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Anthropology after Progress: Situating Public Chemistries Ethnographically to Better Understand Life as Aftermath

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Abstract

Synthetic chemicals are ubiquitous. They circulate in large amounts turning organisms and their environments anthropogenic and constituting life as aftermath (Landecker 2025). Trying to understand life as aftermath challenges modern chemistry and the life sciences. I propose here to use relational-processual ontology, para-siting/parasighting, and anthropology's anticipatory competences to develop in collaboration with chemistry situated and public chemical practices that are able to expand beyond their current progressive commitments to economic growth, molecular knowledge, and reductionist risk assessment and that are able to address life as aftermath. In a second step, I argue for a Wissenschaft *after progress* as a Wissenschaft able to address anthropocenic challenges, and I suggest the need for post-heroic, collective, and cooperative institutions as homes to a more-than-progressive Wissenschaft.

Keywords: aftermath, chemistry, anthropology, progress, Wissenschaft

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Anthropogenic chemicals

Since the summer of 2025, around 3500 inhabitants of more than a dozen small villages in the Meuse and Ardennes region of France have started to rely on bottled water from supermarkets, because the local prefectures have formally banned tap water for human consumption: record levels of per- and polyfluoroalkyl substances (PFAS). These 'forever chemicals' are characterised by a carbon-fluoride bond that is highly resistant to breaking down by virtually any known 'natural' process in the environment or organisms. This stability makes PFAS attractive in applications where non-stickiness is important, e.g. medical devices or water-repellent clothing. Effects on human health from PFAS exposure currently under investigation reach from endocrine disruption to cancer. In the specific case in France, authorities suspect that PFAS-containing sludge from a nearby paper mill has been spread as fertiliser on local fields for years, leading to these high concentrations in local groundwater supplies. How the groundwater supplies might be cleaned up again remains unclear. This is just one of countless examples of PFAS contamination currently gaining visibility across the globe. The industrial-scale marketing and use of PFAS – a heterogene-

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ous group of more than a thousand substances – from the 1940s onwards has led to a near global ubiquity of PFAS in the environment and in organismic tissue with as yet ill-understood consequences for human and planetary health and with ideas about what to do being few and far between. One might frame this issue as an environmental and health crisis. A highly useful and widely used manufactured chemical turns out to be a pollutant and health risk. What made it attractive, namely the strong carbon fluoride bond, now marks the site of trouble. Exposure is high, health effects are manifold and serious, clean-up is difficult and expensive. One might argue that this is another case of "matter out of place" (Douglas 1966) in line with the history of substances such as asbestos, persistent organic pollutants, or microplastic. One might discuss its implications from a political economy or environmental justice perspective emphasising the unequal distribution of risks and benefits along gradients of socio-economic indicators locally, nationally, and globally.

I want to make an argument for a different reading. The industrial-scale circulation of anthropogenic chemicals is *constitutive* of late industrialism (Fortun 2012) and has long created and continues to create "a novel patterning of living matter and process from the molecular to the ecological" (Landecker 2025: 679). Understanding biology as anthropogenic and "life as aftermath" (ibid.) means recognising that industrial and organismic metabolisms have become irretrievably intertwined. This is not crisis. This is what industrialism is. The language of crisis, toxicity, and pollution evokes a world where purity is the norm; where a pristine nature is disturbed by the undue presence of substances; where culprits have done wrong in releasing problematic chemicals; where chemical pollution is an unintended consequence of benign progress and industrial growth. This framing suggests clean-up, technical solutions, liability, and tighter regulation of hazardous substances. This has been and continues to be important. Yet it misses at least two important dimensions: First, life is being altered below the level of toxicity. Not only are studies showing that effects from substance exposure are often delayed and non-linear. In many cases, the industrial-scale circulation and availability of substances is altering patterns of organismic life without this having immediate detrimental effects (e.g. Neubauer & Landecker 2021). While not considered toxic, innumerable substances are legible by organisms' metabolic, endocrine, nervous and immunological systems. These substances are required to scale up the production and distribution of goods in global markets: additives in wood or plastic; surfactants and emulsifiers particularly in liquid goods from paints to food stuffs; supplements in animal feed, etc. The functional and aesthetic qualities that people and businesses alike expect from products currently lead to an ever-increasing complexity of chemical formulations. These formulations interact with each other and with countless biological targets in organisms and the environment. Beyond bioaccumulation, these ubiquitous presences and interactions alter the "inward laboratory" (Huxley 1869/2024) of organisms in manifold and meta-stable ways. Alterations persist beyond exposure. Life as aftermath has become the biochemical reality of the Anthropocene. These alterations are hidden in plain sight (Neubauer & Landecker 2021). This is possible – and that is the second dimension that the toxicity framing sidelines – because the rate of production and release into global market circulation of anthropogenic chemicals exceeds any means of control, monitoring, and assessment currently in operation across the globe. 'Novel entities' have been quantified as a planetary boundary that has long been exceeded (Persson et al. 2022). The industrial-scale circulation of substances thus occurs outside of safe and just operating spaces. It is very much constitutive of modern progress, i.e. of economic growth and inno-

vation, of modern development, and of a techno-scientific hubris "mistaking the ability to temporarily control living things for full knowledge of them" (Landecker 2025: 680).

In the following, I will outline some of the epistem-ontological and methodological challenges that arise from trying to understand life as aftermath and what they mean for a 'science and technology studies'-inflected anthropology. I select those challenges to which Gisela Welz has already alerted us in her anthropological writing: Anthropocenic perspective, the temporality and localisation of fieldwork, and anticipation. I then move beyond chemistry to make the case for an anthropology *after progress* more generally, outlining how universities need to change to embrace more-than-progressive knowing and worlding.

Expanding an Anthropocene Anthropology

A key characteristic of an Anthropocene anthropology (Welz 2021) is the relational perspective that aims to overcome *a priori* nature–culture dualisms; dualisms that are of little help in appreciating the manifold entanglements of material and semiotic dynamics that have been (re-)emerging in empirical findings over the last four decades and dualisms that have stood in the way of normative and political reformulations of human bodies, sexualities, and abilities. Relational thinking comes in very different forms. Much of it operates at the scale of social interaction, e.g. Marilyn Strathern developing thinking on complexity and kinship into partial connections (Strathern 1991) or the conjunctural analyses of cultural studies and their manifold successors (e.g. Hart 2023). An Anthropocene Anthropology takes its cue from a relationality that draws the material world and biological life into social practices (Beck 2008; Haraway 1988; Callon 1984): material–semiotics sets bodies and technologies in motion and characterises them ontologically as constituted through relations. The search for the essence of living things, e.g. in genes or neural networks, is replaced by attempts to understand the relations that constitute a living thing at a particular moment in time. Stability is not given but in need of explanation and legitimacy. While relationality is commonly used as the term that captures this ontological commitment, as well as the analytics that come with it, processuality is equally important. Relationality as a static phenomenon quickly evokes systems or network thinking, i.e. larger entities being broken down into smaller entities positioned in specific patterns of exchange. The key to relational-processual thinking in its Anthropocene Anthropology variety, however, is the distribution and quality of agencies in assembling relations between processes – not between entities. Entities emerge as points of contact between processes. Whether and how they become durable is an empirical question not an ontological assumption (cf. De Landa 1997; DeLanda 2006). In the philosophy and social studies of biology, biomedicine and the life sciences, relational-processual ontologies have emerged in response to the repeated failures of trying to pin the logics and patterns of living things to material entities, most forcefully: genes (Dupré 2014). All the way down, biology was hoping to find firm material ground to stand on. However, living matter continues to escape the modern cage of law-like reductionism to express itself in rather pre-modern regularities and patterns (Daston 2002). Biological life, it seems, is infused with social dynamics and semiotic flexibilities all the way down (Beck & Niewöhner 2006; Niewöhner 2011).

Somewhat curiously, relational-processual analyses have attended to the material world in the form of living matter and material culture, organisms and technologies and their respective 'components'. Yet matter itself, i.e. the building materials from which these 'components' are assembled, has received much less attention. How are molecules assem-

bled and how do metabolisms from economic to biological circulate molecules through living things? How come Western material culture can be full of problematic substances? And what exactly makes them problematic? Chemistry and material sciences are not receiving the attention that scholars have afforded the life sciences and engineering over the last fifty years. As if matter itself is only of interest when already assembled into higher-order entities.

To address life as aftermath, an Anthropocene Anthropology needs to develop an empirical and conceptual sense of material culture at the molecular level and below. This starts from an appreciation of substances in relational-processual terms. Rather than assuming molecules to be stable entities, two empirical realities suggest otherwise. First, at quantum scale, particles lose their definite position in space and time to probabilities. Further, many chemical bonds while treated as stable links actually exist in dynamic spectra of spatial distance and attraction. The clarity of the atom model, that has certainly shaped my understanding of chemicals at high school, hides continuous dynamics and uncertainties. Whether these dynamics and uncertainties become relevant in material interactions is an empirical question and oftentimes a matter of scale. Second, any chemical substance that is scaled-up to industrial levels and marketed globally will enter into an unpredictable number of material interactions with unpredictable consequences. Hence, knowing the molecular structure of a substance is only one dimension of knowing this substance's actual effects 'in the wild'. This latter aspect of interactivity and its unpredictability has been taken up in the anthropological literature on toxicity and convinced scholars to think of chemicals in relational terms, i.e. as constantly in interaction with other substances (e.g. Murphy 2006). Yet even here, the empirical-analytical focus is mainly placed on the relations between a toxicant and multiple biological targets as well as the questions of power and accountability that arise from unequal exposure, in/visibility of effects, and alternative means of sensing and experiencing exposure and pollution. The chemicals themselves in their relational-processual 'nature' remain largely black-boxed; with few notable exceptions (e.g. Dumit 2021; Landecker & Kelty 2019).

Life as aftermath, then, remains largely unaddressed by the life and chemical sciences as well as the social sciences and humanities. Efforts to address chemical complexity and pollution within chemistry itself remain tied to progressive registers of green and sustainable solutions. My own group's work in this area demonstrates that benign-by-design approaches are firmly rooted within a chemical-engineering thought style focused on optimising production processes rather than designing new substances (Roiss et al. Forthcoming): Green or benign design is considered impractical if not impossible by many practitioners in the field as the industrial scaling of any substance is necessarily seen as leading to unpredictable interaction and transformation effects. Attempts to simplify products, i.e. to use fewer substances in products, fail as material and product innovation require additional material functionality, which is achieved largely through tinkering with existing substance mixtures, thus increasing complexity and interactive potential.

An Anthropocene Anthropology needs to go beyond such techno-scientific solutionism. Relational and processual thinking needs to be taken to chemistry and chemicals in an expansion of more-than-human approaches beyond animals and ecologies. Addressing life as aftermath requires at least a twofold approach: First, it is about spelling out a new form of biopolitics, namely the governance of biological life through the circulation of substances. This is not simply a molecular form of environmentality (Agrawal 2005) as it does not focus on the material world as a means to making human subjects or populations. Life is made

sub-subject by altering metabolic and endocrine apparatuses and processes through anthropogenic chemicals. Second, it is about developing social studies of chemicals and chemistry, i.e. a way of establishing rapport with materials and working on and with molecular design practices and material sciences to deconstruct chemical design in its scientific, industrial and regulatory facets and to bring societal matters of concern to design processes as early or 'upstream' as possible. The following section discusses the methodological implications of such an approach.

Building para-sites and para-sights with chemistry

In ethnographic fieldwork, various degrees of collaboration between anthropologist and interlocutors have been developed over the course of the discipline (e.g. Lassiter 2005). The spectrum reaches from using ethnographic methods to work with communities on shared goals (collaboration) to temporary shared epistemic work between ethnographer and field while pursuing separate goals (co-laborative, Niewöhner 2016), to building (feminist) concepts from science (Roosth & Schrader 2012). Experimental approaches using multi-modal epistemic practices and devices are being tried across the entirety of this spectrum (Estalella & Criado 2018).

A relational-processual approach to anthropology that wants to study socio-chemical dynamics has to build rapport with the materials and substances themselves in all their contingencies – rather than focusing only on the social and political effects of extraction, production, and use and related exposures. Such an approach can only be developed by working with chemistry in some form of collaboration. Yet 'chemistry' is not simply a knowledge-driven academic discipline with research and teaching based at universities and public research institutions. Chemistry in its current form is a field shaped significantly by industry and its research and development practices as well as economic frames of shareholder value, supply chain logics, extraction, production, distribution infrastructures, and customer demands, largely articulated in business-to-business transactions. Industry's first and foremost interest is in chemical engineering rather than chemical science per se. It lies in the tinkering with existing substances to add new functionalities or to reduce production costs. Revenue is earned largely through bulk production of platform chemicals that are sold to other industries and manufacturers for their own production chains. Hence, the ability to 'scale up' is paramount for any innovation, and it casts its shadow ahead into academic chemical science where the value of new ideas is often not primarily assessed with regard to originality of knowledge claims but with regard to scalability and the probability of making a difference to existing products and markets. 'Green' chemistry, from this point of view, is not primarily about designing the safest and most sustainable substances or products possible. It is about designing products and materials that can be dropped into the existing infrastructures of industrial production as a substitute for an existing product or material at lower cost or lesser health or environmental impact.

Chemistry is thus a complex global techno-scientific field spanning industry, science, and regulators. How can anthropology address such a complex field collaboratively? In an essay on rapid globalisation and its consequences for anthropological research, Gisela Welz (2009) points out that neither the object of research nor its field are self-evident (if they ever really were) in a world where struggles over the manifest social order have shifted significantly into dynamic scapes or vectors spanning the globe. Welz suggests *sighting* and *siting* as two crucial epistemic practices to address this new condition. Sighting denotes the need

to develop an analytical perspective onto a phenomenon, i.e. define the research object through an oscillation between world and conceptual apparatus. Siting refers to the need to locate the object of research in space. In other words: Ethnographers need to build meaningful cases that enable them to make visible the processes of globalisation (sighting). And they need to emplace these cases (siting). The strength of anthropology does not necessarily lie in capturing the macro-dynamics of global phenomena. It lies in encased and emplaced analytics through which ethnography can grasp how a phenomenon is assembled as global (cf. Ong & Collier 2005). In her own work in Cyprus, Welz (2012) has demonstrated that this requires at least an analytical and a methodological commitment: Analytically, it means developing phenomena, e.g. qualculative regimes around halloumi cheese as a product of European cultural heritage, into cases that allow the researcher to chart and analyse the vectors of multiple late modern politics and economics as they work their way through a seemingly 'local' issue. Welz has taught us the epistemic, political and ethical care that needs to be taken to do justice to the locality of a phenomenon while at the same time appreciating its existence as a prism for much wider concerns that may or may not be articulated meaningfully on site. It is a tightrope act that can really only be performed well in dialogue with people *in situ* and in studying sideways (Boyer & Hannerz 2006). Methodologically, it cannot be done without repeated visits. Cases need to be extended (Burawoy 1998) to map out the panoply of manifest and latent traces that global vectors leave in local contexts. And these traces need to be connected to their points of origin in the political and economic centres of power in a multi-sited approach (Hannerz 2003; Marcus 1995). The risk of asymmetry is obvious as ethnographers excel at thickness in the local while all too happily thinning out the political and economic vectors through distant analyses – another argument in favour of a clear and long-term empirical focus that allows the ethnographer to thicken the analyses of multiple sites symmetrically (Welz 2015).

What does this mean for working anthropologically in and with a complex global techno-scientific field such as chemistry? I have three suggestions: First, it needs an overarching analytical commitment that helps to co-construct an anthropological perspective in interaction with chemistry as a complex field. I propose "materials sovereignty" (Kokai & Iles 2020) to provide this analytical commitment. In analogy with academic and political debates around food, water, and energy sovereignty, materials sovereignty marks the right of people to a fair degree of control over their material culture, i.e. the materials used in the artefacts, building materials, and landscape structures surrounding them. In the first instance, this is a political right and ethical norm. Yet analytics can be deduced from it. Most importantly, it encourages anthropologists to inquire into the epistemic politics of materials design, production and regulation. Whose expertise shapes these practices and whose does not and with which consequences for whom? Chemistry is currently a field characterised by an extremely narrow epistemic politics. Serious and competent discourses about chemistry are discourses at the molecular level of substance structure as determined by chemical science. Such molecular substance knowledge is clearly valid and important. Yet it is necessarily contingent. It struggles to embrace the relational-processual ontology outlined above and it also largely ignores any other ways of sensing, experiencing, and knowing life amid substances (Shapiro 2019). These wider ecologies of expertise (Beck 2015) can be and need to be brought to chemical epistemic communities.

Anthropology, and this is my second suggestion, needs to construct para-sites (Marcus 2000). It needs to attach anthropological and ethnographic competence long-term to chemical epistemic cultures as a methodological form in which participants engage as partners,

in which shared and separate assumptions are openly examined, and in which new insights emerge from the interactions themselves. Para-sites are not designed primarily for the ethnographer to learn about the field, though this will occur. They are symmetrical spaces of mutual learning and of developing para-sights, i.e. shared perspectives onto chemical and material design that are rooted in multiple often conflicting epistemic cultures. This will help to situate chemistries (Quadrelli 2024) in their epistemic, political, and ethical assumptions and objectives, while also helping anthropology to establish rapport with the materials themselves rather than just their conditions of production and their effects. Localising or encasing chemistry in para-sites needs to cover all aspects of this complex field. Starting from working on new curricula for chemical engineering degrees via co-laborative lab research to research placements with industry and regulators. I do not have the space to discuss problems of access in industrial and political settings here. Suffice to say, very much in line with Welz' methodological proposal, that trust and long-term working relationships with all actors involved are paramount.

My third suggestion, therefore, is: expanding beyond the dominant methodological individualism prevalent in ethnographic research. Siting and sighting need to be collective and sustained practices when practiced in and for large complex fields. Sites need to be collective endeavours that achieve continuity in social interaction and thought styles across individual projects and people. Co-laborative work on sighting, i.e. on developing shared analytics, will necessarily involve epistemic agonism (Klein et al. 2024) or the struggle over and turning generative of epistemological and ontological differences regarding substances and materials. The structural asymmetry of a vast and complex epistemic culture of chemistry on one side, and on the other a few lonesome anthropologists engaging with it, may lead to interesting anthropological insights. Its understanding of and impact on chemical epistemic cultures, however, remains limited to put it politely. Building para-sites must mean sustained and concentrated effort rather than eclectic individual engagement. This becomes even more obvious when interdisciplinary work turns into trans-disciplinary engagement to widen the epistemic politics beyond academia as outlined above. And moving beyond individual perspectives will also help in anticipating possible futures and multiplying chemistries yet to come.

Anticipation: from algorithmic to public chemistry

Around 2011, after a talk I gave at Goethe University Frankfurt, Gisela Welz asked me whether I thought that anthropological knowledge might have anticipatory qualities. I was very sceptical in my answer. I did not see how anthropology would have a special ability to foresee developments in the world any better than the poor attempts we witness from all kinds of futures research. Today, I might answer a little differently – particularly in the context of the circulation of anthropogenic chemicals. Why?

The environmental and health effects of the circulation of anthropogenic chemicals at industrial scale cannot be understood from the molecular structure of those chemicals alone. A relational-processual understanding of substances suggests substance–substance and substance–environment/organism interactions in manifold broader contexts must be taken into account. This makes prediction challenging. While data-driven approaches, such as the quantitative modelling of structure–activity relations (De et al. 2022), are being used as part of the regulatory apparatus and in substance design alike, significant uncertainties and unpredictabilities persist. A second approach starts from the human body and tries to

quantify the exposome (e.g. Sillé et al. 2024), i.e. the totality of exposures that an individual encounters throughout a lifetime, including anthropogenic chemicals. As with the first approach, data-driven methods come up against complexity, uncertainties, and lack of data. Both approaches try to anticipate future effects of substances through large sets of data and their algorithmic treatment. Time will tell whether such approaches will lead anywhere meaningful. A third and very different approach starts from life as aftermath as a phenomenon outside of the current observational apparatus and thus outside of large-scale data. If life as aftermath is shaped by metabolisms from the molecular to the ecological and industrial, understanding it requires research across disciplines: from Marx to Medicine, if you will. Or as Landecker argues: Life as aftermath cannot be understood in the same registers that have produced it over the past decades, it is "illegible within its originating logics" (Landecker 2025). Ultimately, it is the inability of modern scientific inquiry to treat matter, markets, and meaning symmetrically in analyses of the production of novel chemicals and the circulation of substances through the world, its organisms, and its landscape structures. Anthropogenic biologies are shaped as much by political economy, supply chains, and markets as they are by epi/genetic regulation and metabolic control. Interdisciplinary research designs need to take this into account and they struggle to do so as long as they remain wedded to modern disciplinary logics and data as the only answer to a major intellectual challenge.

Two responses to this challenge relate to anticipation. First, scaling as an issue within chemistry is primarily framed as 'scaling up', i.e. the challenge of producing a large amount of always exactly the same substance with as little resource use as possible. While scaling up lies at the heart of economic growth and thus modern progress (Tsing 2012), it is also the root cause of life as aftermath. Producing industrial scale volumes of a substance and releasing it 'into the wild,' without much regard for the manifold interactions this substance will encounter, leads to the novel patterning of living matter and processes that defines life as aftermath. How might one be more careful about such interactions and circulations? Situated chemical practices might engage in "scaling out" (Papadopoulos 2022). Scaling out is the proposal to not understand scaling only as the augmentation of self-sameness, i.e. making more of the same substance disconnected from its relations. Scaling out starts from a relational appreciation of substances and thus denies the possibility of self-sameness in ever-larger quantities. Instead, scaling out describes the process of striving to produce substances that can adapt or be appropriated by different contexts and communities in different ways. Substances cease to be the dominant actors that impose themselves rigidly onto new contexts and force particular interactions. Substances that are scaled out are substances that are flexible enough in their structure and properties so as to adapt to new environments and contexts of use. 'One size fits all' as a business model with associated risk profiles gives way to 'customisation' of materials according to purpose and context. Scaling out is a form of anticipating the manifold and heterogeneous contexts a substance will encounter. Ideally, it produces a feedback loop into material and substance design that adapts materials to contexts before environmental and health problems arise for those exposed.

This cannot be achieved over night. It requires the transformation of a global techno-economic sector, its epistemic culture, and its dominant business model. A starting point for such a transformation might be, and this is my second response to the challenge of unpredictable interaction, public interest and engagement. I outlined above that chemistry is a field shaped almost entirely by certified experts in chemistry, defined as the study of mo-

lecular structure and function. Public interest for or even public literacy of chemistry is virtually non-existent. For chemistry to engage with broader matters of concern, it has to become public chemistry – a chemistry that articulates itself "par le milieu" (Stengers 2023). Chemistry makes itself legible to emerging publics as an actual socio-technical practice with all its assumptions, objectives, challenges, constraints and desires across the complexity of the entire sector or field. Only a public chemistry that escapes the techno-solutionism and its marketing can expect to find public support as the basis for co-designing and scaling out substances. Public chemistry is always also a form of discussing how 'we' want to live together, with which kinds of materials, accepting which kinds of risks for which kinds of benefits? Hence, public chemistry is always also acting in an anticipatory mode building capacities to aspire to a shared future (Appadurai 2004). Anthropology in its STS-inflected form can play an important role in shaping public chemistry: by building bridges between thought styles; by engaging and shaping emerging publics and helping to articulate pertinent matters of concern; by building community labs that explore alternative forms of sensing and engaging with material and substance qualities; by mapping ecologies of expertise across professional domains; and by practicing epistemic agonism as a generative and careful form of critique and creativity; all part of anticipating shared material futures.

Anthropology after progress

Framing chemical pollution as matter out of place and as an acute crisis that needs to be addressed urgently, runs the risk of missing how industrialism has systematically produced anthropogenic biologies and life as aftermath. Life as aftermath is constitutive of late industrialism. It is not a phenomenon that can be solved or from which a return to a *status quo ante* is possible. The industrial scale circulation and ubiquitous presence of anthropogenic chemicals is constitutive of modern progress. One may define progress broadly as "a civilisational imagery of a boundless, linear and upwards trajectory towards a future that, guided by reason and technology, will be 'better' than the present" (Savransky & Lundy 2022, 217). Progress is "not a value among others but the very perspective of evaluation from which the values of economic growth, civilisation, human development, moral betterment, industrialisation, human rights and technological innovation were derived" (ibid.: 220). Clearly, the idea of a 'better future' is pervasive at least in modern EuroAmerican cosmology and it has become tied intimately and seemingly inextricably to personal material gain secured by economic growth, which in itself needs to be fuelled by technological innovation at least in resource poor regions such as Western Europe. As anticipated, technological innovation has long become an end in itself and autonomous of wider social and moral innovation and societal development (Simondon 2010). Life as aftermath is just one development that is constitutive of this kind of progress. Others are readily at hand. The UN Environment Programme refers to climate change, the loss of biodiversity, and chemical waste and pollution as the triple planetary crisis. It has set up international science-policy panels for all three crises to coordinate international efforts to address them. Crisis signals an existential threat, it signals urgency, and it signals an all-encompassing, planetary scale of the problem. Unfortunately, it also suggests the need to develop techno-scientific solutions that contain and fix the problems quickly.

Many people (e.g. Pfotenhauer 2023), including myself, have lost the belief that anything meaningful or substantive can be gained from such simple techno-scientific measures. Pursuing them nevertheless, remains paramount to explore every option that

might help to mitigate human and ecological suffering. Yet the hectic search for solutions of this kind gets in the way of asking the more meaningful question: How can and how would we like to live together on a finite planet? The terrestrial question, as Latour (2018) put it. I have tried to show using chemistry as an example that answers to this question require a *Wissenschaft* that addresses its progressive constraints. I use the term Wissenschaft here to denote the entirety of research and teaching as well as a dedicated set of institutions. Wissenschaft needs to embrace biosocial phenomena such as life as aftermath by widening its ontological assumptions, epistemological stance, and methodological capabilities. Bridging the rigidly modern nature–culture divide is a prerequisite for working with truly relational and processual research designs. Wissenschaft needs to question how it is invested into ideologies of economic growth and linear development towards better futures defined by the few. This requires a widening of epistemic politics beyond academic expertise. It requires public science as a means of addressing societal matters of concern and heterogeneous ecologies of expertise with and through the best research and teaching that we can come up with in liberal democratic societies.

An *Anthropology after progress* could play a crucial role in developing such a Wissenschaft. It is a reflexive and self-reflexive epistemic culture that is trained to study knowledge practices in a broad sense and that is trained to translate between seemingly incommensurable languages and cosmologies. It commands a vast historical archive of more-than-progressive expertise on how to live together within precarious landscapes and how to think of 'ourselves' as inhabiting a finite planet. It offers methods to study phenomena across vastly different scales by attaching itself to the vectors of modern scale-making in markets, politics, science, or the arts. However, an *anthropology after progress* cannot flourish within current academic institutions with their exclusive focus on quantitative growth, innovation through competition, individual heroism, and relentless audit culture – not to mention chronic underfunding and ever-denser webs of disincentives from societal 'impact' to increasing student numbers regardless of the quality of teaching. It cannot flourish within institutions geared towards approaching fundamental concerns such as life as aftermath in late industrialism as a crisis needing to be solved and as a grand challenge.

Since around 2017, I have had the pleasure of being part of a team of colleagues (Humboldt-Universität zu Berlin, Leuphana Universität Lüneburg, Stockholm Resilience Center, Dutch Research Institute for Transformations) that hosted the Postdoc Academy for Transformational Leadership funded by the Bosch Foundation. This academy brought together around one hundred exceptionally talented and enthusiastic postdoctoral researchers based at European institutions and working on matters of sustainability and transformation in the widest sense. In five cohorts, each running for two years with multi-day seminars at each institution, we discussed what kind of science and what kind of leadership are needed to shape and drive transformations towards sustainability. Three highly instructive insights emerged from this generative format, which we did not discuss in terms of Wissenschaft after progress when they emerged, but which fit strikingly well nevertheless (see also Care et al. 2021)[1]:

1. Living on a finite planet is an everyday reality for people with a lot of future ahead of them. It is a reality that they are willing to address in the mode of scientific research, if

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research can embrace affect, if research can embrace lived realities both in research institutions and outside, and if research can commit epistemically, ethically, and politically to the need for sustainability transformations – while remaining knowledge driven with respect to the form of those transformations.

2. Wissenschaft needs to enter into and shape a post-heroic mode. The ideal of the fully dedicated and committed individual, commonly a white, EuroAmerican male brain with the privilege of being able to ignore his body, his family, and the society in which he lives, has reached the end of its time. It is not a role model or imaginary that attracts the brightest, most enthusiastic, and most creative minds to Wissenschaft any longer. This is not a Gen Z work–life balance issue. It is about accepting that scientific knowledge that emerges from working with people, from engaging with landscape structures, and from addressing futures within planetary boundaries, is scientific knowledge that is accountable to place, to social reciprocity, and to shared ethical and political rules and orders. It requires the long-term commitment to fields. It requires the co-design of research methods with those concerned with the anticipated findings, i.e. the distribution of epistemic agency beyond the academy without violating collectively agree upon scientific principles and standards. And it requires organised scepticism towards universal knowledge claims that ride roughshod over situated concerns and global contextualisms (Elkana 2012).
3. A Wissenschaft that wants to embrace such an exploration of epistemic cultures beyond singular modern progress needs to build structures and funding mechanisms that are not geared towards individual excellence and linear careers. It needs to fund teams, collectives and ecologies of expertise. It needs to learn to share responsibility and give brilliant minds the opportunities to move in and out of specific thought styles to learn, to maintain creativity, and to live decent lives. It needs to appreciate that creativity and innovation can emerge from diversity, cooperation, and solidarity rather than insisting on existential competition as the sole driver of an ever more specialised science. It needs to develop reward and reputation systems that value qualities and diverse forms of knowledge and expertise. And it needs to value care and humility as the ethos of epistemic and institutional practices: appreciating the contingency of all scientific knowledge and appreciating the situatedness of all scientific knowledge in earthly collectives trying to inhabit a finite planet together.

The list of reasons why anthropology will not contribute to such a Wissenschaft after progress is long and boring. Yet an anthropology after progress with its epistemic kin in science and technology studies and contemporary histories and philosophies of science is ideally placed to treat universities and research institutions as laboratories for a more-than-progressive Wissenschaft and for a public science. Anthropology after progress is a thought collective educated to reflect knowledge practices and institutions as a matter of professional practice. Where it exists at universities, it is usually already deeply embedded within the sciences and engineering, thus bridging major disciplinary divides. Importantly, universities tend not to understand what such an anthropology and such a Wissenschaft, what such collectives actually do all day. Hence, such collectives have some freedom to operate beyond the common institutional expectations of 'more of the same'.

In the current world, where some people who were deemed progressive 'moved fast and broke things' like democracy, liberal order, and the rule of law, a careful Wissenschaft after progress needs all the help it can get. I hope that Gisela Welz as an astute intellectual

and institutional expert will remain so much more than shoulders to stand on to help us shape a future for the many.

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