radical changes within the life sciences in the last 50 years have led to a number of paradigm changes, it will be interesting to see if more interaction between biologists and practitioners from different disciplines, such as hybrid artists, will encourage and accelerate paradigm changes. This interaction can also take place within institutions – such as SymbioticA, a biological laboratory for hybrid artists, that is itself part of the University of Western Australia's School of Anatomy and Human Biology. It can also be found in the extraordinary transdisciplinary practice of individuals such as biologist and artist Brandon Ballengée, microbiologist and artist François-Joseph Lapointe (Lapointe 2012) or Špela Petrič and Kat Austen, both of whom have PhDs, in Biochemistry and Chemistry respectively, and who we will discuss later.

Capitalism has especially encouraged a fusion of biological research and engineering bringing about the biotechnological revolution of the last half century. But this marriage of disciplines also means an intermingling of ideological positions. Engineering implies the practice of changing the world to suit human needs and goals. It also emphasises the importance of simplicity and efficiency as both the 'proper way of doing things' and a form of maximising profit, the latter being a key goal of the markets. On a ground-eye level, Chemist Derek Lowe has a noteworthy blog post *Engineering Biology, For Real?* that criticizes the engineering view prevalent in some sectors of the life sciences. Referring on the biotechnologists' metaphor of 'building blocks' of proteins and enzymes:

> "So when you casually say 'Once we identify the Legos in biology' you're actually asking for a great deal, and by disguising it in terms of similarly-sized little building blocks, you actually are confusing the issue. Let's say that the Lego blocks in this case are the five major nucleotides in DNA and RNA. We've identified them. Does that mean that we understand their systems well enough to mix and match them? Well, crudely, yes – we can go in and change a genomic sequence. But do we know what happens when we do that, and why? Not so often, not at all." (Lowe 2018)

Here one may argue that the ideal of efficiency creates an obstacle in the pursuit of knowledge. Efficiency, mandated by "the market", plays a major role in engineering. But this often contradicts nature and life, where complexity and redundancy play a very important role in the evolutionary process. Beyond the confines of research and 'pure science' the waters become murkier. Important knowledge and developments are 'packaged for consumption' by audiences outside science (Kolker 2016). Thus, science becomes not so much an approach towards seeking out and verifying the world around us, but rather playing a part in some grand human narrative (and often this narrative is adapted towards dominant ideologies). The farther you get from scientific publications, and into more and more general publications, new developments like CRISPR-CAS9 are framed according to the desires of the medium and its audience. While CRISPR-CAS9 is certainly an improvement on previous forms of genetic modification, studies also show problems with unintended deletions of genetic materials and other issues.

Similarly, the recent hype on bioplastics attempts to offer a simple feel-good narrative to a very complex problem (Galla 2021). Certainly, continued plastic production and the waste it produces is a major problem which will plague both our species and the planet for a very long time. But none of the 'sustainable' replacements on offer can really replace the strength, versatility, and current low cost of plastics. Some bioplastics have their own negative issues concerning degradability and sustainability (Zimmermann 2020). There is no simple answer here. Some bioplastics become a realistic option, but only *if* governments find

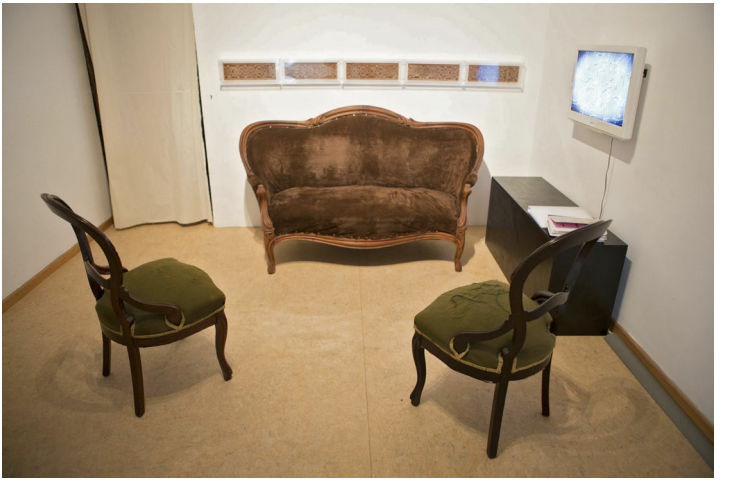
ways to limit competition from fossil fuel-based plastics – for instance, by substantially raising their costs. But this probably requires eschewing some very convenient items (such as plastic bags, synthetic textiles, laminate furniture) and utilising plastics only when we absolutely must. But it is more likely that plastic production will continue to increase well into the future (International Energy Agency 2018), not only because of the convenience for consumers (with a high cost in the future) but also because its production is vital to fossil fuel companies and their political and economic allies.

If doing science depends on a point of objectivity – which in turn is only a Platonic ideal – then certainly this point is situated in a maelstrom. But most scientists remain true to scientific method and adjust the state of science according to the knowledge at hand. Still, Haraway's *Situated Knowledges* presents a more honest approach to the ideal of objectivity, one that may better serve both the natural sciences and society in a troubled future. Having offered this thumbnail sketch of the situation, we now look at outside players intruding into the sphere of science. In contrast with established collaborators – from the humanities, philosophers proposing scientific ethics, historians of science, or science journalists – the interesting thing about hybrid artists is that they too practice science. Bioethicists are rarely 'lab-ready'; bio artists, almost by definition, are. And yet they bring with them a bag of tools – the tradition of 20th century aesthetics, the discourse of relevant fields of humanities such as science and technology studies, posthumanism, anthropology, a working knowledge of electronic media – that not only compliments 'doing science' but can be most helpful in locating 'situated knowledge.'

The following sections shall exemplify how artists hack laboratories and contribute to altering the futures of science. We see a small group of (mostly women or non-binary) hybrid artists challenging the epistemology of natural sciences, without breaking from scientific method or 'doctoring' the results of their inquiry. As opposed to the artist as a visionary, here the artist is a deep critic: Tarsh Bates, Špela Petrič, Mary Maggic, and Kat Austen – to name only a few.

Hacking heteropatriarchal medical practices

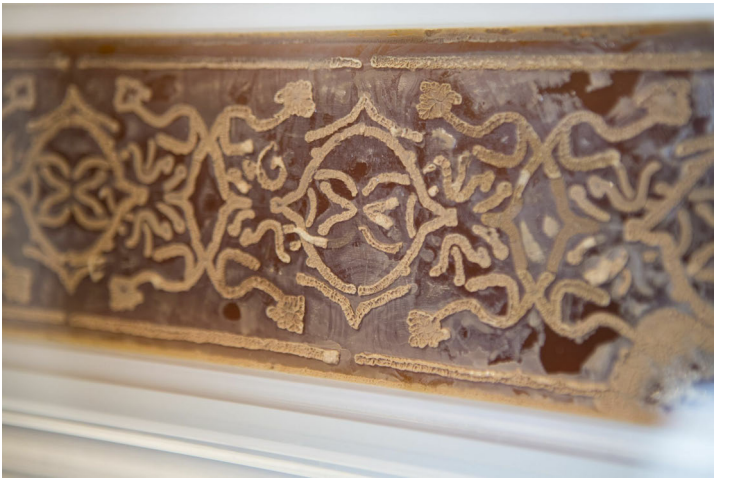
Figure 1



Tarsh Bates: Surface dynamics of adhesion, 2016, exhibition view Art Laboratory Berlin, photo: Tim Deussen

Artist and researcher Tarsh Bates is interested in the aesthetics of interspecies relationships and the human body as a multispecies ecology. Already in her educational training, she combined science and arts: After completing her Bachelor of science in Biotechnology (environmental biology), she has been part for many years as a researcher at SymbioticA, the artistic lab at The University of Western Australia (Many noteworthy artists received essential experience at SymbioticA. Canadian artist WhiteFeather Hunter, for instance, is currently realizing her PhD at SymbioticA. She dedicates her biotechnological art practice to the topics of postcolonial ecofeminism, witchcraft, microbiology and cellular biology with performance, new media and craft; Hunter 2020). There, Bates shaped her artistic paths and realised both her Master thesis and her PhD.

Figure 2



Tarsh Bates: Surface dynamics of adhesion, 2016, detail, photo: Tim Deussen

The latter is titled *The Unsettling Eros of Contact Zones. Queering evolution in the CandidaHomo ecology* (Bates 2013). Her collaborator, co-partner and subject of artistic attention is the fungal micro organism *Candida albicans*, who she is particularly enamored with. "I am particularly interested in the microbiopolitical 'response-ability' of CandidaHomo ecologies because the infections attributed to *Candida albicans* are almost exclusively human induced", Bates remarks. "What we do to our bodies – antibiotics, prosthetics, feminine hygiene products, dietary choices, hormone adjustment, immune suppression, biomedicalisation, latex and silicon sex toys, prophylactics, biomedical devices – encourages *Candida albicans* proliferation." (Bates 2019)

While challenging hetero patriarchal medical approaches of *Candida albicans*, she has centred this yeast in her artistic works. One of her outstanding art projects is *Surface dynamics of adhesion*, created for the exhibition *The Other Selves. On the Phenomenon of the Microbiome* at Art Laboratory Berlin in 2016 (Rapp/de Lutz 2016). This work puts the living candida

in a cultural, social, and psychological context. At the same time, it reveals essential microbiological aspects of *Candida albicans* (Rapp/de Lutz 2016).

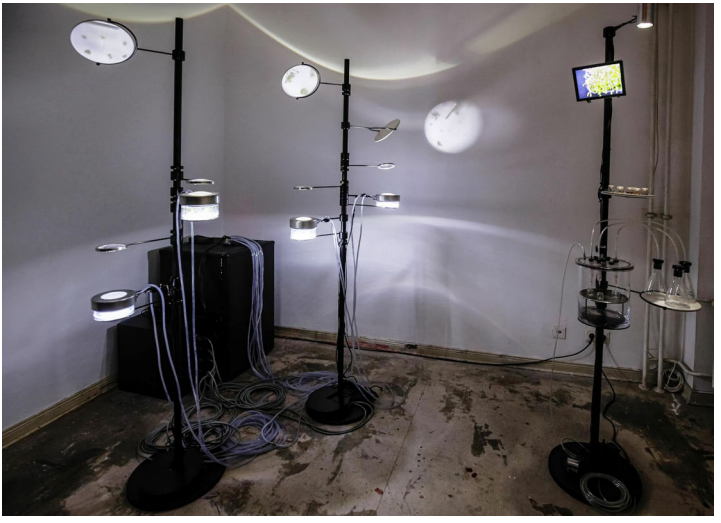
In this installation, prepared as living artwork at Deutsches Herzzentrum Berlin Charité, there is a red-brown frieze on the wall, resembling flocked wallpaper.

> "The living *Candida parapsylosis*, which is applied in five acrylic plates on agar with the blood of the artist, grows in a pattern very similar to the first drawings of its relative *Candida albicans*, made by the biologist Charles Philippe Robin from 1853. The formal aesthetic combination of microbiological knowledge and social-historical decoration is fascinating. Especially in the Victorian era, the awareness of hygiene increased rapidly. Thus, Bates integrates subtle historical references to the mid-19th century in several respects." (Rapp 2019)

Exploring Human-plant Relationships

Being a hybrid artist with a PhD in biochemistry, internationally renowned artist Špela Petrič very consciously follows her dual epistemological approaches: Her work is dedicated to the Plant Kingdom as part of a multi-species collaboration exploring the ontologies, methodologies, ethics and practices of care involved in our relationship to the vegetal. The green kingdom, a central point of interest for the artist, functions on a biological basis radically different from that of humans: seemingly inert, literally vegetative and endowed with unexplored forms of intelligence. Yet science reveals an intricate world of mysterious chemical conversations, interspecies networks and non-centralized operations alien from our own existence. Through her radically transdisciplinary artistic research Petrič "proposes novel modes of human-plant communication, intercognition and exchange." (Rapp/de Lutz 2018)

Figure 3



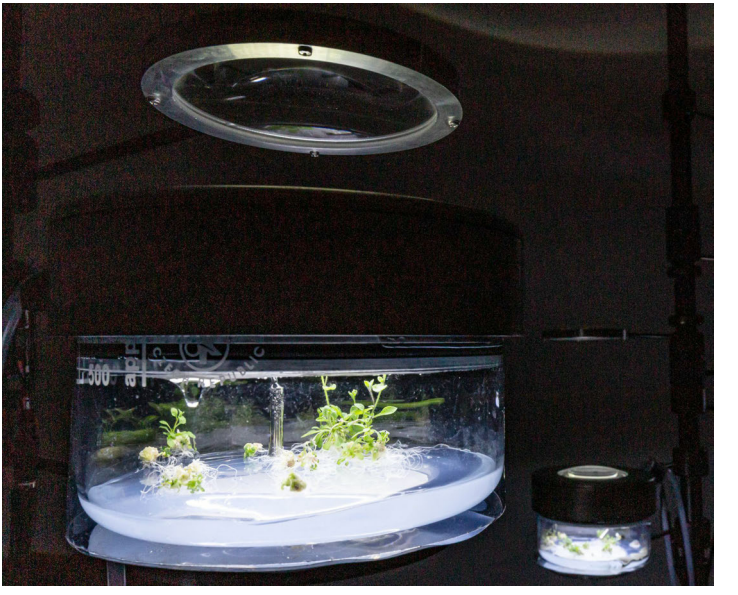
Špela Petrič: Phytoteratology, 2020, installation view Art Laboratory Berlin, photo: Tim Deussen

An excellent example is the installation *Phytoteratology,* based around thale cress, *Arabidopsis thaliana*, which Petrič lets grow from embryo form in a bath of chemicals from her own urine. The resulting plants are by consequence partially biochemical chimeras with the artist as a hormonal – but not genetic! – co-mother (Petrič 2018). "In *Phytoteratology* blood kinship and genetic lineages give way to subtler streams of radical trans-species intermingling and category mongrelisation" the artist says. "The project embodies my desire to conceive and mother a trans-plant, to conjoin the gentle green alien, metaphysically dubbed the most primal of life forms, the barest of bare life." (Petrič 2016)

The artist Špela Petrič critically questions the dominance of genetics versus other criteria such as bio chemistry. Her work can be understood as a challenge to the biotechnological canon, proposing a biochemical inheritance instead of the genetic inheritance, which can be understood as masculine, coded and connected to patrimony and ownership.

The hormonal and biochemical is fluid, crossing boundaries, and therefore harder to define.

Figure 4



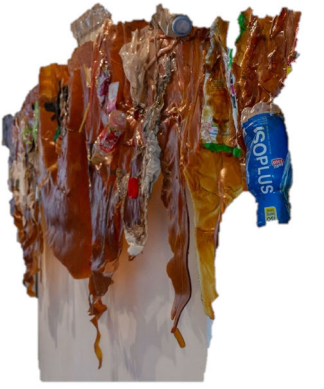
Špela Petrič: Phytoteratology, 2020, installation view Art Laboratory Berlin, photo: Tim Deussen

Hacking the river and molecular fluids

Artist and biohacker Mary Maggic works at the intersection of biotechnology and cultural discourse, having studied Biological Sciences and Art at Carnegie Mellon University as well as Media Arts and Sciences at MIT Media Lab. Their artistic work spans documentary filmmaking, DIY science, and public intervention and has been exhibited intensely and internationally. Their refreshing radical artistic research is essentially based

on civil disobedience and uses workshopology, DIWO ("do it with others") and hacking to collectively gain transdisciplinary knowledge (Maggic 2021; Maggic 2018; Rapp/de Lutz 2019).

Figure 5

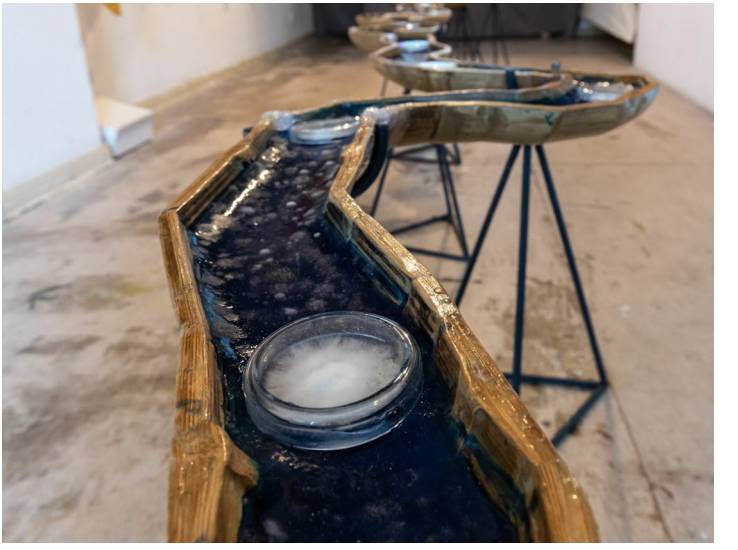


Mary Maggic: Milik Bersama Rekombinan (Recombinant Commons), 2020, installation view Art Laboratory Berlin, photo: Tim Deussen

A good example of Maggic's artistic research approach based on open science is the work *Milik Bersama Rekombinan (Recombinant Commons)*, for which the artist spent the year 2018/19 researching in Yogyakarta, Indonesia as Fulbright scholar. They explored the surreal landscape of Code ("cho-deh"), an urban Indonesian river in Yogyakarta, colonised by plastic, with toxic implications for nearby inhabitants. "While water is the medium that connects us all, it is also the primary carrier of harmful industrial molecules that 'queer' both the river and the bodies of its inhabitants," states Maggic about their art project. Maggic points out the multi-facetted and complex root of the problem – poverty, lack of infrastructure, and pollution as a form of colonialism. The artist sees an

urgency to rethink toxic conditions with empathy, care, and collective survival (Rapp/de Lutz 2020).

Figure 6

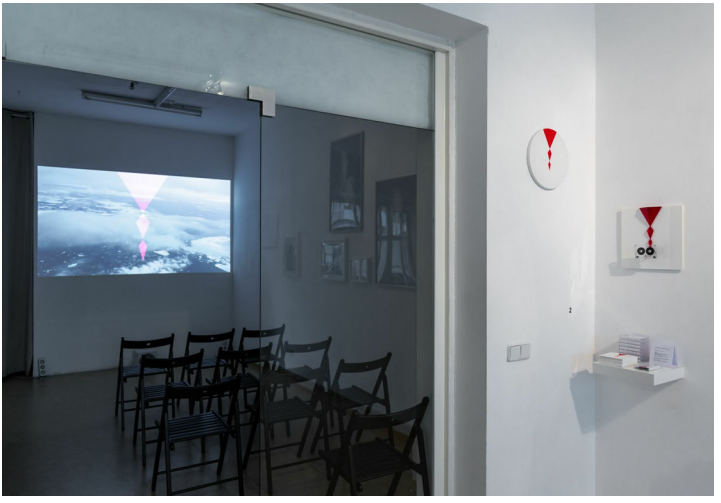


Mary Maggic: Milik Bersama Rekombinan (Recombinant Commons), 2020, installation view Art Laboratory Berlin, photo: Tim Deussen

Maggic considers the assumption that science was 'neutral' as a cultural myth, as scientists constantly take sides. "The tools and apparatuses used in the lab are especially not neutral because they supposedly produce 'truths' while making biased cuts in the deep web of entanglements", Maggic remarks by referring to Karen Barad. The artist considers these truths rather "as fictions in order to challenge the authority of science, and show that we don't have to be scientists to construct our own fictions. That's why so much of my work and research is in do-it-together science—to see how we can produce our own tools and knowledge, and ways of seeing." (Maggic 2018).

Watery Ecologies and Artistic Research

Figure 7

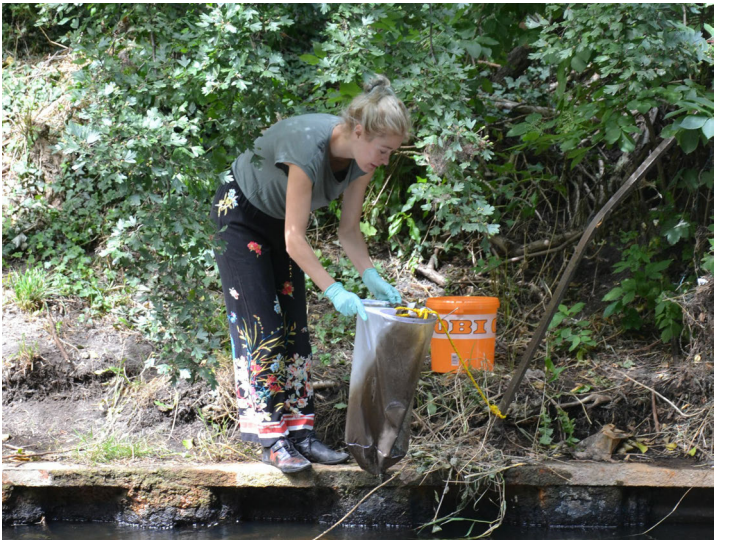


Kat Austen: *The Matter of the Soul* (2017-ongoing), exhibition view Art Laboratory Berlin, photo: Tim Deussen

Berlin-based artist Kat Austen, who holds a PhD in Chemistry and has a background in science journalism, combines scientific knowledge, hacked equipment and ethnographic research with a strong aesthetic approach (Austen 2021). Central to the artist, who is one of the founding members of *DIY Hack the Panke* (Rapp/de Lutz 2021), is the experience of living in a time of dramatic climate change, such as the melting of the Arctic ice shield. Climate change is the most essential aspect she evolves her approach and artistic research around – and with this she is keen on finding and creating empathy for a planet in crisis. In her project *The Matter of the Soul* (2017-ongoing), part of the exhibition project *Watery Ecologies* at Art Laboratory Berlin in 2019, she examines the impact of cli-

mate change in the Canadian High Arctic through a multimedia sound work, sculpture, and performance (Austen 2021).

Figure 8



Kat Austen during the workshop DIY Hack the Panke: Microplastics, Art Laboratory Berlin, 2018, photo: ALB

During the last few years, Kat Austen has also been working on the subject of microplastics in the wild, first in sea life, then in urban waterways, and more recently in trees. An important part of her artistic research and practice has been an evolving series of workshops in collaboration with scientists, artists, and DIY science practitioners (Austen/MacLean/Rapp/de Lutz 2018). In the context of DIY Hack the Panke, and jointly with microbiologist Joana MacLean she realized the workshop *(Un)Real Ecologies and Microplastics* several times between 2018 and 2020. In the workshops Austen and MacLean, together with participants, examined the 'plastisphere' of the river Panke (in Berlin Mitte) and

observed how organisms interact with plastic, including a microscopic observation of the collected particles, in order to get a closer look at plastics and living creatures.

In the online event *Microplastics and Coexistence* with Austen and MacLean, we discover their art and science research on microplastics and become aware of the potential of open format DIY/DIWO approaches mediated by workshopology: "[They] allow us to rediscover our agency in the world, the ability to research and make sense of the world is to have agency within it," remarked Kat Austen, "and when you are aware of your agency you are more able to and likely to act, and to act in a constructive way that will change the problem you are looking at. And so, for me, the development of these DIY techniques is a political act." (Austen/MacLean/Rapp/de Lutz 2020). This is only one of numerous examples we could offer to show that workshops can be understood as an artistic performative medium for the 21st century – not only interactive but also participatory.

Final note

As we have shown in this short paper, hybrid artists propose current and essential questions of epistemology, ontology, ethics and politics, refreshingly transgressing the political boundaries of research – yet in their practice they remain true to principles of science. Instead of 'pure research' which, despite its pretension for purity, in reality exists to provide marketable products, hybrid artistic research seeks to recontextualize both knowledge and our species within planetary ecology. In a long-term sense the approach of these artists asks vital questions about the survival of *Homo sapiens*.

Be it challenging hetero-patriarchal medical practices (Bates), critically exploring human-plant relationships (Petrič) as a means of discussing the epistemologies of science, hacking the river and molecular fluids (Maggic) or providing research on watery ecologies (Austen) – artistic research shows an impressively versatile approach to 'doing science' beyond the confines of short-term economic interest. Additionally,

their engagement with a diverse public, through both their artwork and new forms of media such as DIY/DIWO science workshops, talks and inter-species performances, do broaden both knowledge and debate. The workshop as artistic performative medium for the 21st century radically broadens the fields of knowledge production. These new formats also offer the lay person tools, structures and impetus for scientific literacy within a broader ethical, ontological, epistemological and political framework.

Finally, a strong awareness of discourse enables hybrid artists to situate their own knowledge (which includes relevant fields of the humanities and post-humanities) in a way that not only compliments 'doing science', but can also aid in building an awareness of issues of 'objectivity' and 'situated knowledge' in the natural sciences.

A first version of this text has been published in 2021 (with the exception of the first paragraph, which was added for the current publication).

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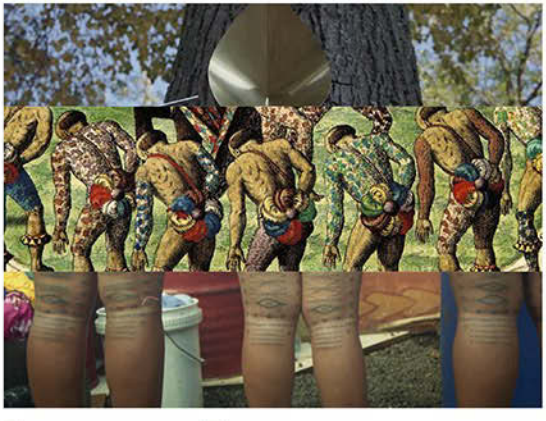
JULIO VELASCO,
KLAUS WEBER (EDS.)

BIO ART

VARIETIES OF THE LIVING IN ARTWORKS FROM THE PRE-MODERN TO THE ANTHROPOCENE



[transcript] Image

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