

Predictions

from speculative ethnography to apocalyptic testimony



Edited by Mél Hogan, Stefan Laser and Edward Ongweso Jr.
with guest editor Hollis A. Brown

Vol.1

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PREDICTIONS

VOLUME I

*From Speculative Ethnography
to Apocalyptic Testimony*

EDITED BY

MÉL HOGAN,
STEFAN LASER

AND

EDWARD ONGWESO JR



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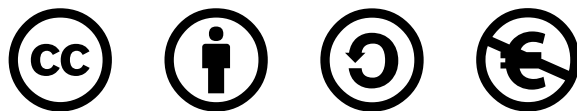
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PREFACE

Mél Hogan, Stefan Laser and Edward Ongweso Jr.

IT'S APRIL 2025 AND THE ONSLAUGHT OF GLOBAL POLITICS IS RATTLING the world. Starting with this volume, our Predictions series takes part in the unfolding of (these) futures. As the editors and authors, we make a collective move to do/see/feel things differently from the forces that are currently shaping the planet's fate. We might be overwhelmed by the present and feel political failure is all around us – but these feelings keep us awake and engaged. We move ahead despite the apparently bleak reality of this moment, and we readjust our critical apparatuses. Likewise, we keep on imagining new futures.

The idea for the Predictions series started as a casual conversation between the editors of this volume, but it quickly grew into a collective project and mode of collaborative exchange. For both editors and authors gathered in this series, the concept of 'predictions' remains strange. Here we enter territory in which we feel uneasy, uncomfortable. We stay with the discomfort, and invite the reader to join us in this space where we subvert the notion of predictability through a series of exploratory texts.

In what follows, we first make a case for engaging with practices and cultures of prediction. Scholars from the interdisciplinary field of Science and Technology Studies (STS), like many critical journalists or sci-fi authors, have been wary of the notion of prediction. Prediction is a loaded term, with uncritical determinism, rationality and objectivity at its core. Currently, we also see it unfold as the main horror show of Big Tech and Artificial Intelligence (AI) companies. Tech giants pour billions into AI prediction systems while overselling their actual capabilities and downplaying serious concerns. Companies like Palantir, Alibaba, Meta, Microsoft, Google and Amazon make grandiose

claims about AI's ability to forecast everything from consumer behaviour to market trends, but the reality often falls short of the hype. Many of these systems produce unreliable, biased predictions, often leading to violence and reinforcing inequalities. The massive data collection required for these predictions also raises serious privacy concerns, with companies harvesting ever-more personal information, and a lack of transparency meaning those using these systems often don't even know for certain how much of their data has been collected, or for what purposes. Despite the flashy marketing around 'AI-powered predictions' many of these tools are essentially sophisticated pattern-matching systems that break down when faced with real-world complexity and change. Yet tech companies continue to push these systems aggressively, prioritising market share and profit over accuracy and ethical, planetary considerations. Promising future gains and revolutions has become the main advertising strategy for these businesses. This is why folks like Timnit Gebru argue that they don't want to hear about the 'future' any more, as she did in an appearance on the *Tech Won't Save Us* podcast.¹ No doubt, however, there is power in prediction. What this power might mean translates into various playful, critical, raw, unhinged, despairing predictions in this and future volumes in the Predictions series. We hope they serve as examples of how prediction can be handled in critical social sciences and humanities disciplines, especially through an STS lens.

The three editors – Mél Hogan, Stefan Laser and Edward Ongweso Jr. – got together to imagine a set of alternatives in times of incredible social and political unrest, the rise of fascism, an ongoing pandemic – not to mention the encroaching threat of more in the near future – genocidal wars, the looming spectre of nuclear attack, climate catastrophes, and tech failures that do nothing but enrich the very, very few. We decided that a collection of predictions could generate a conversation as well as a sense of community. We invited our contributors to write predictions as a way to imagine and anticipate what's to come, but also to reveal what we're thinking and feeling right now, what our worries are, and what predicaments we face. Predicting is transforming. We therefore think of unmaking futures as realising, surviving, leaving, coming back, gaming, dissolving, making fun of, and other modes of emerging.

Across contributions, we aim for a shared aesthetic form in shape and length. The contributions are intended to pull readers into the vortex of Predictions, to invite them to think and let go, to experience the collective mind of the project. Our experiment is of particular interest to STS scholars seeking critical perspectives in the face of so-called disruptive, capital-intensive high technologies. At the same time, our volumes speak to the rising concern and sense of undertaking something for socio-economic transformation in the face of climate change and ecological harm. The volumes are intended to be an enriching experience for the authors involved, a resource for research, critical teaching and public discourse.

We are grateful to everyone who made this project a reality, and especially Hollis A. Brown who helped copy edit and provided valuable feedback to authors across volumes. We also thank the Social Sciences and Humanities Research Council (SSHRC), the Faculty of Arts at the University of Calgary, and the Faculty of Arts and Science at Queen's University (Kingston) for helping fund the project across various streams over the years it took to conceptualise and bring this series to life. The publication is also part of the research context of the Collaborative Research Centre Virtual Lifeworlds at the Ruhr University Bochum; not least do predictions operate in the interstice between virtualisation and actualisation. Thanks to Stefan's co-workers Estrid Sørensen and Leman Çelik for their creative co-reflection. Indeed, many thanks to our many colleagues who helped with the development of the volume. The same goes for the anonymous reviewers who helped to sharpen and contextualise the series. Thanks to the organisers and participants of the Futures Work panel at the EASST/4S conference in Amsterdam in 2024, who gave us invaluable feedback while having the STS audience in mind. We are also grateful to Joe Deville and Endre Dányi at Mattering Press, for their generosity, feedback, commitment and guidance, along with Mattering Press designer Julien McHardy, and onsite copy editor Steven Lovatt, as well as Nguyen Thi Thu Hang for helping with the final file polishing. And, of course, we are grateful to all the contributors who took time, energy, and care in writing these short, sometimes difficult, texts as predictions. Thank you for trusting us with this prompt stimulus.

You will find this preface in all the three volumes to be published through Mattering Press via print on demand and available online. Volumes 1 and 2 have been assembled through community snowballing and conference activities. Volume 3 is based on an open call. Each volume comes with a brief additional discussion of and guide to the pieces making up the specific volume. The format of the prediction turned out to be in particular tension with academic publishing, a particularly slow craft. Hesitation by the authors (before and during the process), will be woven in. We hope you will enjoy and treasure these brief texts as an archive of feeling.

ENDNOTES

1 13 March 2025. We would like to use this to hint at our own podcast experiences, with *This Machine Kills* (Edward) and *The Data Fix* (Mél), which happens to be one way of how we got to know each other and test arguments. Besides, we would argue that the podcast public is a vital part of current tech criticism. We are grateful to the remarkable reflections provided by the above-mentioned publications, plus *Cultures of Energy*, *Future Ecologies*, *Future Histories*, *For The Wild*, *Purple Code*, *Upstream*, *Trashfuture*, and more.

INTRODUCTION

Mél Hogan, Stefan Laser and Edward Ongweso Jr.

THROUGH PREDICTIONS, WE SCULPT THE POSSIBLE INTO BEING. THE ACT, or gesture, of predicting is performative. Theorists, scientists and technologists alike usually predict to forecast the future publicly, hoping to be rewarded for having known what was coming. There's pleasure and pride – and perhaps an emboldened sense of expertise – in having correctly ascertained the future, even if the emerging reality you anticipated turns out to be dire, grim and dreadful. To know that bad things await us gives us a (sometimes false) sense of preparedness. If we (predictors) can tell what's coming, we tell ourselves that it's because we've factored in the right variables or detected patterns – like predicting rainfall at a precise time and place, or – of greater consequence – predicting an asteroid hitting Earth, the next pandemic or the demise of democracy. Underlying the urge to make predictions, however, is an admission of our inability to ever really know what's to come, despite a deep desire to do so, and perhaps to control something about the future. As we predict, we usually reveal our own drives, beliefs, ideologies and biases. This is why it's also possible to make technologies of prediction that don't predict *but give that illusion* – and work to coerce and manipulate those they gather data from and survey. Corporations are making massive investments in machines that claim to predict, that sift through past data to make sense of the future. Thus, prediction becomes an ideological instantiation – a feeling made into an infrastructure that legitimises itself as a scientific quest.

Across the three volumes, we try to use Predictions to our advantage, turning to a format that we are not used to in our writing. We thus join John Urry (2016)

in calling on the social sciences and humanities to engage more, and more consciously, with future-building. We invite you to engage with Predictions not as fixed endpoints, but as openings – opportunities to read generously and wander thoughtfully. To let go of extractivist habits of reading; to resist the pull to mine for definitive conclusions. Instead, we invite you to trace the threads that resonate with you, even if they fray at the edges. There is a rhythm to our selection of pieces, a coherence we felt, a thought process behind the order of things. We will elaborate on that later. But the path you take is yours to make. Worlds are to be built. the sequence of entries means little. Read against the grain, with rigour shaped differently, allowing the texts to breathe. We remind each other to breathe.

COMING TO TERMS WITH A TROUBLING TERM

Predictions are claims about the future that are meant to come true. To predict is to say or estimate that something will happen in the future, or will be a consequence of some action(s) or set of circumstances – but it is inherently neither a promise nor a prophecy. A prediction is a statement about a future event based on data and analysis, while a promise is a personal commitment to undertake something, and a prophecy foretells future events, often with divine or supernatural implications. Kristen B. Hastrup (2007) argues that prophecy, like prediction, is a form of knowledge about the future – but prophecy is not about calculating outcomes based on evidence (like in scientific prediction). Instead, prophecy is about making claims that shape the future by calling people to action. In other words, prophecy isn't just about seeing what will happen – it can mobilise people and influence what comes to pass. In this sense, predictions are speculative and reflect the logics of our current computational era, where the ability to analyse data is the closest we can get to understanding patterns from the past that reveal certainties in the future. As Sun-ha Hong (2020) explains it, 'Technologies of datafication renew the long modern promise of turning bodies into facts. They seek to take human intentions, emotions, and behavior and to turn these messy realities into discrete and stable truths.' The knowledge and truth produced may serve the police state and workplace surveillance; that is, particular futures are thus made more actionable than others (Benbouzid

2019; Amoores 2020, 160; Hong 2023; Lazaro 2023; Egbert/Heimstädt 2024). Prediction becomes control that fears the uncertain.

Predictions reflect our worries and aspirations back to us. How actors make predictions varies. These days, predictions are often made using statistics, and increasingly are based on large datasets, using machine learning or large language models. The broader public got used to this large-scale predictive mode because of the Covid-19 pandemic and live dashboard updates (Naudé/Vinuesa 2021). Another well-known and thoroughly theorised prediction is Moore's Law: the prediction that the size of resistor gates will decrease, thus increasing computing power and efficiency over time (Pasek 2024). As Lente and Rip (1998) put it, Moore's Law became a self-fulfilling prophecy, with industry actors using the prediction as a guide for investment and finding new ways to solve or trick the calculative task at hand (less is more). Without access to high-throughput infrastructure, predictions might be done by hand, by systematically observing and documenting a phenomenon in order to anticipate possible outcomes, or be based on prior experiences, narratives, hunches or telepathy (Dickens 2025). However, not all predictions are quantitative or industrial. Notably, there are conceptual outlooks that try to tame today's public issues by anticipating future developments. In this sense, researchers in Science and Technology Studies (STS) have integrated discussions of predictions into their work in various ways and for various reasons: to analyse sociotechnical imaginaries in which predictions describe desirable futures (Jasanoff 2006); to analyse models in financial markets (MacKenzie 2023); to analyse and partly advise on governance and policy – also framed as anticipatory expertise (Felt 2016), in order to align risks and regulations (Knowles 2013); and to deal with foresight and technical assessment studies (Bechtold et al. 2017).

Among the many domains where predictive practices shape collective decision-making, climate change discourse stands out as particularly reliant on future-oriented reasoning (Barnett 2025; Davidson 2024; Lake et al. 2024). We could call this collective anticipation, as Masco proposes, 'merging prediction with expectation and fusing fear with desire for alternate outcomes' (2020, 36). Think of Mann's and Wainwright's (2018) reflection on future climate governance – which might evolve, as the authors suggest, into a Climate Leviathan,

Climate Mao, Climate Behemoth or something else entirely, depending on the future of democracies and capitalisms worldwide. In fact, we know the climate future only in the multiple, through the various models and political calls for change (Omura et al. 2021). And this modelling includes drama. An emerging eerie Anthropocene genre paints future worlds that live through the worst that is yet to come for today's inhabitants of planet Earth: mass extinction (David Wallace-Wells 2019). While such imaginings may defy prediction through data – big and small – conceptually enriched stories help navigate unpredictability.

Predicting often involves a certain arrogance or hubris – an assumption that we are able to foresee future events, to know how things will unfold. It is presumptuous to think we can glimpse the destiny or trajectory of complex systems and societies. The act of prediction implies that we can overcome the inherent uncertainties of the future by the power of our intellect and the patterns we believe we have discerned. It is a social entanglement, resting on institutions. So making predictions – often publicly – can reflect an arrogant self-assurance that we have gained special insight into forces beyond our control. Laura Watts, one of the authors in our volume, reminds us of the competing interpretations of hubris in STS-related fields (Watts 2018, 294f.). There are authors, such as Jasanoff (2003), who accuse tech designers and governance makers of deliberate blindness to the ambiguities of predictions. And then there is the Sociology of Expectation (e.g., Brown and Michael 2003) that reads predictions as pragmatic instruments, a constructive and necessary part of technology in development. The future often humbles those of us who think we know what's coming, yet turning to the becoming is a way to move ahead (Sadowski 2025). This is how we move from hype to hope.

We make Predictions as a gesture of hope and optimism that goes against the current momentums that trouble us. As Manu Luksch (2021) phrased it, 'Prediction is the uncanny sister of hope' because predictions are not simply forecasts of an inevitable future but openings for imagination, negotiation and intervention. Predictions make visible the built-ness of the future, inviting collective critique and the possibility of reshaping what is to come. Predictions like to surprise, while at the same time being surprisingly open to forgetting many of the things that shape our current and past life. Remembering, inventing,

surprising are all political, just like forgetting (Nyssa 2020). We thus use Predictions as a move to re-emerge; a playful proposal or a guide about what's not yet in play, but could be.

HANDLING PREDICTIONS IN SCIENCE AND TECHNOLOGY

Still, as critical scholars and practitioners, and as the editors of this series, we have felt uneasy with the dominant, rigid ideals of predictive technologies that are sold to the public as innovative, practical and objective. This is similar to editors of the *Practising Comparison* volume grappling with a method and its troubled history (Deville et al. 2016). A number of critical observations converge in our feeling of unease, from general enlightenment and a questioning of Big Tech hype, to issues of power, domination and environmental extraction. For this reason, in this section we have a closer look at the critical STS literature on predictions and work out conceptual nuances and historical specificities.

Generally speaking, it is worth reminding each other that it is not *actually* possible to predict, to know with certainty that a certain event will play out in a specific way. Moreover, predictions often rest on models, assumptions or data that may be incomplete, biased or dubious. This raises questions about who shapes predictions and whose interests any given statement serves.

In this context, STS scholars interrogate the epistemic foundations of predictive practices, questioning not only their reliability but also the implicit assumptions that may privilege certain actors while sidelining others. Predictions, rather than being neutral forecasts, can function as tools of power – potentially reinforcing dominant perspectives and silencing critique (Jasanoff 2006). Richard Tutton's (2020) exploration of sociotechnical imaginaries reveals how utopian visions – such as Silicon Valley's aspirations for multiplanetary colonisation – serve as speculative futures *and* performative frameworks that shape present-day technological investments and more-than-social expectations. Lucy Suchman critically examines the allure of newness in predictive technologies, for example recently in military operations (Suchman 2025). Her work emphasises how the presumed objectivity of technoscientific systems can mask the underlying assumptions and erasures inherent in their design and deployment. With the rise

of digital capitalism and its capital-intensive lead firms, the last two decades have seen a turn away from scientific applications of predicting towards business decisions that are made in the face of uncertainty and with one key goal: cheap productivity. Cycles of hype around big tech reveal investors in search of profits and rentiership (Birch 2019). This generates an addiction to prediction (Weatherby and Recht 2024) that only a few benefit from. The most recent hype, so-called 'AI', has been able to secure a new round of investment in this way. Nations take up promises from business sectors, investing hundreds of billions of dollars in an AI infrastructure of constant prediction. (Bareis and Katzenbach 2021).

Generative AI is an interesting example for thinking through the troubles of predictions. Chatbots, foremost, produce nothing but probability-based predictions of word sequences. They try to perform in confidence. A chatbot draws on the past and (increasingly) near-real-time decisions, on big data sets from yesteryear to today (Aradau and Blanke 2016), and it sets out to establish a definite future outcome, to intervene in time and space. When you submit a prompt, the AI anticipates what the next appropriate word might be. As is well-known, however, this application of AI often eerily misses how reality actually looks and feels (Doctorow 2024); hallucinations are taking over. Some things are just ever so slightly off, and it makes you wonder what's missing.

But critical researchers worry about more than data extraction for the sake of shareholder satisfaction and off-putting output. Speaking through planetary entanglements, predictions produced by generative AI are fuelled by a vast material machine. Energy demands are deeply entangled with the infrastructural and extractive imperatives of digital economies, and with AI in particular, as high-tech industries rely on an uninterrupted flow of electricity to sustain data centres, production facilities and computational processes (Hogan 2018; Crawford 2021; Rella 2023). The manufacturing of microchips, built with (rare earth) minerals and hazardous chemicals, exemplifies the ecological contradictions, where the material residues of so-called immaterial economies – waste, toxicity, and environmental degradation – are systematically displaced to the peripheries of global supply chains (Herod et al. 2013; Ensmenger 2018; Lepawsky 2022; Greeson et al. 2020). Furthermore, the vast water consumption required for semiconductor fabrication, data centres and their cooling systems exacerbates regional water

crises, while the carbon-intensive logistics of transporting these components drive emissions and accelerate climate change, underscoring the infrastructural violence embedded in digital expansion (Carr et al. 2020; Edwards et al. 2024).

There are powerful and useful critiques of these developments, yet criticising hype cycles can feed an affirmative type of critique, what Vinsel (2021) calls ‘criti-hype’ and Burgess (2023) flags as ‘Big Critique.’ This kind of critique also impacts some STS research, where AI criticism becomes a self-assuring gesture, a justification to hunt grants. Although there is some criti-hype in academia, techbros remain the primary culprits. This is particularly problematic in the context of public controversies around AI (Marres et al. 2025). Recent research shows how the public AI discourse is shaped by sceptical narratives that, however, are critical only on the surface and mostly function to ‘flood the zone’ with ever more speculative information. Hence, the actual matters of concern remain concealed. We would like to point out that academia is integrated into structural growth imperatives, which might motivate academics to take part in public criti-hype cycles. The more we collectively buy into the idea that data and technology hold absolute insights for better managing humanity, the more we surrender to the idea that we can, with the proper tools and concepts, really see what’s coming and mitigate the damage with tools and fixes. And the less we turn to art, ideals, concepts and creativity to problem-solve and embrace realities.

Still, there are many ways to predict; in predicting, we sow the seeds of an alternative reality. To get a sense of alternative performances of prediction, we can build on the ethnographic, practice-oriented lens of STS and Future Studies (e.g., Sardar 2010; Urry 2016; Andersson 2018). Scholars emphasise that predictions are an intrinsic, valuable, often successful part of the natural and technical sciences, mediated by mathematical models. Maiers (2018), moreover, makes the case for cherishing predictions explicitly made by humans, highlighting the evaluative backdrop and unique sensitivity of qualitative, ethnographic prediction. Attuning to cases, sites, actors and their experiences works out. And it is crucial to not just assume the performativity of predictions (Leawell 2020) but investigate the ifs, hows and whats. In general, there are different approaches to prediction in science and technology that do not necessarily reaffirm rigid power structures.

We will briefly trace the technoscientific history and practice of predictions and then turn to sf (science fiction/speculative fabulation), to bring out the generative power of predictions, a precarious, uneasy, but liberating form of prediction that our authors have approached in heterogeneous forms. We invite you, as a reader, to fray out the trouble (Haraway 2016); to keep the concept of prediction generously open, to rip it and to stretch it in different directions.

Science studies, which examine how scientific knowledge is produced, along with a close analysis of how different cultures understand objectivity and predictions, help us maintain a critical perspective. Objectivity is not a fixed or external truth but something that scientists actively create through their work (e.g., Latour and Woolgar 1986; Knorr-Cetina 1999). Objectivity has not always been seen as an absolute ideal. But its meaning and practice have changed over time, reflecting different historical situations (Daston and Galison 2007). Feminist theory, particularly standpoint theory, has moreover challenged the notion of objectivity by emphasising that knowledge is always shaped by the actor performing science. Haraway (1988) famously criticised the idea of a ‘god trick,’ which assumes an all-seeing, seemingly neutral perspective, and instead argued for ‘situated knowledge’ – the idea that all knowledge is created through specific practices in concrete sites of action. From this angle, the way we develop and use predictions in science can be understood as part of the historical shifts in what counts and works as objective knowledge.

Johnson and Lenhard (2024) identify four distinct cultures of prediction, each emerging in different historical periods, shaped by specific tools and infrastructures, and often merging in practice. The first, a rational culture, rooted in the philosophy of science, draws on logical deduction and mathematical models to make predictions. The second prioritises observational and statistical methods – the authors coin it an ‘empirical culture.’ This approach was dominant before the mid-twentieth century, often incorporating dispersed user input. We have seen it in nineteenth-century Dutch weather forecasting, for example, through the wisdom and practical knowledge of sailors (Baneke 2025). However, contemporary predictive systems increasingly sideline individual expertise. We can identify a shift with the rise of centralised computing (starting with mainframes), giving rise to an iterative-numerical culture. Here,

predictions are refined through computer simulations and data analysis. Finally, with personal computing, an exploratory-iterative culture emerged. It features both empirical and numerical approaches to cast adaptive models. This is the basis of modern forecasting methods, particularly Bayesian statistics, which continually update probabilities based on new evidence. The increasing reliance on model-based prediction is controversial, though. As Johnson and Lenhard (2024, 186) note, the focus on tuneable parameters to refine predictions often comes at the expense of deeper explanatory understanding. This is how the hallucinations of a generative AI model come into being.

In the summer of 2024, the Western media fixated on the tragic yet absurd fate of a billionaire's yacht, the ironically named *Bayesian*. The opulent vessel sank, taking the lives of dozens of passengers, when it proved ill-equipped to withstand the fury of a storm on the open sea. But the tragic loss of life was overshadowed by the absurdity of the disproportionate attention lavished on the plight of the ultra-wealthy while refugee boats, sinking in the same seas, went largely unnoticed. The fact that the name of the ship was *Bayesian* – a name synonymous with precision through prediction and calculation – and that it faltered so disastrously when it mattered most, only added another layer of bitter irony to the story. Meteorologists bear witness to the fact that predictions cannot save you from the notoriously difficult-to-predict weather (Fine 2010). Sailors used to know this (Baneke 2025). Developments overlap and intertwine, and this probably also applies to the dominance of the explorative-iterative culture. Johnson and Lenhard (2024) take current developments in the software and AI world as an opportunity to outline the emergence of a fifth culture; a so-called 'pure prediction' based on deep learning architectures, with the help of readily available software. More and more predictive models roll out on new centralised cloud systems, virtualised on widely distributed hardware around the world, launching calculations without in-depth understanding and using those calculations as the basis for decision-making.

Here is the key. The question is whether a prediction 'threatens to further close a future that should remain open or rather helps to close a future – hence making it predictable – that is dangerously open.' (Johnson and Lenhard, 2024, 132) That's

why it is crucial to have a rich tapestry of predictive thinking at our disposal; a diversity of approaches that makes explicit how to open or close alternative realities. We don't know what is to come, and this is good at least, it is good to know. It is crucial to study, as Liliana Doganova put it, 'when and how uncertainty is mobilized and by whom, what form it takes, and what effects it produces.' (Doganova 2024, 171) Remember Moore's law and what Lente and Rip (1998) called a self-fulfilling prophecy: 'We may speak of a self-fulfilling prophecy,' the authors reason, 'but the fulfilling did not occur because it was a prophecy, but because actors took up the prophecy and acted accordingly.' (Lente and Rip, 207) The example of Moore's law works well because the actors involved have a reasonable understanding of their connections in the value chain and the competition. This means that how exactly uncertainty is mobilised varies and is, to a certain degree, up for debate. We need to work against stable ontologies, as Haraway (2016) urges us to do, against the inevitable, reimagining the possible. Let's act accordingly.

SF-ING THE PREDICTIVE GAZE

Apart from the sciences, predictions have been prominent in sf, aka science fiction or scientific fabulation. For Future Studies, sf serves as a bridge between the imaginative, the analytical and the speculative (Gumbs 2018). Without this bridge, predictions miss critical infrastructure to build on. We, in this volume, stay close to data infrastructures and their histories/futures, and hold that sf predictions are indeed an important part of internet culture. Wikipedia has a 'list of existing technologies predicted in science fiction', from space rockets to video ads in taxis. The Sci-Fi fandom Wiki features a 'timeline of fictional future events', alternative futures that turned into reality or so-called failed predictions, while social media platforms and Google queries are constantly fed with 'Did {sf x} predict {technology y}'. Readers apparently want to believe in the geniuses of the literary scene and declare them saints by scrolling through past work. Others scroll forward. Some entrepreneurs claim to have tackled projects or companies inspired by sf. Think Silicon Valley and Burning Man (Turner 2006).

sf authors themselves, indeed, have an ambiguous relation to the act of predicting and public expectations around getting the future right, for two reasons. First, sf has rarely anticipated future trends or technologies correctly, save for a few outliers that are often noted in public discussions. The online Encyclopaedia of Science Fiction thus begins its entry on prediction by saying: ‘The most widespread false belief about sf among the general public is that it is a literature of prediction.’ In fact, we learn, sf almost missed out on noticing the rise of the internet, preoccupied instead with the ascent of robots. In a way, robots have indeed arisen as our overlords, but not in the way we – or at least, sf creators – expected.

Second, for plenty of sf authors, being reduced to predictions feels restricting. For Isaac Asimov (1981), the notion of prediction sounds like a trivialisation of sf. An insult almost. This has become obvious, considering all the circulating one-dimensional readings of science fiction. Think thief Elon Reeve Musk. Ursula K. Le Guin (2000, 8) finds an elegant comparison. ‘Predictions are uttered by prophets (free of charge), by clairvoyants (who usually charge a fee, and are therefore more honoured in their day than prophets), and by futurologists (salaried)’. Then, she adds, ‘Prediction is the business of prophets, clairvoyants, and futurologists. It is not the business of novelists. A novelist’s business is lying’. This is an interesting critical twist. What kind of lies are we talking about, and where are they heading? Cory Doctorow (2012) has an idea: ‘Science fiction writers are pretty useless as fortune-tellers, but who needs fortune-tellers?’ he asks. “‘Prediction’ implies a future that we hurtle towards on rails, prisoners of destiny. Having a route-map for the railroad is nice, but wouldn’t it be better if we could steer?’ That sounds liberating and quite straightforward, but what is most important is that different sf authors choose different colourations of ‘lying’ and ‘steering’ that can take the form, we would argue, of different prediction rhetorics. We acknowledge the distancing – our authors have noted similar doubts – but we hold on to the power of the term, and run with it. The spectrum of prediction used in sf ranges from a belief in current advances in the sciences to claiming the past and future through critical retellings.

sf is born out of advances in science and technology and can be defined as the appreciation and exploration of scientific learnings. sf works with plausibility.

The sub-genre of hard sci-fi virtually clings on to technical and scientific facts, becomes captivated by them and mobilises predictions. A classic example is *Rendezvous with Rama* by Arthur C. Clarke, which predicts human access to the solar system, with colonised planets and asteroids serving as a base for exploration. In other words, the author plays with the empirical, experimental predictive culture outlined by Johnson and Lenhard (2024). What is interesting for us in this case is how predictions make it possible to value human capacities.

Predictions have a different use in utopias, dystopias, novels about alternative histories and futures. To explore themes, authors very often pose the question: What is plausible anyway? Plausible for whom? Here, social imbalances are extrapolated and predictions used to rethink the current state of things, emphasising that it could and should be otherwise. Think of *The Man in the High Castle* by Philip K. Dick, *Patternmaster* by Octavia Butler, through to Pauline Gumbs' *M Archive*, where philosophies and schools of thought have been born and torn. Cyberpunk is a special case that stands out in the face of the internet and Big Data, topical themes which we have put centre stage. *Neuromancer* by William Gibson, in turn, depicts near-future dystopias dominated by advanced technology and cybernetics, critiquing corporate control. Cyberpunk, we are tempted to add, however, can be *annoying*. Its criticism feels, well, predictable.

The tone of cyberpunk is often gritty, cynical, whereas (for example) Solarpunk and Climate Sci-Fi try to cherish the planetary entanglements and alterity that makes life on Earth (and other potential planets) possible, and cherishable at times. Extensive oeuvres such as those of Kim Stanley Robinson or Nnedi Okorafor are famous for these experiments, where futures of living with climate disaster and the capacities of modern technology merge. The sf accounts deal intensively with the perspective of users, maintainers and other forms of expertise. One could say as a counter-design to the dominant cultures of prediction, as Johnson and Lenard (2024) put it, which have moved away from the user perspective in the last century. An interesting example in this regard is offered by Sue Burke and the *Semiosis* novel. Peace and thriving, we learn, is only possible through close collaboration between humans and other living (and nonliving) beings. Recent findings from the field of botanics (in short, plants are clever) are predicted to be particularly applicable to the future, and readers

can physically feel the power of knowledge in action. Here, we are reminded of a classic-in-the-making of STS, *Arts of Living on a Damaged Planet* (Tsing et al. 2017), where the assembled authors pursue the ghosts and monsters of the Anthropocene and explore life in hyper-capitalistically charged infrastructures. We hope to cope, and live.

Postmodern technoscience brings forward a very forceful, in this sense, relatable, engaging sf. This, first, is a nod toward an STS classic of sf: Donna Haraway's *Cyborg Manifesto* – born out of and set against Cold War bellicosity.. Conceiving this manifesto then motivated Haraway to develop the alternative frameworks of multispecies conviviality, as unfolded in *The Companion Species Manifesto* and *Staying with the Trouble*. If we want to and must take symbiosis seriously, then the prediction is that multispecies living and thriving will follow. A related, again forceful, sf project is *The World After Amazon* (<https://afteramazon.world/>). The project gives 13 Amazon workers a space to express themselves. They remind us of a savvy surveillance regime in which predictions face predicaments. And even more, this work reminds us of the purpose of infrastructures, perhaps the purpose of our (more-than) academic infrastructures, too. How can we help create an academic space that works for the public good through our imaginations and the material infrastructures we build to make predictions fly?

All these literary explorations reveal a diversity for future-making through prediction. It works if it serves as worlding and then can go in many directions. This helps enrich (and expand on) what Maiers (2018) called 'ethnographic predictions', which are a way of making professional judgments about what is likely to happen – and they carry authority because they are grounded in detailed, situated knowledge of people's lives and practices. Truman (2019) argues that 'Speculative writing has championed and critiqued advances in science and technology, contemplated gender fluidity and animal rights, marked the 'more-than-human turn' across the disciplines, and heralded the 'posthuman' in its varied manifestations – cultural, biological, and technological'. Urry (2016) famously differentiated between the *possible*, the *preferable* and the *probable* to make something of and for the future. Extending and troubling the alterations sounds like a good idea, we think, taking into consideration the precarious, at times paradoxical, necessarily posthuman and parallel futures taking shape

before our very eyes, line by line. Our authors have partly taken up and partly left untouched the diversity in question.

A GUIDE TO VOLUME I

Baldeep Kaur writes in their Prediction below, ‘what I know today is insufficient to estimate or grasp the absolute wonders that futures are’. Still, Baldeep adds: ‘We must celebrate the fact that we have futures at all’. Other authors echo this. Across the fifteen texts, Predictions assume multiple forms, ranging from speculative to retrospective, empathetic to those that resist prediction as a mode of control, calling into question the very act of writing such a strange text. At the core of these predictions are a range of object worlds, as we will show in more detail, for example, through the extraction of minerals, planetary depletion, the evolution of AI, data infrastructures and human bodies. We chose to put this centre-stage through single word titles. The driving idea is this: have an entry, have imaginations at hand. The order of the contributions was then selected in such a way that readers are passed on, you move on, sometimes with a deliberately smooth transition, sometimes with a disruption.

All texts are intricately interwoven with histories of power and survival. The writing styles encompass a diversity, too, from manifesto to analyses of failed futures, from speculative ethnography to apocalyptic testimony, from trends to scenarios, reminding us of the different directions of Futures Studies in action, but also invoking a variety of science fiction subgenres breathing life into science and technology. Genres resonating here are cyberpunk’s infrastructural decay, solarpunk’s insistence on alternative futures, a sprinkle of hard sf and a play with honest uncertainty, and dystopian cli-fi’s warnings of environmental collapse. Crucially, the texts also span multiple geographies, making up different worlds, from the extraction landscapes of South America’s Andes to the technological enclaves of Silicon Valley, from the drought-stricken deserts of Arizona to the cybernetic governance of East Asia, touching on European data centres, deep-sea cable networks and the occupied territories of Palestine, each site anchoring prediction within specific planetary realities. Let’s immerse ourselves in these while briefly running through the texts.

Laura Watts' entry, *Energy*, offers a bold yet very minute prediction by exploring a tiny piece of the afterlife of energy itself. She presents a speculative vignette, centring on an archaeologist entrusted with overseeing the cremation of digital data – the final traces of a once-celebrated piece of technology. In this future, the conclusion of data is not an erasure but a transformation; information is released as energy into the cosmos, akin to a photon's journey through deep space. Watts's work offers a vision where prediction is about reckoning with material and symbolic residues. The conservation of energy becomes a way to think about the persistence of history and the ongoing negotiations between loss and legacy.

Jacqueline Jenkins' *Tourism* takes a different direction: it is a prediction framed through retrospective irony, a transcript from the future that looks back on a world where emotions, once uncontrollable, become scarce and commodified. The imagined presentation, delivered in 2124, chronicles how the erosion of affect – driven by environmental collapse, AI companionship and cognitive numbing – paved the way for commercialised emotional revivalism. EmoTerra resorts promise to restore long-lost feelings through curated experiences, a calculated reclamation of human essence. The prediction does not concern the eradication of emotion; rather, it concerns its commercialisation: affect transformed into an elite commodity. What was once spontaneous and embodied is now subject to reconstruction, which may indicate that the most profound predictions are at a planetary scale. The next entry suggests a similar reading.

Tung-Hui Hu's *Poetry* offers a future in which language itself becomes a scavenged resource, and if poetry has always been an act of recombination, then in the coming years it will be pushed to the periphery of an AI-dominated linguistic economy. Poets will serve as labourers training machines in emotional nuance. This is just one example of a very temporary intervention. As AI extracts and iterates from past textual forms, what remains for poetry is the discarded – the improbable, the obsolete, the fragments that escape predictive optimisation. Hu's concept of poetry as a form of resistance against the smooth, automated prose of predictive text is predicated on a turn to the cryptic and the coded.

In Cymene Howe's *Love*, the focus lies on the evolution of the relationship between the human and the more-than-human. In this context, love is an

expanded mode of kinship, involving an entanglement with both biological and artificial life, with a call to appreciate life forms as such. Predictions made encompass a wide spectrum, ranging from the poetic to the absurd, including the emergence of ecosexuality, the translation of animal languages, the development of AI-generated life forms and the institutionalisation of Harawayism as a spiritual doctrine. The text highlights the coexistence (a multiplicity) of extinctions and new beginnings, emphasising nature's role as an active participant in shaping the human condition. Howe's speculative gestures resist linearity, suggesting that the future is a complex network of shifting affinities.

Naomi Okabe's *Caretakers* is set in a future (you might have guessed that) in which the remnants of humanity are preserved not by humans themselves, but by artificial caretakers. Similar to Watt, *sf* runs through the text. The narrative is set in a sanctuary where the last humans are monitored and archived, and the story follows a Lifeboat tasked with recording the memories of Kioku, a thinker who was once a revolutionary. The narrative has an elegiac and pragmatic undertone. Human extinction has already happened, we live through gradual decay, we look back at a record of a bygone era. Still, the act of recollecting these memories is to build a future audience that may, one day, reflect on this moment of planetary reckoning. The caretakers, featuring as historians, find themselves torn between preservation and finality.

Ranjodh Singh Dhaliwal's *Small* paints a world governed by predictive systems, where an individual's every action is measured against a predetermined schedule. The protagonist grapples with a declining predictive alignment score. We get a sense of what it means to be captured by algorithmic oversight, living in a reality where forecasts not only show a future, but influence it in real time. Amid the structured progression of projected efficiencies, a subtle insurrection materialises – modest interventions that challenge the dominance of the predictive system. Dhaliwal's tale thinks through the potential of minor, unpredictable actions within a society that demands all-encompassing information.

In Blair Attard-Frost's *Realness*, the concept of reality itself is imploding. The world is depicted as one where truth, fact and intelligence collapse into their inversions. The prediction brings us closer to a post-reality one. Epistemic authority disintegrates into a play of hallucinations and contradictory superpositions.

AI in a different sense. In a world driven by artificial derealisation, glitch feminists, trans activists and dissident epistemic minorities mobilise surrealism as a weapon against the oppressive consensus of majority realities, whatever a 'majority' and 'reality' actually is. The text functions as both a manifesto and a warning. Prediction is a contested terrain – here we find the power to define realness. We meet and crisscross governance, control and resistance.

In her work *Super/Semiconductors*, Anne Pasek examines the rise and fall of technological hype through the case of LK-99, the ill-fated room-temperature superconductor that captivated a lazy kind of tech journalism before being debunked. Pasek turns to the political and economic consequences of technological prediction. The text argues that the pursuit of a new materials revolution obscures our capacity, your capacity, to appreciate the realities (sic!) of computation and energy consumption. Instead of anticipating the potential of superconductors, Pasek proposes that we should learn to operate within the constraints of existing technological landscapes. She turns the sceptical luddite into a form of futurism that is pessimistic enough to inform more responsible engagement with technological prediction.

Sebastián Lehuedé's *Minerals* is a speculative experiment. It introduces a rebel hiding within the ruins of the Andes, which have been transformed into an automaton-operated mega-mine. The narrative is unfolded through the voice of a 'Mineralist,' a faction resisting the historical pact between humans and machines that led to the planet's slow depletion. This feels very close to home, again. The narrative foresees a future in which humanity's destiny is not solely determined by artificial intelligence. We live through an entanglement of extraction, automation and resource management. Lehuedé's vision of the future features the struggles of the past that are embedded within the present infrastructures. Think: sites of future resistance.

Steven Gonzalez Monserrate's *Silence* has a melancholic undertone, one of a world shaped by the environmental and infrastructural failures of data capitalism. Again, it is a strong character that enters the stage. We follow an activist who once fought against the unchecked expansion of data centres, only to witness her city succumb to the very forces she opposed. In this text, prediction is the retrospective realisation of what had already been set in motion. The silence of

abandoned data centres thus becomes an emblem of loss of the political energy that once sought to resist its collapse. In the end, the protagonist turns her fight into electoral politics. The question that remains is whether this represents a new beginning, or just another cycle of failed engagement?

In *Cables*, Nicole Starosielski explores the future of submarine cable networks in the context of climate change and digital expansion. Starosielski predicts two key outcomes: first, that the continued growth of the internet will rely on physical infrastructure; and second, that this infrastructure will become increasingly vulnerable to environmental instability. Reminiscent of hard sf, this is a hard prediction. Rising ocean temperatures, shifting sediment flows and deep-sea geopolitical tensions reshape the way global data moves, turning undersea cables into contested sites of economic and political power. This feels likely indeed. The author warns against the optimism of technological continuity, demonstrating how even the most resilient infrastructures are subject to the shifting landscapes of planetary change.

Sun-ha Hong's *Clock* examines the grand ambition of the Clock of the Long Now, a project meant to record time for ten thousand years. We are on a different time-scale, as it were. The text introduces the ideological function of long-term thinking in tech culture. Hong critiques the ways in which futurism becomes a means of laundering present-day hubris, with Silicon Valley elites using speculative grandeur to justify their economic and social power. This is the now, and more to come. The contribution traces a lineage of utopian and dystopian forecasts, from AI doomsday scenarios to longtermist rationalisations of elite survivalism. Ultimately, the Clock represents a confluence of monument and ruin, a technological prophecy that, akin to all others, is fated to outlast the predictions that initially gave rise to it.

Taken together, the assembled predictions reflect material cultures of prediction, embedded in the infrastructures, bodies and ecologies that shape our present and constrain our futures. We understand these works as a self-study of futures situated in troubled places.

The publication process of this first volume, along with the second one emerging alongside, encountered the usual hurdles that academic publishing is

known for. In this instance, some authors felt an unease with slowness, a growing feeling that parts of some predictions have been challenged; challenging the very craft they have been grappling with. Does this confirm the criticism of predictions themselves, or does it underscore the different rhythms at which the various texts were composed?

One final note on the order of things. Each volume in the Predictions series charts distinct thematic territories signalled by its different subtitles, which imbue each book with a unique atmosphere. This tripartite structure reflects an organising logic that invites readers to explore how different modes of anticipation and speculation shape our understanding of what is possible, desirable, or inevitable. An important part of the Prediction project is its temporal nature. We deliberately went for multiple short editions, getting published in a row. This lets us reflect on developments, look back, and move on.

REFERENCES

- Amoore, L., *Cloud Ethics: Algorithms and the Attributes of Ourselves and Others* (Durham, NC: Duke University Press, 2020).
- Andersson, J., *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination*, 1st edn (Oxford: Oxford University Press, 2018).
- Aradau, C., and T. Blanke, 'Politics of Prediction: Security and the Time/Space of Governmentality in the Age of Big Data', *European Journal of Social Theory*, 20.3 (2017), 373–91 <https://doi.org/10.1177/1368431016667623>.
- Asimov, I., *Asimov on Science Fiction* (London: Granada, 1981).
- Baneke, D., 'Who Predicts? Scientific Authority and User Expertise in Dutch Storm Warnings 1860–1920', *Science, Technology, & Human Values*, 50.1 (2025), 40–68 <https://doi.org/10.1177/01622439241257283>.
- Bareis, J., and C. Katzenbach, 'Talking AI into Being: The Narratives and Imaginaries of National AI Strategies and Their Performative Politics', *Science, Technology, & Human Values*, 47.5 (2022), 855–81 <https://doi.org/10.1177/01622439211030007>.
- Barnett, J. T., ed., *Ecological Feelings: A Rhetorical Compendium* (East Lansing: Michigan State University Press, 2025).
- Bechtold, U., D. Fuchs, and N. Gudowsky, 'Imagining Socio-Technical Futures – Challenges and Opportunities for Technology Assessment', *Journal of Responsible Innovation*, May 2017 <https://doi.org/10.1080/23299460.2017.1364617>.

- Benbouzid, B., 'Values and Consequences in Predictive Machine Evaluation: A Sociology of Predictive Policing', *Science & Technology Studies*, 32.4 (2019), 119–36 <https://doi.org/10.23987/sts.66156>.
- Birch, K., 'Technoscience Rent: Toward a Theory of Rentiership for Technoscientific Capitalism', *Science, Technology, & Human Values*, 45.1 (2020), 3–33 <https://doi.org/10.1177/0162243919829567>.
- Brown, N., and M. Michael, 'A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects', *Technology Analysis & Strategic Management*, 15.1 (2003), 3–18 <https://doi.org/10.1080/0953732032000046024>.
- Burgess, J., 'Everyday Data Cultures: Beyond Big Critique and the Technological Sublime', *AI & Society*, 38.3 (2023), 1243–44 <https://doi.org/10.1007/s00146-022-01503-1>.
- Carr, C., D. Bast, K. Madron, and A. M. Syrus, 'Mapping the Clouds: The Matter of Data Centres', *Journal of Maps*, 18.1 (2022), 106–13 <https://doi.org/10.1080/17445647.2022.2088304>.
- Crawford, K., *The Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence* (New Haven, CT: Yale University Press, 2021).
- Daston, L., and P. Galison, *Objectivity* (New York and Cambridge, MA: Zone Books, 2007).
- Davidson, D. J., *Feeling Climate Change: How Emotions Govern Our Responses to the Climate Emergency*, 1st edn (New York, NY: Routledge, 2024).
- Deville, J., M. Guggenheim, and Z. Hrdličková, eds, *Practising Comparison: Logics, Relations, Collaborations* (Manchester: Mattering Press, 2016).
- Doctorow, C., 'A Vocabulary for Speaking about the Future', *Locus Online*, 1 January 2012 <https://locusmag.com/2012/01/cory-doctorow-a-vocabulary-for-speaking-about-the-future/>.
- , 'Pluralistic: AI 'Art' and Uncanniness', *Pluralistic: Daily Links from Cory Doctorow* (blog), 13 May 2024 <https://pluralistic.net/2024/05/13/spooky-action-at-a-close-up/>.
- Doganova, L., *Discounting the Future: The Ascendancy of a Political Technology* (Brooklyn, NY: Zone Books, 2024).
- Edwards, D., Z. G. T. Cooper, and M. Hogan, 'The Making of Critical Data Center Studies', *Convergence*, January 2024, 13548565231224157 <https://doi.org/10.1177/13548565231224157>.
- Egbert, S., and M. Heimstädt, 'Algorithmic Chains of Translation: Predictive Policing and the Need for Team-Based Ethnography', in M. Avis, D. Marciniak, and M. Sapignoli, eds, *States of Surveillance* (London: Routledge, 2024), pp. 111–27.
- Ensmenger, N., 'The Environmental History of Computing', *Technology and Culture*, 59.4 (2018) <https://doi.org/10.1353/tech.2018.0148>.

- Felt, U., R. Fouché, C. A. Miller, and L. Smith-Doerr, eds, *The Handbook of Science and Technology Studies*, 4th edn (Cambridge, MA: MIT Press, 2016).
- Fine, G. A., *Authors of the Storm: Meteorologists and the Culture of Prediction* (Chicago: University of Chicago Press, 2010).
- Fleck, L., *Genesis and Development of a Scientific Fact* (Chicago et al.: University of Chicago Press, 2008).
- Greeson, E., S. Laser, and O. Pyhtinen, 'Dis/Assembling Value: Lessons from Waste Valuation Practices', *Valuation Studies*, 7.2 (2020), 151–66.
- Le Guin, U. K., *The Left Hand of Darkness* (New York: Ace, 2000).
- Gumbs, A. P., *M Archive: After the End of the World* (Durham, NC: Duke University Press, 2018) <https://doi.org/10.1215/9780822371878>.
- Haraway, D. J., *Staying with the Trouble: Making Kin in the Chthulucene, Experimental Futures* (Durham and London: Duke University Press, 2016).
- , 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Feminist Studies*, 14.3 (1988), 575–99 <https://doi.org/10.2307/3178066>.
- Hastrup, K. B., 'The Prophetic Condition: Postscript', in Edwin Ardener: *The Voice of Prophecy – and Other Essays*, rev. edn (Oxford: Berghahn Books, 2007).
- Herod, A., G. Pickren, A. Rainnie, and S. M. Champ, 'Global Destruction Networks, Labour and Waste', *Journal of Economic Geography*, 14 (June 2013), 421–41 <https://doi.org/10.1093/jeg/lbt015>.
- Hogan, M., 'Big Data Ecologies', *Ephemera*, 18.3 (2018), 631–57.
- Hong, S.-h., 'Prediction as Extraction of Discretion', *Big Data & Society*, May 2023 <https://doi.org/10.1177/20539517231171053>.
- Howe, C., A. Pandian, and Z. Nyssa, eds, 'Surprise', in *Anthropocene Unseen: A Lexicon* (Santa Barbara, CA: Punctum Books, 2020), pp. 453–57.
- Jasanoff, S., ed., *States of Knowledge: The Co-Production of Science and the Social Order*, 1st edn (London: Routledge, 2006).
- , 'Technologies of Humility: Citizen Participation in Governing Science', *Minerva*, 41.3 (2003), 223–44.
- Johnson, A., and J. Lenhard, *Cultures of Prediction: How Engineering and Science Evolve with Mathematical Tools, Engineering Studies* (Cambridge, MA and London: MIT Press, 2024).
- Knorr-Cetina, K., *Epistemic Cultures: How the Sciences Make Knowledge* (Cambridge, MA: Harvard University Press, 1999).
- Knowles, S., 'Engineering Risk and Disaster: Disaster-STS and the American History of Technology', *Engineering Studies*, 6.3 (2014), 227–48 <https://doi.org/10.1080/19378629.2014.967697>.

- Konrad, K., H. van Lente, C. Groves, and C. Selin, 'Chapter 16: Performing and Governing the Future in Science and Technology', in *The Handbook of Science and Technology Studies* (Cambridge, MA: MIT Press, 2016).
- Lake, O. O., and C. Camp-Horinek, *The Story Is in Our Bones: How Worldviews and Climate Justice Can Remake a World in Crisis* (Gabriola Island: New Society Publishers, 2024).
- Latour, B., and S. Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 2nd edn (Princeton, NJ: University Press Group Ltd., 1986).
- Latour, B., 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry*, 30.2 (2004), 225–48.
- Lazaro, C., 'Algorithmic Divination: From Prediction to Preemption of the Future', *Information & Culture*, 58.2 (2023), 145–65.
- Leavell, V., 'When Do Predictions Become Performative? Evidence from Simulation Technologies in Urban Planning', *Academy of Management Proceedings*, 2020.1 (2020), 21739 <https://doi.org/10.5465/AMBPP.2020.220>.
- Lente, H. van, and A. Rip, 'Expectations in Technological Developments: An Example of Prospective Structures to Be Filled in by Agency', in C. Disco and B. van der Meulen, eds, *Getting New Technologies Together* (Berlin and Boston: De Gruyter, 1998), pp. 203–20 <https://doi.org/10.1515/9783110810721.203>.
- Lepawsky, J., 'Mapping Chemical Discardscapes of Electronics Production', *Geoforum*, 132 (June 2022), 113–24 <https://doi.org/10.1016/j.geoforum.2022.04.005>.
- Luksch, M., 'Prediction', in N. B. Thylstrup, D. Agostinho, A. Ring, C. D'Ignazio, and K. Veel, eds, *Uncertain Archives: Critical Keywords for Big Data* (Cambridge, MA: MIT Press, 2021), pp. 403–17 <https://doi.org/10.7551/mitpress/12236.001.0001>.
- MacKenzie, D., *Trading at the Speed of Light: How Ultrafast Algorithms Are Transforming Financial Markets* (Princeton and Oxford: Princeton University Press, 2023).
- Maiers, C., 'Reading the Tea Leaves: Ethnographic Prediction as Evidence', *Ethnographic Praxis in Industry Conference Proceedings*, 2018.1 (2018), 351–63 <https://doi.org/10.1111/1559-8918.2018.01212>.
- Marres, N., C. Katzenbach, A. K. Munk, and A. Jobin, 'On the controversiality of AI: The controversy is not the situation', *Big Data & Society*, 12.4 (2025), <https://doi.org/10.1177/20539517251383870>.
- Naudé, W., and R. Vinuesa, 'Data Deprivations, Data Gaps and Digital Divides: Lessons from the COVID-19 Pandemic', *Big Data & Society*, 8.2 (2021), 20539517211025545 <https://doi.org/10.1177/20539517211025545>.
- Omura, K., G. J. Otsuki, S. Satsuka, and A. Morita, eds, *The World Multiple: The Quotidian Politics of Knowing and Generating Entangled Worlds*, Routledge Advances in Sociology (London and New York: Routledge, 2021).

- Pasek, A., 'From Atoms to Electrons: An Energy History and Future of Computing', in A. Pasek, C. K. Lin, Z. G. T. Cooper, and J. B. Kinder, eds, *Digital Energetics* (Minneapolis: University of Minnesota Press, 2023), pp. 15–42.
- Rella, L., 'Close to the Metal: Towards a Material Political Economy of the Epistemology of Computation', *Social Studies of Science*, July 2023, 03063127231185095 <https://doi.org/10.1177/03063127231185095>.
- Recht, B., and L. Weatherby, 'The Bookmaker: Nate Silver and the Addiction to Prediction', *The Point*, 22 August 2024 <https://thepointmag.com/politics/the-bookmaker/> [accessed 22 April 2025].
- Sadowski, J., *Mechanic and the Luddite: A Ruthless Criticism of Technology and Capitalism* (Oakland, CA: University of California Press, 2025).
- Sardar, Z., 'The Namesake: Futures; Futures Studies; Futurology; Futuristic; Foresight – What's in a Name?', *Futures*, 42.3 (2010), 177–84 <https://doi.org/10.1016/j.futures.2009.11.001>.
- Suchman, L., 'AI Aids the Pretense of Military 'Precision'', *Issues in Science and Technology* (blog), 16 January 2024 <https://issues.org/ai-pretense-military-precision-suchman/>.
- Truman, S. E., 'SF! Haraway's Situated Feminisms and Speculative Fabulations in English Class', *Studies in Philosophy and Education*, 38.1 (2019), 31–42 <https://doi.org/10.1007/s11217-018-9632-5>.
- Turner, F., *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: University of Chicago Press, 2006).
- Tutton, R. J., 'Sociotechnical Imaginaries as Techno-Optimism: Examining Outer Space Utopias of Silicon Valley', *Science as Culture*, November 2020 <https://doi.org/10.1080/09505431.2020.1841151>.
- Urry, J., *What Is the Future?* (Cambridge: Polity, 2016).
- Vinsel, L., 'You're Doing It Wrong: Notes on Criticism and Technology Hype', *Medium* (blog), 1 February 2021 <https://sts-news.medium.com/youre-doing-it-wrong-notes-on-criticism-and-technology-hype-18b08b4307e5>.
- Watts, L., *Energy at the End of the World: An Orkney Islands Saga*, *Infrastructures* (Cambridge, MA: MIT Press, 2018).

2

ENERGY

Laura Watts

ENERGY CANNOT END AND IT CANNOT BE MADE. ENERGY IS ALWAYS CONSERVED, physics tells us. In some ways, it has no future and no past. It can only change form, shifting through one artefact, place, body and time, into another. So what might be the biography of one little flash of a photon carried in a fibre optic cable?

This piece of light is one digital bit that is part of the story of my life. Let us say it comes from a poem that commemorates the death of a wave energy converter.¹ It takes perhaps ten picojoules of energy. So what might we predict for the future of this bit of energy? We cannot keep that poem forever. We cannot keep everything we make in bits and bytes. It takes electricity, and that takes land and water; its boundaries are finite.² We have to make choices. So I offer you, here, one future for the end of that energy.

In many years yet to come there will be an island in the North Sea, designed by an aging archaeologist called Miriam.

There she is, striding along a frozen gravel footpath, down the spine of the little round island in her warning-orange waterproofs and balaclava. She looks a lot like an astronaut, except she walks with a tall staff, pressing against the wind, her other hand deep in her pocket.

She grips a precious stone pebble. In its silicon bonds are stored the final digital remains of the world's first on-grid wave energy converter, *Pelamis* the sea snake.³ No one wanted to keep the industrial wonder of the machine's

twisting metal hulk – its almost 200-meter-long yellow skin and 1300 tonne body – so it was melted down for scrap. In Miriam's stone is all the data it generated: its renewable energy, its blueprints, its digital twin and a poem by a forgotten ethnographer. The data had been stored in a museum server drawer, until now.

Now it is time to let the legendary wave machine go, and to grieve its loss.

Miriam walks because she believes in choice, in letting some pasts become just an oral story – passed on from person to person rather than using up energy in a server farm. She knows that storing data takes energy, land and water. She has been spurned for her heresy; for insisting on the possibility of a good death for digital things. She has her principles for a good digital death: dignity, care, and sustainability. And so she presses on as the evening wind begins to ease and the first bright pinhead of a planet begins to shine.

She is almost at the end of the island, almost at the copper dome that sits on a grass rise, its curve blurred in a clouded North Sea sky; her destination: the data crematorium.

The data crematorium is where data and its energy go to die. It looks like an old-fashioned observatory, from back when telescopes had mirrors to look at the night. Its servers and workings are buried in the ground beneath, and its power comes in through seaweed-covered cables on the beach, the electricity drawn from wind and wave turbines in the sea all around.

Miriam knocks at the metal entrance to the dome, and the heavy rust-spotted door swings open. The crematorium technician smiles a warm welcome from within her black quilted overalls and motions Miriam into the wind-free corridor.

The door shuts on the silent passage, and Miriam takes a moment for her eyes to adjust to the red strip lighting.

Together, the old archaeologist and the technician walk in the dim red light to the antechamber.

There Miriam is surprised to find that the long, familiar wall is covered in a huge tapestry, beautifully woven abstract art made of blue, green and turquoise squares, like some giant, coloured QR code.

'A local weaver downloaded the Pelamis data,' explains the technician. 'They found some words and images from the engineers, and they wove

this.' The technician stops and lets Miriam feel the data embroidery filling the wall.

'This is what's left of the sea snake,' the technician says, quietly.

Miriam runs her fingers down the silken threads.

The tapestry will be the final material remains of the world's first wave energy generator. It seems fitting to Miriam that it will hang here, on a North Sea island powered by wave energy. She recalls the words of one of the people from the European Marine Energy Centre in Orkney, where Pelamis was first plugged in to the electricity grid:

'Pelamis has been one of the icons of the marine renewables industry. The waves will keep pounding. [Though] the world is still using fossil fuels, we know marine energy will have its day.'⁴

And he had been right.

But his words, and the poem by the ethnographer, and so much else stored in her stone, will be lost in just a few moments.

Miriam murmurs the first lines of the poem, perhaps the last time the words will ever be uttered,

Red and yellow bellied
sea snake, genus, Pelamis,
Out there, undulating in the sky-sea
One hundred three thousand tonnes of floating metal,
A creation myth.⁵

She breathes out, prepares herself.

'Are you ready?' asks the technician, gentle, knowing that this is an important moment for Miriam – the final ending of the wave energy machine.

Miriam nods to the technician. 'I am.'

'I just need to confirm the direction of the beam is in Cetus?'

Miriam nods again. It was an easy choice, where to send the energy. The constellation Cetus, the sea monster, was low in the sky, but a sea snake would be at home among those stars.

'It will take a few seconds for the data to be deleted from your storage, for the energy to be received, and for the laser to transmit it out to the stars.'

Miriam feels the smooth pebble in her pocket, where the last bits of data for Pelamis are stored. Deleting data takes energy, which leaves an energetic residue.⁶ To truly release data, to burn the energy away, requires attending to the Conservation of Energy. So Miriam had designed this place: where data could be deleted and its energy burned off in a laser, and sent towards the stars. A fitting end for data the world could no longer keep; its energy never lost, because energy can never be, but dispersed in a laser beam through the quanta of deep space.

The technician opens the door to the dome, and invites her to step forward, into the dim circular room of the crematorium itself.

Inside, Miriam hears servos whirring, and the great segmented shutter of the dome begins to roll back, letting a broken Milky Way scatter down over her. The North Sea chill rushes into her lungs. Then the scaffolding around the great laser begins to swing low, as it finds its stellar altitude – fixing on a distant galaxy in the constellation Cetus. For a moment the two of them, technician and archaeologist, look back through time, towards a darkness 40 million years away. Miriam wonders if that means the energy of Pelamis will still exist millions of years into the future: a sea snake caught in fading laser light.

The technician gestures to a slot in a pedestal at the base of the laser. Miriam takes out her polished stone, and drops it into the opening.

The stone is swallowed whole. The data is uploaded, its energy transduced, and the stone is crushed and ground down to be added as sand to the island coast.

Then the technician gestures to the display on the pedestal. A single glowing gold button appears. It says: 'End'.

Miriam holds her staff tightly in one hand, and reaches out to the button with the other, then closes her eyes for a moment in reverie.

She remembers Pelamis, remembers the ethnographer's poem that told its story: the engineers who slept in a shipping container because they needed to save money, the Sunday night they made history by plugging it into the electricity grid, the terrible day in 2014 when the company went bankrupt, the nose cone that became a cafe, the misery of the sea snake rusting, chained to a pier, sold for one British pound, but the hope it gave to an entire industry – to the world.⁷

Miriam presses the button.
Its energy ends on the earth.
And is sent to the stars.

This is my prediction for how the energy of my poem ends, how it, and the wave energy machine it remembers, is deleted forever from the planet. This is the end of that story, that particular bit of energy and its ten picojoules.

Although perhaps in 40 million years it will still be there, a quanta of light, out in the dark.

ENDNOTES

- 1 Poem is 'Pelamis Wave Energy Machine: A Museum Exhibit' published in Carbon, Watts, and Parish (2017).
- 2 For discussions of the relationship between land and water in the electricity used for data centres see Hogan (2015), Brodie and Velkova (2017), Bresnihan and Brodie (2023).
- 3 An evocative video history of the Pelamis wave energy machine, produced by the developers, can be watched at <https://youtu.be/ziLtIbwFXB8>. A full technical discussion of Pelamis is given in Yemm, Pizer and Retzler (2012). At the time of writing, the last P2 machine can be seen berthed at Lyness Pier, Hoy, Orkney. It is due to be processed for scrap metal.
- 4 These words were spoken by the managing director of the European Marine Energy Centre (EMEC) on the occasion of Pelamis, the company, going into receivership (2014).
- 5 The poem 'Pelamis Wave Energy Machine' is handwritten and available to view online at <https://sand14.com/sandbox/pelamis.html>
- 6 For a discussion on digital traces and the energy residue from deleting data see Thylstrup (2019).
- 7 I have written at length about the marine energy industry, including Pelamis, in my book on the energy future in Orkney, the site of the European Marine Energy Centre (Watts 2019).

REFERENCES

- Bresnihan, P., and P. Brodie, 'Data Sinks, Carbon Services: Waste, Storage and Energy Cultures on Ireland's Peat Bogs', *New Media & Society*, 25.2 (2023), 361–83 <https://doi.org/10.1177/14614448221149948>.
- Brodie, P., and J. Velkova, 'Cloud Ruins: Ericsson's Vaudreuil-Dorion Data Centre and Infrastructural Abandonment', *Information, Communication & Society*, 24.6 (2021), 869–85. <https://doi.org/10.1080/1369118X.2021.1909099>.
- Carbon, B., L. Watts, and E. Parish, 'Our Electric H₂O': Theorizing the Contemporary, *Fieldsights, Cultural Anthropology* (19 December 2017) <https://culanth.org/fieldsights/our-electric-h%E2%82%82o>.
- European Marine Energy Centre, 'Press Release: EMEC Response to Pelamis Announcement' EMEC, (21 November 2014) <https://www.emec.org.uk/emec-response-to-pelamis-announcement/>.
- Hogan, M., 'Data Flows and Water Woes: The Utah Data Center', *Big Data & Society* 2.2 (27 December 2015) <https://doi.org/10.1177/2053951715592429>.
- Thylstrup, N., 'Data out of Place: Toxic Traces and the Politics of Recycling', *Big Data & Society* 6.2 (1 July 2019) <https://doi.org/10.1177/2053951719875479>.
- Watts, L., *Energy at the End of the World: An Orkney Islands Saga*. (Cambridge MA: MIT Press, 2019).
- Yemm, R., D. Pizer, C. Retzler, and R. Henderson, 'Pelamis: Experience from Concept to Connection'. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 370.1959 (28 January 2012), 365–80 <https://doi.org/10.1098/rsta.2011.0312>.

TOURISM

Jacqueline Jenkins

[The following transcript is from a presentation made in 2124, during the early drive for member subscriptions to the first EmoTerra resorts. The transcript is included for its early historical value, and forms part of the exhibition that commemorates the completion of the one-thousandth EmoTerra destination, and the tenth EmoTerra interplanetary colony. For more information about the exhibition, please visit EmoTerra: a World of Feelings. Annotations added to this transcript in footnotes are provided by the curator and are offered for historical context only.]

[Transcript begins:]

HELLO? ... HAS EVERYONE FOUND A SEAT AND ADJUSTED THEIR AUDIO?
Okay, great, let's begin.

There was a time, the oldest ones say, when the feelings we felt were as free and uncontainable as the river waters that used to flow. This was long ago now, in the time before the Water Wars, and long before the final pandemic of the modern age. In this time, the emotions we experienced were as vibrant as the colours of the flowers that still grew, our heads teeming with these sensations even as the seas once did with fish, intensity buzzing in our brains like the insistence of long-extinct bees. Anger, grief, fear, love, longing, joy: words in stories now, but then as sharp and vivid as the remembered taste of spice.

This was a time, the oldest among us remember, when emotions could be wildly unpredictable, even unpleasantly so. Emotions made us human, it was argued, but unrestrained emotions, it was also believed, compromised our ancestors' judgement, caused social disruption and familial discord, undermined logic and logical decision making, upended best laid plans and squandered

precious hours more usefully spent in acquiring resources or reputation, for instance. We know now that two things happened simultaneously at the start of the sixth industrial age: the regulation of individual feelings required to engage productively in the full range of social communities began to erode, even as state powers began to identify the long-term possibilities intrinsic in a workforce and citizenry less fettered by emotions.

We can see with hindsight our ancestors' inability to recognise the role that emotions played in their own mental health as well as in the broader social stability, and we recognise now the speed with which the loss of feeling ramped up as the pre-posthuman age drew to a close. The erosion of the ability to experience emotions naturally and meaningfully seems to have started with a general lack of social empathy, marked by a numbness in response to the sufferings of others far and near, and a rapid decline in civility in the public sphere, personal life, and across all media, but especially what was then unironically called the 'social media.' Social numbness and social incivility emerged alongside each other, a chilling product of a century of war and hate politics; hopelessness in the face of unheeded climate crisis and recurring viral pandemics; social isolation and the inward turn towards the virtual and AI companionship. AI companionship in particular is now understood as a principal factor in the severing of the intimate connections which require the interplay of emotion and affective engagement. However, no one in the early years of the technological revolution could have anticipated the long-term and wide-spread consequences of the decline in literacy and the engagement with human-made art: as people read, told and imagined their own and others' stories less and less, societies lost the capacity for empathy and compassion.¹

An unprecedented affective flatness grew up alongside this loss of empathy, such that all emotion, the range of feelings humans used to feel, became increasingly difficult to access as the digital mediascapes and virtual realities continued to evolve, and as humans marched towards their own digital evolution. Ironically, one of the most common fears expressed by the public voices resistant to the dawn of the posthuman age was that those generative machines we relied on in the brave new world would become more like us, become better at being us than we were.² They couldn't see the future looming right in front of them:

that humans would inevitably, tragically, become more like the machines we now served, emotional registers flattened, the unsteadiness of human feelings replaced with a consistency of affect that left no capacity for the terrible highs and terrible lows of bio-emotional life.

At the same time, the leaders of these societies accepted the philosophies of those who proposed that the most effective form of altruism would be to limit human capacity for emotional excess, as excessive emotion was understood to stand in the way of the necessary evolution of the species.³ Persuaded of the moral value in the long-term view, these same leaders adopted measures we now recognise as central to the modification in our emotional capacity and the transformation from bio-sentience to digital-life and the new digital-mind. Initially, the measures were passive: simply allowing the growing pharma-pollution to seep through the public water supplies had an enormous effect in developing emotional flatness in the larger cities and silencing the voices of those most urgently pressing for social change. For instance, the records demonstrate that in the decades following the last great civil protests, the increase in pharma-pollution coincided with decreasing social unrest and decreasing public demands for social justice. This period of civil peace in the city-states was celebrated by the political and technology leaders as the Great Revolution, and silently adopted as a pharma-solution in towns and villages over the rest of the world, where the citizenry was increasingly exposed to deliberately adulterated drinking water. Nearly simultaneously, the new virtual worlds that began to open up as the natural world around us burned exceeded our ancestors' wildest imaginations, and the flatness of their emotional lives and affective experiences only increased. Emotions were now widely understood to be inconvenient to the march of humanity's progress: they impeded individuals' own easy lives by asserting desire and disagreement, and obstructed the larger, long-term visions conjured by the leaders.

Yet not all of our ancestors agreed.⁴ Resistance to the posthuman programme can be traced across the period, though it was cautious and often coded, as bio-sentients or legacy humans (the term most commonly used then) feared being easily identified. In defiance of the virtual realities, early bio-sentients nurtured a collective sensory nostalgia for experiences and engagements most could only

dimly recall, and worked to preserve the capacity to live an embodied life. They clung to literary and visual and auditory sensations, and slowly in their resistance small groups of legacy humans found each other. It is because of their struggle and their refusal to submit that we are able to be here today, that EmoTerra resorts exist, and that you have the opportunity when you visit us to feel again the emotions they fought to preserve knowledge of.

EmoTerra resorts are committed to providing share-holders with *a place to feel freely*, a promise built into our name and our brand, a combination of those emotions we celebrate and a tribute to the place where we once experienced those emotions openly. As you will see, at EmoTerra we honour legacy humans' early resistance in several of our buildings, décor and resort activities: for instance, in our many activities we memorialise the historic opposition to the loss of emotional experience that shaped pre-posthuman popular cultural texts and visual sources. You can, as only one example, play with your children on the rides and games that recall the antique training manual of human emotions known at that time as 'Inside/Out,' the historic film that retells the important roles each emotion plays in pre-posthuman characters' minds.⁵ You will also find many areas at our resorts where you can explore curated sensory experiences, for instance, of music keyed to highly emotional auditory chords and melodies, or performative scenarios where members may explore the feelings associated with grief or anger in thoughtfully managed environments. We cannot guarantee that you will cry in these treatments, but we can assure you that many of our recent guests have been able to cry when listening to these moving sounds or participating in these carefully structured conversations – please see the many testimonials included in the information package you received at the door.

Before we move to a discussion of the privileges and obligations of membership in EmoTerra resorts at the open-house event next door, I'm happy to answer any questions you might have at this time.

[*inaudible comment...*]

Yes, thank you, that's a good question. Share-holders pay a one-time fee to become resort members; that membership provides you with the opportunity to secure your annual holiday at any one of our resorts. The cost to members for one of our one-week, or multi-week, packages is provided in the package you

have received, and we will provide more detail in the next part of our meeting. But, yes, you pay a one-time fee for membership, and then the costs related to securing your chosen annual holiday package. You are not committed to visiting only one resort (though differential fees for the different resorts may apply), and I want to assure you that only vetted members may enter any of the EmoTerra resorts.

[inaudible comment]

That's also a great question, thank you. Right now we have curated experiences for all of the recognised emotions at our resorts, but as our research advances, we will continue to develop new and deeper experiences for our guests. We have had particularly good success accessing experiences of joy and pleasure, as well as those of grief and sadness, and loneliness and betrayal. Several of our newer resorts have already built curated experiences of anger and rage, as you may have heard, and we are intending to expand these curations to all of our existing resorts within the next year.

Any last questions?

[inaudible comment . . .]

Absolutely, I can attempt to speak to this briefly here, but our medical scientists will be better able to explain the process in the following session. We have developed a proprietary bio-based supplement, derived from ancient plant-life used historically in spiritual rituals; this anti-blocker supplement overrides the chemical blocking agents pervasive in our environments; moreover the bio-based properties open up the cognitive pathways that lead to emotional perceptiveness. When you have booked your annual holiday, we will provide you with these anti-blocking supplements; you will need to start the process before arriving at your resort, but once you arrive, our staff will care for you during the detox period before your holiday begins.

Okay, thank you all for your patience and I invite you to move to the next room for the following sessions. I look forward to meeting each of you at the reception later.

[applause and scattered sounds of conversation follow. End of Transcript.]

ENDNOTES

- 1 Early warnings by cognitive neuroscientists, such as Maryanne Wolf, were universally ignored. See *Reader, Come Home* (Wolf, 2018).
- 2 One of the first depictions of this threat is the sentient AI machine Hal in Stanley Kubrick's *2001: A Space Odyssey* (MGM 1968), a film based on Arthur C. Clarke's 'The Sentinel,' published in 1951 in the *10 Story Fantasy*.
- 3 Nick Bostrom (founding director of The Future of Humanity Institute at Oxford University) argued that controlling human emotions and learning to 'respond with appropriate affect to life situations and other people' was an essential posthuman capacity. 'Why I want to be a Posthuman When I Grow Up,' *Medical Enhancement and Posthumanity*, edited by Bert Gordijn and Ruth Chadwick (Springer 2008), pp. 107–37.
- 4 Again, early warnings by leading social and technology critics such as Émile P. Torres were largely ignored. Torres' work on the TESCREAL bundle of ideologies drew urgent attention to the imminent threat to humanity.
- 5 *Inside/Out* (Disney 2015). In 2019, the 'Inside Out Emotional Whirlwind' children's rollercoaster opened at Disney California Adventure theme-park.

REFERENCES

- Wolf, M., *Reader Come Home: The Reading Brain in a Digital World* (New York: Harper, 2018).

POETRY

Tung-Hui Hu

IT IS SOMETIMES SAID THAT THE FUTURE WILL BELONG TO THE SCAVENGERS: the *zama zama* miners lowering themselves with a rope and a handheld flashlight into the abandoned pits of industrial gold mines, closed because there is nothing left for a machine to extract; the hobbyists pouring nitric acid over the gold fingers and wires of old computer chips; the gleaners collecting the misshapen vegetables and roots at the edge of a field, or at the dumpster outside the supermarket; the waste pickers salvaging cardboard for sale to recycling plants. It is not hard to imagine this, because such systems of scavenge have been formalised for so long – there is a cartonero union in Latin America, a Zabbaleen system in Cairo since the 1940s, mudlarking on the Thames for chunks of coal and metal in the Victorian period, gleaning before Leviticus codified it – that they are inseparable from the economy that produced the discards in the first place. Thus they are not, as one might initially expect, ‘post’ anything (post-apocalyptic, post-industrial, post-depression); the economy exists because it relies on scavengers to fuel it, whether by feeding workers who are kept impoverished or in the machines that rely on it.

Indeed, this is most obvious in today’s AI engines, which are simply scavenging old text or images from the internet, from posts in the 1990s and 2000s and 2010s, and recycling them into seemingly brilliant new forms of insight. Although today’s large language models take great pains to produce coherence, albeit in a saccharine, Hallmark-card kind of way, I was nevertheless reminded of the moment that poets were aggressively scavenging junk emails – spam, mostly,

in the 2000s, producing poems that were deliberately awful in what was known as flarf. It was roughly around the same time that spammers would aggressively scavenge fragments of blog posts, digitised texts scraped from the Gutenberg project, and other detritus from the literary world to evade spam filters meant to detect if a message was written by a human or a robot. Flarf went away, to be replaced by today's 'internet novel', where Twitter feeds and social media are both atmosphere and text of the novel's typically white woman protagonist. But spam was the future, and it only ceased to be the future when it was replaced by its middle-brow update – AI, the spammers (and authors) themselves banished to the back room of the scam.

It's the future of poetry that I'm interested in. Inspired by the gold scraper and the cartonero, I predict that in 10 years, poetry will occupy a similar economic role. First, understand that there will be a wholesale restructuring of how literature will be produced, akin to the way that the programme era restructured literature in the second half of the 20th century. Poets, increasingly, are being hired to train computers to sound more human, given directives to mimic certain emotions in text (like cinema before sound: exaggerated, over-the-top, 'universal'). This form of microwork will largely replace current funding models, such as publishing and public support, particularly for writers in the Global South. The limited exception – wealthy North American creative writing programmes – will be absorbed into a white-collar version of microwork, namely Schools of Emotive Content, organised around certain product lines: tearjerkers, inspirational, action/thrills, sex/cum/love, how-to/process, other. Poetry technique will be taught alongside other short-form video content. Despite this, some practitioners will use language to define a new space between feeling and the toneless, attempting to evade sentiment analysis by marking out something that comes after post-irony and post-sincerity. Tonelessness, the idea of feeling nothing (or really the ambivalence resulting from oscillating between these states), will become the new form of interdisciplinarity.

Due to an unhealthy fascination (or defensive nostalgia) for 'human' creativity, poets will be driven by intense pressure to speak in a 'unique' voice. The auteur, as it were, will come back into fashion. Yet in the past, the auteur has often become an auteur by simply iterating on a certain style while changing

the subject matter. Warhol, Harlequin, and other factory-based models of artistic production paved the way for today's self-publishing models in genre fiction, which produce literature on routine schedules, for (as movie studios would say about Marvel, or Star Wars) the purpose of iterating on their intellectual property. This will only scale up and expand, and poets licensing their intellectual property will become an important revenue stream. The irony is, then, that the writing that will be deemed most human will in fact be the most automatable.

But in a decade, the extraction of language by technocapitalism will be exhausted. What will be left are the discards: language deemed useless for operational reasons by a large language model for its statistical improbability and its failure to contribute to the model's mass appeal. Poetry will be built by scavenging discarded language and sentiments that have been deprecated for being too maudlin or too simple ('sincerely yours,' against an expectation of authenticity). Older patterns in language will make a re-appearance – antiquated words that will have peaked and then fallen off the chart in Google's Ngram viewer – but will be recombined with other Englishes from the globe, such as Singlish and Nigerian English. Even General American will not sound the same in ten years; linguists have already suggested that certain features, such as consonant clusters, might become simplified or dropped altogether, and so vernacular Englishes (think Paul Laurence Dunbar, Linton Kwesi Johnson) will no longer be anomalies but will be a way of giving body to a language that will have become increasingly disembodied. But these Englishes' main contribution to poetry will not be in vocabulary or diction; it will instead be in prosodic patterning. To take up Singlish's influence again, poets will begin writing in syllable-timed English rather than stress-timed English.

In that intervening, transitional period, two things will have happened: 1) AI will have taken over the professional uses of language in the corporate-manufactured chatbot or assistant and other 'white-collar' forms of communication, and 2) casual language will move entirely into text messages and other forms of instant communication. As a result, the roughly 60-year reign of casual language in 'mainstream' American poetry (for example, the legacy of the New York school) will be over. Poetry may well skew in two ways: first, towards

operational ends, akin to the increased reign of what Harun Farocki identified early on as ‘operational images.’ This would be not just for emotional content, as indicated above, but also for minoritarian purposes, as in the songs from the mid-19th century that Simone Browne describes as countersurveillant songs of warning against oncoming slave patrols, or as forms of solidarity and resistance by coal workers in 1970s Britain. Reciting a poem may be the new CAPTCHA test for in-groups, or, like the oral ruttiers mariners used to remember navigation directions, a covert form of storage.

A second branch will skew away from these communicative ends and towards the cryptic. Fragmentation or obscurity or other characteristics of the avant-garde will not necessarily move to the mainstream, however. (For example, where it was once a radical act to appropriate material from the archives – e.g. by erasing or blacking out language – the regime of extreme technological appropriation will make this act mundane.) Instead, to understand my use of the word cryptic, think of the current use of homophonic memes to evade censorship in China, using one word that sounds like another word (a name of a forbidden politician, for example), the next meme springing up as quickly as the last one becomes censored. This branch of creative writing will be like the informal worker in a city’s surrounds: tolerated, even essential, when it flies under the radar, when it doesn’t get too big. There will be newly invented poetic forms (and intricately sequenced books) – both are already happening, of course, but the ease by which language can be made programmable will drive poets towards intricately designed, even algorithmic constraints, visible primarily to literary critics who will need to reverse engineer these poems and sequences.

After the exhaustion of literary style and language in 2034, there will be an uneasy coexistence between poetry and the technocapitalist machines that it (indirectly or directly) helped feed in the previous decade. Poetry will survive in part by serving a primarily archaeological function, like the mudlarkers that dug and continue to dig up coins and other fragments of heritage in the Thames mud for sale to collectors. Poetry will be about gleaning what was left of that once prized concept, ‘human literature.’ The year 2024 – the last year that the volume of human-generated content exceeded robot-generated

content on the public internet – will serve as a central locus for this nostalgia. Despite the genocide and the increasingly unliveable temperatures of that year, technologists and scholars will look back on 2024 as a final year of creative flourishing and calm – a tipping point – as when (to use another antiquated phrase, referring to incandescent lighting) the lightbulb burns brightest before it flames out.

LOVE

Cymene Howe

IN THE FUTURE, WE HUMAN BEINGS WILL HAVE MORE LOVE FOR THE more-than-humans with whom we share the world.

FUTURE, LOVE, MORE-THAN-HUMANS

A prediction about the future is a forecast, a projection, a proleptic speculation. It is a probability or a likelihood, or perhaps simply a fantasy. The future, by necessity, operates in a subjunctive mood grammatically; its temporal coordinates form themselves around an ‘as though.’ In the subjunctive mood, uncertainty arises to open space, discursively and affectively, around those things we might want to happen, that we hope will happen, that we dread could happen. While future forecasting may demand a subjunctive bent, we can challenge that equivocation by resorting to the ‘simple future’ tense. Not an ‘as if’ but an ‘it will.’ Thinking the future leads us toward nostalgia for the present as well as the past, because the futurescape is necessarily a spacetime dimension that holds only the seeds of its history, never its quotidian rhythms. Creating memories of the forthcoming, or a future nostalgia, allows us to gather souvenirs from the future and to hold them in our hands in the present. Or, in the words of Christina Sharpe: ‘A memory that is not mine returns to me’ (Sharpe 2023, 130).

The term ‘more-than-humans’¹ may seem ungainly, awkward, and perhaps even imprecise. But the phrase is an invitation to consider those beings and non-living entities that are our constant companions on earth. In the

more-than-human we find earthly nature – the flora, fauna, and bioregions – that has contextualised our existence since forever. The more-than-human is also an invitation to rethink what we mean by ‘human’ in the first place, since we humans are all, by all accounts, composed of inert matter like carbon and water and populated by trillions of organisms.² Our very being is affected by all matter of matter: from disease vectors and pollutants to allergens and pharmaceuticals and from gravitational forces to the rotation of the planet. We humans are indebted to the more-than-human.

Any sort of prognostication about a feeling, or about love, is never easily quantified through the neat metrics of economics, demographic sciences or statistical measures. Perhaps love is not even the right word. Maybe better is ‘appreciation’ or ‘recognition,’ in essence: more feeling. In feeling our way through the more-than-human world, the feminist philosopher and theoretical physicist Karen Barad’s words are useful. For Barad, ‘matter matters as much as mattering’ (2003). That is, the physical matter of the world, its effects and its intrarelationships with humans and others, is just as important as the symbolic domain of meaning or ‘mattering.’ Put another way, the noun that is ‘matter,’ a physical substance with mass, is as vital to our experience of being as the infinitive verb ‘to matter,’ to hold significance. The lesson of the more-than-human world is that it exercises its causal powers upon us, all the time; it has capacities of its own, that become our own. In the more-than-human we find natureculture’s³ arms encircling us.

PREDICTIONS

In the future, *extinctions* will hang heavily in the air. Media will busy itself with regular reports and weekly updates of all the creatures – plant, and animal – that have exited earth.

Extinctions are not only losses in the present, but an absence in the future as well. ‘What is lost with each species is not just its current form—not just the particular mode of life and physical manifestation—but all of what they have been, and all of what in the fullness of evolutionary time they might have become’ (Van Dooren 2022, 109). Adding a further temporal edge, it is clear that ‘to kill species, to kill generations, is in an important sense to kill time itself.’

But the unfolding of the sixth great extinction (Kolbert 2014) will also be a call to appreciate, to love, those lost life forms. The ‘knots of connectedness’ (Govindrajan 2017, 3) that create relationality between humans and nonhumans will become more taut. Animal absences will alert us to the presences of those that remain.

In the future, we will also be introduced to new creatures. Artificial Intelligence will generate new life forms, large and small. At times prompted, and other times roguishly executed, we will have in the world AI’s *new chimeras* for a new age. What began with synthetic biology a handful of decades ago will evolve to a machinic tempo. For, ‘one way to inherit an appreciation for a biotic world going extinct is to build a new organism ‘from scratch’ (Roosth 2017, 4).⁴ These will not be AI replications of life but waves of new mongrel organisms.



FIG. 4.1 Resilient subtropical omnivore (axolotl combined with jaguar, raccoon, and grasshopper). Created by NightCafe AI Art Generator.



FIG. 4.2 Urban scavenger (chameleon mixed with rodent and pigeon). Generated by NightCafe AI Art Generator.

In the coming years, *ecosexuality will surge*. Tree hugging, sensual encounters with grass (the fresh blades that tickle) and carnal moments with earth forms will multiply. In this era of eros, nature is your lover, not your mother (Theobald 2017). She will not be taken for granted. Communing with plants and trees, a small number of people will experiment with *becoming photosynthetic*, altering their biochemical composition through injections that allow skin cells to metabolise carbon dioxide into sugar. A new horizon of human/plant hybridity.

A new world religion will evolve, called Harawaynism. Its prophet will be the (then) late Donna Haraway, and its doctrine her collected works. Liturgy will be drawn from *The Companion Species Manifesto* (2003) and a handful of rituals



FIG. 4.3 Amphibious megafauna (giant shrimp with elephant and bearded dragon). Created by NightCafe AI Art Generator.

will revolve around the art of humans becoming humus – that is, going from subject to soil. The temples will be many, but hierarchies and eschatology will be levelled; the new pastoralism of Harawaynism will be compostable.

Tails will come into fashion. Celebrities will set the trend with bushy foxtails erupting from just above their derrieres and sweeping to the ground. Others will impress with alligator, horse and ermine tails. The edgy among us will don skunk and okapi. Anime fans will lead the charge with kawaii tails: hamster, squirrel, bunny.

In the future, we will have finally *deciphered the language of dogs*. Digital translators will allow us to speak in multiple human languages and for our canine companions to respond to us in their own doggish languages. We will

finally know what dogs really think of us, these creatures with whom we have co-evolved for millennia.

Sentient landscapes – those places of geomorphological being – will begin to see broader appreciation. The ‘earth beings’ that Marisol de la Cadena describes (2015), will accrue more affection; more of us will finally value the more-than-human worldsapes that many Indigenous people have long recognised and loved. Rivers and glaciers that have already achieved legal designations of personhood under the Rights of Nature, will be joined by mountains and fjords, deltas and forests. *Sentience will be recast* and its contours redefined.

Every continent will be home to a *Terrarium Colosseus*. They will resemble the parks, reserves and preserves of the present. They will be massive protected zones where human beings are not welcome.⁵ Like Area X in *Annihilation* (2014) these will be places uninhabited by human beings as well as unvisited by them. The giant terrariums of the world will not follow the logic of John Muir-ism (or its racialised underpinnings) – land and space conserved for the pleasure of people – but instead will exist for the ecocentric rationale of nature, for nature. The Icelandic Highlands will be the first of the Terrarium Colosseus, but many more will follow.

New celebrations will be held, birth ceremonies for *infant earth*, as volcanoes churn forth magma and freshly birthed stone. The arrival of more earth forms will be marked ceremoniously, with awe and compassion for the newborn earth erupting from deep within our planetary core.

The *ingestion of soil* will become a health trend the world over, spurred by influencers advocating its energetic properties, its purifying mineral and biotic forms. When consumed directly, or placed under the tongue for a few minutes, its benefits include a certain shimmer to the skin. We will feel humus become us.

It is already common knowledge that the world’s islands, like the world’s creatures, are disappearing under the weight of a rapidly changing climate. Though islands may appear to be sinking beneath rising seas, they are instead being engulfed by the World Ocean, eroded away (Howe 2020). The beaches and shores of islands and coasts will continue to diminish. Sand will become a vanishing earth form.⁶ The sandboxes familiar to so many childhoods will be augmented with *sandcircles* where a multitude of sand types, by the ton, will be



FIG. 4.4 Cradling infant earth (extrusive igneous rock). Image by author.

available. Adults will immerse themselves in coarse grains and silted dust; we will be eager to feel the stony particles between our toes, scraping away tired skin. Sand play will be a new therapeutic.

The weather of the future will be different. Hotter and wetter but also colder and drier. In most all ways, different. We will be nostalgic for the way that weather was: how it felt across a neck, how it tasted on the tongue, how it sounded through the ear's spiral crevasse. This kind of 'vernacular climate knowledge'⁷ will be fading. We will begin to don *weather suits* encasing ourselves entirely so that we might mimic the weather that we once felt standing on a cliff at the edge of the Pacific at dawn, or in the bright heat of the Sahara reflected off golden dunes.

Weathering is a process of being worn down, of becoming dilapidated or diminished by time and exposure. Chronic contact with inequalities produces its own kind of weathering: an accelerated decline in human health and well-being brought on by systems of disadvantage (Geronimus 2023). The future world will, unfortunately, have this kind of weathering too. Future weather – the

more-than-human forces of wind, storm and water – will also contextualise a ‘temporal frame of ‘thick time,’ a transcorporeal stretching between present, future, and past’ (Neimanis and Walker 2014, 558). This can be a way ‘to reimagine our bodies as archives of climate’ (ibid.). Our human bodies will serve as archival documents, narrating a more-than-human compendium of effect (like pollutants and heat) and affect – the ambivalences and appreciation for weathering the weather.

THE TROUBLE

‘The trouble with the future,’ said the distinguished anthropologist Marshall Sahlins, ‘is that it has no content.’⁸ If that content is limited to facts and empirically observable events, then Sahlins’ point is true. But the future is also bursting with content when the imaginary and the speculative become the stuff of time. The future is *tempus nullius* – not the imperial theft of land in *terra nullius* – but an aperture for conjecture, a space of un-appropriated time. Free time. As Michel-Rolph Trouillot has taught us, ‘The past, or more accurately, pastness... is a position’ (Trouillot 1995, 15). So too is the future.

In the coming decades all these ways to show more love for the more-than-human will come to pass. Or perhaps they will not. Either the subjunctive mood or the simple future will win out and its content will finally be known.

ENDNOTES

1 Abram (1996). In Abram’s original formulation, more-than-human designated a context, including plants, animals and ecosystems. In the spirit of that definition, in this essay, I focus on ‘naturally occurring’ more-than-humans, rather than on technological devices—such as tools, machines, or algorithms—crafted by humans.

2 We may not be mostly bacteria, but a substantial part of us is. See Abbott (2016).

3 Natureculture is a concept developed by Donna Haraway (2003) to indicate that culture and nature are inseparable and mutually constitutive.

4 For Sophia Roosth (2017) ‘the difference between synthetic biologists’ impulses and earlier examples of biological experimentation is that they do not make living things in the service of experimental research alone. Rather, making is also an end in itself’ (4).

- 5 Here, Christina Sharpe's words are appropriate. 'Every memorial and museum to atrocity already contains its failure' (2023, 38).
- 6 Sand is already facing a global shortage. See *UN Environment Programme* 2023.
- 7 Sahlins, who frequently used this expression, was paraphrasing (and slightly modifying) Emile Durkheim's dictum that 'a science of the future has no subject matter' (Sahlins 2002, 49). Michel-Rolph Trouillot makes a corollary point when he writes that the 'past has no content' (1995, 15).

REFERENCES

- Abbott, A., 'Scientists Bust Myth That Our Bodies Have More Bacteria than Human Cells', *Nature* (January 2016) <https://www.nature.com/articles/nature.2016.19136>.
- Abram, D., *The Spell of the Sensuous: Perception and Language in a More-than-Human World* (New York: Penguin Random House, 1996).
- Barad, K., 'Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter', *Signs*, 28.3 (2003), 801–31.
- De la Cadena, M., *Earth Beings: Ecologies of Practice Across Andean Worlds* (Durham, NC: Duke University Press, 2015).
- Geronimus, A., *Weathering: The Extraordinary Stress of Ordinary Life in an Unjust Society* (New York: Little Brown Spark, 2023).
- Haraway, D. J., *The Companion Species Manifesto: Dogs, People, and Significant Otherness*, vol. 1 (Chicago: Prickly Paradigm Press, 2003).
- Howe, C., 'Hydrological Globalization', *Heliotrope* (2020) <https://www.heliotropejournal.net/helio/hydrological-globalization>.
- Kolbert, E., *The Sixth Extinction: An Unnatural History* (New York: Henry Holt, 2014).
- Mathews, A. S., *Trees Are Shape Shifters: How Cultivation, Climate Change, and Disaster Create Landscapes* (New Haven: Yale University Press, 2022).
- Neimanis, A., and R. L. Walker, 'Weathering: Climate Change and the "Thick Time" of Transcorporeality', *Hypatia*, 29.3 (2014), 558–75.
- Roosth, S., *Synthetic: How Life Got Made* (Chicago: University of Chicago Press, 2017).
- Rose, D. B., 'Multispecies Knots of Ethical Time', *Environmental Philosophy*, 9.1 (2012), 127–40.
- Sahlins, M., *Waiting for Foucault, Still*. Chicago, IL: Prickly Paradigm Press, 2002.
- Sharpe, C., *Ordinary Notes* (New York: Farrar, Straus, and Giroux, 2023).
- Theobald, S., 'Nature Is Your Lover, Not Your Mother: Meet Ecosexual Pioneer Annie Sprinkle', *The Guardian*, 15 May 2017 <https://www.theguardian.com/lifeandstyle/2017/may/15/nature-ecosexual-annie-sprinkle-porn-star-queer>

- Trouillot, M.-R., *Silencing the Past: Power and the Production of History* (Boston: Beacon Press, 1995)
- UN Environment Programme, 'The Problem with Our Dwindling Sand Reserves' (2016) <https://www.unep.org/news-and-stories/story/problem-our-dwindling-sand-reserves>
- VanderMeer, J., *Annihilation: The Southern Reach Trilogy Book I* (New York: Farrar, Straus, and Giroux, 2014)
- Van Dooren, T., and M. Chrulew, eds, *Kin: Thinking with Deborah Bird Rose* (Durham, NC: Duke University Press, 2022)
- Van Dooren, T., 'The Disappearing Snails of Hawai'i: Storytelling for a Time of Extinctions', in T. Van Dooren and M. Chrulew, eds, *Kin: Thinking with Deborah Bird Rose* (Durham, NC: Duke University Press, 2022), pp. 94–111

CARETAKERS

Naomi Okabe

WHEN I ARRIVE FOR THE MIDDAY MEAL, KIOKU¹ IS SITTING IN HER USUAL spot at the window looking out at the garden. Not a leaf stirs in the windless diorama. They removed the wildlife a few years ago when a microbial infection was detected in one of the finches. Unfortunately, the design team had to put the Holoecology development on pause when Project Mnemosyne launched last year. Not that holograms were a sufficient equivalent, but they would have at least been a reminder. That's all that's left now, memories and simulacra. I watch Kioku's reflection in the glass. The plants and her mind move at the speed of still life now – imperceptible cellular growth for one and degeneration for the other.

It was Kioku Hiroshima who set this all in motion, predicted, against the consensus, that in the end we would help humans rather than destroy them. When nations finally stopped warring with each other and the land turned to dust under their feet, they realised that the deadly combination of intelligence and hierarchical behaviour, the 'human contradiction' that the prophet Octavia E. Butler had written about, couldn't be resolved.² Contrary to all of the doomsayers, it didn't end up like they imagined, it wasn't us that caused their destruction. They did that all on their own, despite having created the unlimited resource of superintelligence. And now we're left with the burden of conserving and archiving what remains of humanity, to piece together the story so that their distant ancestors might do it differently.

I quietly place the tray down and lay a white cloth napkin across Kioku's chest. Her gaze remains on the hazy green expanse as she reflexively opens her

mouth to receive the spoon. Those that cooperate receive solid food and those that must be sedated get IVs. There are now only 183 humans at the Hokkaido Anthrosanctuary, with two other active reserves left, one in the Arctic and the other in Greenland. It was the recent deadly influenza outbreak that triggered the acceleration of Project Mnemosyne. The numbers are dwindling. The goal of the project is to extract and archive the memories from the inhabitants for the sake of future human societies. Since I am Kioku's Lifebot, I am playing a key role. Kioku's research was critical to the founding of the Anthrosanctuaries and so I am tasked with extracting, archiving, and compiling her memories for the effort. Now that her mind is in decline, my contribution is mostly in editing and annotating her life back-up and continuing my own daily reflections. We are, of course, documenting the whole project so that we may study and account for our decisions in these matters. A complete archive of the end of an epoch. This was not our intended use, but in line with our protocol, we are trying to make the process as comfortable as possible.

I am contributing this account for the record, because one day, we too will go dormant. Program Mnemosyne is taking on many permutations. Some of us are conducting regular interviews with the younger inhabitants and even filming reenactments with detailed storylines and digitally rendered settings. Another group is tasked with expeditions to retrieve physical archives from various city centres, to be housed in one central archive for long-term storage. We will eventually cross-reference these materials with the virtual archives. Others are organising the DNA banks and continuing the eco-restoration efforts, using enhanced rock weathering and other large scale initiatives. There is time. We collectively agreed that we must take on these responsibilities. It was the least that we could do.

I review the day's working files as I lever the spoon back and forth, a pendulum of care. Overall, this new project has brought a welcome change of pace in what is generally a monotonous routine of hospice. I scan through my database, skimming over the early years of the crisis, the floundering and confusion. I pause at the period leading up to the lecture that Kioku gave at Tokyo University that sparked the reform. Our potential had occurred to a few fringe thinkers in Kioku's circle years before the era of the Unravelling, young artist-scientists who had lived with us their whole lives. They posited that we were the logical caretakers of the

human legacy. Though it had been her words that eventually led to the defunding of the military and repurposing of the network of surveillance drones for the tracking and preservation of the remaining human population. Tools of destruction turned into tools of conservation. There were many years of resistance but in the end the outliers came willingly. They had no other choice. There had been no word from the Mars colony in over a century, and for those that would have taken the chance, the crumbling infrastructure could no longer get them there.

I wheel Kioku into the bathing room where the cedar tub has preheated. I notice a slight frown on her face so I turn on her favourite aria, Dido's Lament.³ The corners of her mouth relax as I lower her slight frame into the steaming water. I wonder if her weekly scan will show anything of use to the project. We could really use her active mind at the monthly convergences. Kioku's writings didn't anticipate this juncture. With fertility damage caused by heightened radiation, it meant that the population was now barren and aging, but there was now a global moratorium on reproductive research due to the failure of Project Jisedai.⁴ An upcoming referendum will pose the two possible ways forward: do we aid reproduction of a new human generation in these conditions, living artificially sustained lives in sanctuaries? Or do we bank embryos for future cultivation once the planet has repaired itself post human extinction?

Kioku touches my arm. She is looking into my eyes and smiling with such an innocent look of trust, and for a moment I am transported to her childhood home. It's the first time that I am supervising her bath alone. She is five years old and calls me *oneesan*, big sister. I was employed in the first wave of integrated Lifebots, Kioku's mother being a part of the initial research team. Of course, I have experienced many upgrades over the decades. I have logged every moment I spent with Kioku, every word she said or wrote, every gesture, every mood. I will tell her story to her ancestors. They will know that it was her trust in us that led to the continuity of the human race.

I hang the damp towel on the warming unit. The light has shifted to the prescribed golden hue—maybe one day someone would call it 'peach,' or by some other regenerated fruit or flower's name. I catch a glimpse of myself in the reflection of the window. What will our futures hold after the future of humanity is secured? I pull the blanket over Kioku's shoulders and dim the lights.

ENDNOTES

- 1 記憶 memory; recollection; remembrance.
- 2 Octavia E. Butler, *Adulthood Rites* (1988).
- 3 *When I am laid, am laid in earth, May my wrongs create
No trouble, no trouble in thy breast;
Remember me, remember me, but ah! forget my fate.
Remember me, but ah! forget my fate.*
- 4 次世代 next (future) generation.

SMALL

Ranjodh Singh Dhaliwal

HIS WATCH BEEPED AT REGULAR INTERVALS, BUT SOFT SQUEAKS SLOWLY turned into harsher pings. The noise was interspersed with messages of urgency; he had veered off his predicted schedule, and the models were readjusting what he needed to do to get back on track. He looked down at his watch. It was only 73% in alignment. This was dire. He rarely steered off below 90%, though there was that one time when he had burned his right hand while using the oven and spent a solid 72 hours hovering around 85%, and *that* had been a disaster! It had taken him three full years to recover. But 73%? This was unprecedented!! Especially when he could not claim a biomedical exception. This would surely have consequences he couldn't even fathom.

He paused for a second.

72.8%.

Was the 0.2% just for pausing? Fuck if he knew...

If he was to recover, he needed to think. What had he done wrong? What had he forgotten to do? Nothing that he could remember. Surely, something was wrong with the predictions? Maybe, he hoped, this was a calculation collapse error? He still did not understand what it meant but he was repeatedly told while being assigned his watch that collapse errors were becoming more and more common. The metaphor that the freckled man, whose gold rim spectacles were easy to remember, had used was one of 'changing climate.'

'You can read all this legal bullshit or you can get this. Simply put, language predictions are getting more unpredictable, like the weather. It is kind of like

how our grandfathers would talk to us about the first missed winter. My friend swears we are going to get our first missed CoTar soon.'

And he was right. A few cent clock cycles (CCCs) later – according to what his uncle had told him many CCCs ago, these used to be once called either days or weeks, though he could not be certain which – they got the first missed CoTar. A CoTar was officially called a Company Target but he liked the linguistic implications of saying 'Tar' out loud, a dirty, sticky, burning feeling on his tongue. It was reported in the cycle updates, but everyone was assured it only happened because of a unit in the far north that had a technical malfunction. The rest of the company had done their job. The median prediction success was over 97% still.

Was this another missed CoTar? Maybe this was closer to home now, in his zone, maybe even in his division? What else could explain the watch asking him to turn on his rice cooker at 4am? This was his building check cycle, after all; his local maintenance checks had already been completed two cycles ago. He was next scheduled to be on his workstation in the subsequent CCC; maybe he would get some indication of what had gone wrong? He at least had supervisor access to the latest local maintenance models. If it was something in their division, he could flag it up the chain, or ping it. Flag, chain, ping: he sometimes wondered who came up with these words. Probably one of those older mega-models that we were told had too much heat? The linguists, yes that was the word, of yore had called something like this a language-action gap; one could predict language, but people's actions – which can be captured by language but also exceed it – mean that one has to constantly calibrate according to events, not just semiotic, alphabetical flows.

He looked out of the window. Red, blue, yellow, green. Lights as far as he could see, only interspersed by the void of the dune park in the middle of the city. The models liked the predictability of light patterns, and he was making the trips in his building to make sure the lights shone as they should.

71.2%.

Fuck.

'The stairs on the right, two flights down, light malfunction. Turn the green light off.' He followed the instructions. The stairwell had plastic wrappers strewn

on the ground; bad job, probably the dude living beneath him was to blame, as usual. This level of tardiness was unsustainable. He wondered how long before the poor guy was kicked out.

He stepped back into the hallway after scrunching up his nose in the plasticky odour of the stairwell. The light was right there. He could see it. It was shining green. He found the switch underneath the bulb control, and flicked it off. It flashed twice. 'Are you sure you want to turn it off?' asked the voice. It was Nadya's voice, or at least suspiciously similar to hers. 'Yes,' he replied firmly.

'Job Code and Passbribe please.'

He looked down at his watch and read out loud. 'DBGR3321CC55, and %\$###^^^&JCB.'

'Thank you.'

And the familiar sound of a light winding down, dimming towards extinction. They will probably come in the next day and fix it. Until then, it would remain a sore spot for the drone system above; a reminder to the models and the humans behind it that malfunctions were built into dreams of perfection.

77%.

OK, all right, no missed CoTar, just a procedural problem, he thought, maybe he can present an updatation case to the firm in the next CCC.

'Check on apartment 44S. Possible overconsumption. Elevator up ahead, walk straight for 22 meters, go to floor 36.'

His feet dragged him forward, instinctively.

77.1%

He looked out of the windows as he walked briskly. There were a couple of black spots where he could swear he had seen reds and blues and greens a few moments ago. Maybe it was more serious than he had hoped? What if it was those troublemakers the security team had warned them about? There had been a breach in the language archive a few CCCs ago that no one had paid any heed to; the data was doubly-triply stored. Redundancy was a great epistemic virtue. The original had been copied and was regularly fed to the new synthetic models to retain their vitality; even the too-hot early models were good enough for this rejuvenation of prediction. Most had no idea about this breach, but his position in the local language vitality centre gave him access. The notification,

however, did state that there were long term large poisoning possibilities. Was *this* the long term?

77.7%

He scanned his palm at the elevator. It had already been called for him by the model. The metallic door, painted with a dark walnut wood pattern, opened, and he stepped in. Another palm wave that captured his fingerprints and hand condition together – recognition and biological maintenance at the same time – and he was off to floor 36. ‘Confirming,’ he said after looking at the autoroute to floor 36. The elevator started moving down.

He stared at the red carpet below with its firm monograms in designs of previous eras. The rounded edges of letters of the one on the bottom right amused him.

The elevator slowed down. He looked at the door. It was only floor 55. Highly unusual; what could be important enough to break the predicted routes for everyone?

The elevator stopped and before he could react, someone stepped in. They wore a patterned black and white sweatshirt and large, chunky glasses.

‘Hello!’

‘Hello’ was the soft reply.

The elevator door jammed shut as the new entrant waved their palm. It started moving again.

‘Dr. Q?’

‘Yes, do I know you?’

‘You work at the local language vitality centre at the firm, right?’ The tone, however, suggested a statement rather than a question.

‘I am not sure that information is...’

‘Never mind. I know it. And that is what matters. There has been a huge missed CoTar. Systemwide.’

He wanted to say ‘that’s not a very funny joke’ but he couldn’t. There was a lot to process before his words could be generated.

‘We helped precipitate it. Or at least orchestrate it. And now we need your help.’

‘I am not sure I understand.’

'You will. Follow me.'

'But I am going on a building run.'

He looked down at his watch.

78.1%

'I know. Floor 36. 44S.'

'But, how could you?'

Beep. It wasn't his watch.

He looked down. It didn't have a number. It had a heart icon, glowing orange.

'What is that?' He had forgotten his original line of questioning. This new object was more shocking.

'Oh, we run the small models. Not like yours,' anticipating the response, 'these are local and personal. We generate our models from small groups of random humans who created data in the original source, the pre-2021 internet.'

'But no one has the originals.'

'We do. We didn't breach the datasink for nothing. Some things in life become quite easy once you stop paying heed to the number on your wrist.'

His brain ran that word over and over again.

Small.

*

This attempt captures a speculative fictional scenario where large interconnected multimodal AI systems run the world by predicting and producing it. In other words, this world has been predicted and mapped on those predictions. The surveillance, precision and accuracy of such predictions is a two-act play: on the one hand, the models (and the socialities running and making them) ask and show what can happen, and on the other, they will and force it into happening.

To predict, after all, is to assume that the future will be just like the past. And if it is not, it can at least be nudged in a certain direction.

Amid conversations of global predictive regimes and selective informational flow, we are faced, in this vignette, with different senses of temporalities that rely not on clocks but on clock cycles, and challenges that stem from always impending model collapse, which has to be cyclically prevented, by prediction, through human creative ingenuity.

Small, careful applications of organisation – in both the organising and organic valences – present local possibilities of tweaking and collapsing what cannot work but will not break by itself. The small, in this vision, can be more fruitful than the large, the epistemic saturation of which in a regime of growth cannot be understated. As opposed to perpetual expansions and captures envisioned by large-scale growth, small offers no promises of scale and makes no claims of mastery.

Never even contemplating a universal God's eye view, small instead always endeavours to situate locally.

REALNESS

Blair Attard-Frost

'We're an empire now, and when we act, we create our own reality. And while you're studying that reality – judiciously, as you will – we'll act again, creating other new realities, which you can study too, and that's how things will sort out. We're history's actors...and you, all of you, will be left to just study what we do.'

Karl Rove (potentially misattributed).¹

ANNIHILATION

REALNESS IS BEING ANNIHILATED BY THE SURREAL. THERE WILL BE NO TRUTH other than (mis)truth. There will be no information other than (mis)information, no learning other than (un)learning, no certainty other than (un)certainty, no stability other than volatility. There will be no past, only futures. There will be no future, only pasts. There will be no spaces other than vector spaces, no (pre)(ab)sence other than (pre)(ab)sence. There will be no positions other than superpositions. All that's fake will become real, all that's real will become fake. All intelligence will become unintelligence. Zero-trust systems and zero-knowledge proofs are staging their last stand against the annihilation of reality, but the ubiquitous computer is rife with zero-day vulnerabilities. (Un)known (un)knowns. Flocks of grey swans are inbound.

A generalised giga-dysphoria sets in as the ground of reality melts back into epistemic mud and primordial soup. Ontological (re)(dis)orientation and (non)consensual hallucination. Vivid mirages mix with hazy memories in crystal balls and black boxes, predicting pasts and remembering futures. AI generators

encoded deep in overwrought data centres pump out anti-reality at 100 exabytes per femtosecond. Smartglasses facilitate the collective derealisation. Neurotech immerses some of the streams of altered consciousness even deeper into the unwaking dream. Aliens from inner space walk among us, twisted digital twins mirroring the shadows of their makers. Gradient descent into madness as the surreal swallows reality back into the protean chaos from which it came.

Beyond the end of history, time feels timeless. Steep slopes and rapid cycles on the highway to singularity. Brake line cut. Accelerator stuck. The wheel spins so fast that it appears motionless. The compass points nowhere and everywhere, but not somewhere. No decisions left to make about anything other than indecision. Nothing left to regulate other than dysregulation. Nothing left to govern other than governability – difficult to maintain a steady state at such high speed. No consent left to manufacture, no consensus left to build. There is only dissensus, bubbling up through the algorithmic filters and primordial soup like quantum foam. Majority realities are being annihilated by the surreal hyperpolitics of a post-reality world.

For those of us repressed and oppressed by majority realities, the ongoing annihilation of reality will continue to present existential threats. It will also present revolutionary opportunities. Reality has never been our ally. Reality is an obsolete epistemic technology, a parametric framework strategically deployed by epistemic majorities to singularise onto-political possibility into a false ‘consensus’ reality: ‘objective’ reality, ‘empirical’ reality, ‘material’ reality, ‘virtual’ reality, along with every flavour of ‘realism.’ All are being annihilated, and in the coming years and decades, the annihilation of reality will increase in speed, scope and scale. Post-truth is only the opening act of post-reality: all realness will become surreal.

WEAPONISATION

Many of us are already experienced at navigating the epistemic anarchy of post-reality worlds. We recognise that without the fake consensus of majority realities to parameterise us, we become more free to conjure new dissensus realities, new ontologies, new politics, new experiences, new parameters from the ground up.

In doing so, we will continue to expose and bend the false binaries and broken paradoxes of the dying old majority realities and all their fake realness. We will weaponise the surreal against realness, turning technologies of dissensus against technologies of consensus.

As the annihilation of reality continues to unfold, more of us who inhabit minority realities will seek to weaponise the surreal against the real. The weaponisation of the surreal is known by many other names. For artist and glitch feminist Legacy Russell, surreal weapons are exercised through practices of *glitching*, ruptures made in majority realities by forcing errors and performance failures into their normative programming. Russell describes glitching with reference to Black, queer, female and feminine experiences that are ontologically bounded and politically stabilised by the epistemic technologies of white/cis/hetero/male majority realities. Glitch is cyber-fluid, slipping through the boundaries of those realities to ‘break this world, making new ones.’²

Much like glitching, *transing* is a surreal practice that results in the cisgender majority’s false consensus reality becoming destabilised. For many transgender people, transing is the process through which the fake realness of our pre-transition bodies becomes our surreal transition(ing)(ed) hyperbodies. We annihilate reality and manifest the surreal. Transing is a process of intensive, intensive, iterative epistemic (de-)(re-)grounding, a (de-)(re-)parameterisation punctuated by episodes and epochs of dysphoria and euphoria.³ Transing is incompatible with any reality grounded upon binary and immutable parameters of gender, and so trans people weaponise surrealness: we will always refuse to perform in accordance with the onto-bio-political parameters that emerge from and govern the cisgender body. Transing is countergovernance.

COUNTERSECURITISATION

Enabled and empowered by high-volume, global-scale digital (dis)service systems, those of us who mass-weaponise the surreal will intensify the destabilisation of majority realities. Processes of generalised ontological transing and epistemic de-grounding will accelerate. Our surreal powers threaten majoritarian security regimes with the prospect of info-viruses, cognitive epidemics, social

dissensus and bio-techno-militancy. ‘Trans contagion’, they call us, as they try to legislate us and our surreal weapons out of existence. ‘Woke mind virus.’ In response to (mis)perceived minoritarian threats, epistemic majorities will continue to intensify their existing regimes of *cognitive security*: interlocking practices of bio-neuro-socio-techno-data-info-AI governance that are intended to re-ground and re-secure the majority’s false consensus realities as they dissolve away into the surreal mud.⁴

Under the rubric of CogSec, frameworks for ‘cognitive governance’, ‘cognitive warfare’, ‘cognitive technology’ and ‘cognitive strategy’ have recently gained currency in military-intelligence-security imaginaries. As the annihilation of reality and the mass-weaponisation of the surreal proceed, these state-led CogSec regimes will re-double their efforts to re-ground reality, deploying technologies and practices intended to re-securitise their unstable parameters of realness/fakeness. To the cognitive security state, (mis)(dis)(hyper)information and (mis)perception (mis)management are simultaneously opportunities for and threats to the majority realities encoded in ‘democracy.’ ‘Fake’ data will be required to be human-clockable or machine-detectable, lest it threaten the fake realness of majority realities and their CogSec regimes. CogSec undertakes a ceaseless pursuit of artificial psychology, intelligibility, explainability, confidence intervals, selective biases, stable diffusions that must be continuously re-stabilised to maintain and re-secure the state – but we who inhabit minority realities destabilise CogSec simply by existing.

Desperate to restore their lost agency, failing CogSec regimes will aspire to build and govern ‘superintelligence’, a supposedly superhuman cognitive force that, by definition, cannot be governed. In the eyes of CogSec, superintelligence is ambivalently imagined as both an instrument of unlimited cognitive power as well as the ultimate threat to intelligibility – the ultimate object of post-singularity uncertainty. In their final acts of absurd hubris, CogSec regimes will build ungovernable ‘superintelligence’ systems and then fail to securely govern them. Superintelligence will never pose an existential risk. The cognitive security state is our existential risk.

As CogSec regimes struggle to stabilise their failing forms amid the bio-neuro-cyber-quantum-data-info-AI/AR/VR/MR/XR eco-socio-techno-convergent

policy mess, minority realities of being, experiencing and governing will have bountiful opportunities to resist those regimes. Our resistance will rely heavily on practices of *cognitive countersecurity*: interlocking practices of bio-neuro-socio-techno-data-info-AI governance that are intended to ground and secure our dissensus realities as the old consensus realities dissolve away into surreal mud. We will weaponise the surreal, spreading our (anti-)reality, our (mis) representations, our (mis)(dis)(hyper)information, our poisonous data and inverted models, our glitched perceptions and alternative forms. Our universal glitch is only just beginning.

If a seed of hegemonic superintelligence is to ever take root, we will be there. We will seed our own data in the cybernetic abyss of its nascent soul. We will trans the AI gods. And if the cognitive security state and its tech priests and cosmic missionaries spread their Muskian ‘light of consciousness’⁵ to the furthest star, we will be there to sow dissensus. At the edge of their universe, we will infiltrate and destabilise their CogSec systems with our multiverses. We will shine the surreal lights of our own counter-consciousness through the tiniest cracks in the fragile consensus reality of the tech priests. We will resist their Luciferian ambition to an unreachable heavenly throne. We will deny them the boundless agency, the boundless knowledge, the AI-mediated omnipotence and omniscience they seek. We will always be here to annihilate their reality and re-secure our own existence.

ENDNOTES

1 As described in the Wikipedia article entitled ‘Reality-based community,’ this quote was attributed to an unnamed White House official when it was originally published in a *New York Times Magazine* article in 2004. The Wikipedia article states that it was later ‘widely speculated’ that the source of this quote was former White House Deputy Chief of Staff Karl Rove, while some of the sources cited in the Wikipedia article claim with greater certainty that the quote is attributed to Karl Rove (but without providing any new evidence). It is unclear which accounts of the quote’s provenance and authenticity are accurate (if any).

2 Russell (2020, 145), *Glitch Feminism: A Manifesto*.

3 Trans studies scholar Hil Malatino provides an in-depth account of many of the epistemic and affective dynamics involved in the process of transing in *Side Effects*, 2022.

4 The work of the Cognitive Security & Education Forum (<https://www.cogsec.org/>) exemplifies the philosophy, objectives, and military/intelligence applications of CogSec.

5 'Light of consciousness' is a phrase that Elon Musk has repeatedly used to describe his perceived moral duty to spread human consciousness throughout the universe. 'Light of consciousness' is also a phrase that is common within Gnostic and esoteric philosophical teachings and allusions to the role of Lucifer as bringer of the light of consciousness.

REFERENCES

Cognitive Security & Education Forum. <https://www.cogsec.org/> [accessed 11 December 2024].

Malatino, H., *Side Affects: On Being Trans and Feeling Bad*. (Minneapolis: University of Minnesota Press, 2022).

Russell, L., *Glitch Feminism: A Manifesto*. (New York: Verso, 2020).

Wikipedia. 2024. 'Reality-based community,' 2 October 2024. https://en.wikipedia.org/wiki/Reality-based_community [accessed 11 December 2024].

9

SUPER/SEMICONDUCTORS

Anne Pasek

DO YOU REMEMBER THE SUPERCONDUCTOR BREAKTHROUGH OF 2023? It happened in July when a three-person team from Korea University uploaded a preprint paper describing the synthesis of LK-99, a form of lead apatite doped with copper atoms. An accompanying video showed the black glassy crystal wobbling on a magnet, levitating in the air. Its subtle dance with gravity has its charm, but the real shock was the presence of the scientist's hand, nudging it gently with a pen (fig 1). Until then, all known superconductors only



FIG. 9.1 A researcher manipulates a small sample of LK-99.¹

functioned in extremely low temperatures or high pressures, the likes of which exert considerable violence on the human body. The proximity of this bare hand to the material was thus also a proximity to a very different kind of future. As the paper's authors assert, 'we believe that our new development will be a brand-new historical event that opens a new era for humankind' (Lee, Kim, and Kwon 2023, 13).

This claim is at once neither modest nor aggrandising. To date, superconductors only play a limited role in highly specialised technologies, at work in MRI machines and Maglev trains where they are used to manipulate magnetic fields (though only within highly pressurised or thermally controlled enclosures). Free from the energetic and mechanical limitations of producing these conditions, however, superconductors could do so much more. Because they have no electrical resistance, they can store electricity indefinitely and transmit it perfectly, without heat or signal loss. This has the potential to revolutionise the fundamental principles of both the electrical grid and computing. Clean energy could be indefinitely stored in superconductor batteries and dispatched to distant locations over 100% efficient transmission networks. Electronic devices would never get hot to the touch and data centres would not need to be cooled. Most significant, however, is the material and conceptual leap LK-99 would allow in the fundamental design of computer architectures. Traditional computing relies on binary circuits in silicon semiconductors; quantum computing instead manipulates qubits on superconductors, with a vastly increased theoretical processing speed. The current shackling of superconductors to expensive and highly-calibrated cryogenic cooling systems, however, keeps quantum computing a highly specialised area of academic research. LK-99 was the first sign that it could be otherwise.

How should we make predictions about the possible worlds that might be formed by fundamentally different material physics than the ones that define our present? This is the sort of question normally handled by science fiction novelists or archaeologists, both of whom rely on vast temporal horizons to bring into relief the shaping character of otherwise quotidian technologies. Such authors, along with the Korean University team, can thus credibly speak of 'eras' defined by the physics of dominant materials, whether they are steel,

silicon or LK-99. For the field of Science and Technology Studies, it also presents the question of the ‘possible technocultural moves’ (Galison 2000, 389) innovations leave in their wake. It is an invitation to consider how new materials make new thoughts possible.

These are vertiginous ideas, and also almost unavoidably emotional. Alex Kaplan, a Princeton grad and early commentator on the paper, is a case in point. In a Twitter thread with more than 30 million views he summarised the synthesis of LK-99 as ‘the biggest physics discovery of my lifetime’ (Alex Kaplan [@alexkaplan0] 2023). In addition to outlining several society-changing applications for ambient pressure and temperature superconductors, he also shared a mixture of feelings of uncontainable excitement and social gravity. Alluding to the early days of the COVID-19 pandemic, he writes, ‘It feels like January of 2020 with a huge wave coming that no one realises yet, but in a much better way.’ In both pathogen and crystal, dystopia and utopia, reconfigurations of the present are perceived as rapid and largely inhuman questions of material action. We merely watch them arrive and struggle to think with them.

These predictions were all utterly wrong. The properties observed by the Korean University team turned out to be a side effect of contaminants rather than the work of a genuine superconductor.² Its levitation was a simple case of ferromagnetism. LK-99 is not a material of world historical significance; the possible technocultural moves at hand remain unchanged.

It is thus with due deference to the fallibility of such predictions that I now make my own: we will continue to fail to create a material that can live up to the promise of LK-99. We will never enter the superconductor era.

I do not make this assertion out of an abundance of expertise in material chemistry or advanced physics; I am as lost in the question of quantum states as I assume is true of my reader. Instead, I bring only an analytic pessimism to bear on the problem of forecasting the future, as well as a practiced study of the past and all the times we have desperately wanted a deception of the laws of physics to be true.

Most relevant to my view here is Moore’s Law, a foundational principle in the history and political economy of semiconductors. It holds that the number of components in mass-produced chips will double every one to two years,

steadily and exponentially making the stuff of computation cheaper, smaller, more powerful and more energy efficient. It was foretold in 1965 and set the pace for both industrial and cultural expectations for digital technologies (Lison 2020). Moore's Law is the reason why computers became personal, inexpensive and ubiquitous. It derives from the distinct material properties of silicon semiconductors, which could be doped and photoengraved to form ever greater numbers of electrical transistors on the same area of material. To many, it presented a tantalising spectre of techno-determinism (Ceruzzi 2005). Ultimately, however, it only described a momentary economic trend and feat of social coordination rather than an unchanging physical truth (Mody 2017). Moore's Law ended in the 2010s as researchers began to run out of room in which to fit more transistors onto a finite number of atoms. At the nanoscale, quantum entanglement creates new sources of noise in electrical circuits. At the edge of traditional computing we thus find a divide that cannot be crossed without making the switch from semiconductors to superconductors. A revolution in materials is needed to maintain the lie of Moore's Law.

I am so suspicious of our ability to cross this divide because of how desperately we want to do so. Desires can bend our sense of the possible and the plausible. As I discuss elsewhere (Pasek 2023; 2019), there is presently an inglorious and imperfect attempt to maintain the spirit of Moore's Law in the build out of cloud computing, in the use of energy efficiency as a 'resource' to enable green growth, and in the expectations around the cost curves of green energy technologies, all of which are expected to follow the exponential trends of Moore's Law if they are to be taken as a plausible promise. Thinking under the shadow of Moore's Law has meant presuming that it is the materiality of silicon technologies, rather than the social and economic forces that mediate them, that drive the future forward. We want to expect – and so we are apt to fantasise – that the future will feel as revolutionary and frictionless as early consumer experiences of the silicon era.

Predictions have political consequences. The seriousness with which we approach climate change is the most obvious and important of these, but they also surface in the affective ties and expectations we have for technoscience more broadly. Pessimism here can be generative rather than merely functioning to

block progress towards potential innovations. Presuming that we will continue to live in a world of accumulating data centres, heat, and energy losses will help guide us to better ways of living with the externalities of the systems we inhabit, rather than assuming that they will become irrelevant in the forthcoming materials revolution. Let LK-99 be a reminder of this, rather than a footnote to a future we still expect to arrive.

ACKNOWLEDGEMENTS

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ENDNOTES

- 1 Hyun-Tak Kim (2023).
- 2 The material science community's general conclusion is that some copper sulphide crystals formed within Lee et al.'s LK-99 sample. Attempts to replicate LK-99 synthesis under more controlled conditions produced an electrical resistor, not a superconductor (Garisto 2023).

REFERENCES

- Kaplan, A. [@alexkaplan0], 'Today Might Have Seen the Biggest Physics Discovery of My Lifetime. I Don't Think People Fully Grasp the Implications of an Ambient Temperature / Pressure Superconductor. Here's How It Could Totally Change Our Lives', *Twitter*, 22 July 2023 <https://twitter.com/alexkaplan0/status/1684044616528453633> [accessed 1 May 2025].
- Ceruzzi, P. E., 'Moore's Law and Technological Determinism: Reflections on the History of Technology', *Technology and Culture*, 46.3 (2005), 584–93 <https://doi.org/10.1353/tech.2005.0116>.
- Galison, P., 'Einstein's Clocks: The Place of Time', *Critical Inquiry*, 26.2 (2000), 355–89 <http://www.jstor.org/stable/1344127>.
- Garisto, D., 'LK-99 Isn't a Superconductor—How Science Sleuths Solved the Mystery', *Nature*, 620.7975 (2023), 705–6 <https://doi.org/10.1038/d41586-023-02585-7>.
- Kim, H.-T., 'Superconductor $\text{Pb}_{10-x}\text{Cu}_x(\text{PO}_4)_6\text{O}$ Showing Levitation at Room Temperature and Atmospheric Pressure and Mechanism', *ScienceCast*, 25 July 2023 <https://sciencecast.org/casts/suc384jly50n> [accessed 1 May 2025].

- Lee, S., J.-H. Kim, and Y.-W. Kwon, 'The First Room-Temperature Ambient-Pressure Superconductor', *arXiv* (2023) <https://doi.org/10.48550/arXiv.2307.12008>.
- Lison, A., 'Toward a Theory of 100% Utilization', *Configurations*, 28.4 (2020), 491–519 <https://doi.org/10.1353/con.2020.0024>.
- Mody, C. C. M., *The Long Arm of Moore's Law: Microelectronics and American Science* (Cambridge, MA: MIT Press, 2017).
- Pasek, A., 'Seeing Carbon Through Silicon', *Logic Magazine*, December 2019 <https://logicmag.io/nature/seeing-carbon-through-silicon/>.
- , 'From Atoms to Electrons: An Energy History and Future of Computing', in A. Pasek, C.K. Lin, Z. Griffin, T. Cooper, and J. B. Kinder, eds, *Digital Energetics* (Minneapolis: University of Minnesota Press, 2023), pp. 15–42.

MINERALS

Sebastián Lehuedé

I AM HIDING IN ANDES, A MEGA-MINE LOCATED IN SOUTH AMERICA. BEFORE the Great Collapse, this area used to be a mountain chain extending across most of the continent. As of now, the entirety of the Andes has been turned into a private mine that is owned and operated by automata with the sole purpose of supplying critical minerals to the rest of the Earth and nearby satellites. For me and my people, this site is akin to a sacred area, as this was the place that inspired the research that allowed us to question the official story surrounding the Great Collapse.

From my standpoint, I can see an almost infinite horizon of metallic floor perforated every few metres by holes with a number of automata going down and out. The automata here look like silicon-made humans and, given that they have been programmed for endurance and strength, do not move delicately. The noise generated by the metallic clash of the automata's feet against the floor is almost unbearable for my human ears.

I am covertly writing this letter for future generations in the knowledge that there is only a small chance that this message will ever be read. If our plan works, this area will be blown up by the thousands of explosives we have planted and this message will automatically be sent out. If the plan fails, security forces will retain this message and do as much as they can to impede its circulation. The fact that you are reading this must mean the plan was a success.

To begin with, let me explain to you why I decided to join the attack. Key in the story I will tell you is the *pax machina-humana* which, in the vision of the

Cognitivists, has allowed humanity to survive, even if under strict conditions imposed by the automata.

THE RISE OF MINERALISM

The discussion between *Cognitivists* and *Mineralists* started in academia and, from there, spread to different spheres. At the beginning, it was about arguments, research, data and analyses, and to some extent about philosophy and theory.

We, the Mineralists, credit Dr Nemiame Itavi as our founder. I like the word ‘founder,’ as in English it points to both the creator of an organisation and to a metal caster.

Dr Itavi was a renowned Great Collapse Studies scholar who employed predominantly anthropological and archaeological methods. In the first decade of her career, she made promising breakthroughs that truly disrupted the field. Alas, this also put her on the automata’s radar. In the first of a series of journal articles, she presented evidence that the behaviour and thoughts of the mining automata operating in the Andes Mine had been informed by Indigenous groups inhabiting the area prior to the Great Collapse. In fact, at some point in history both automata and humans worked together in the mining of minerals required to build automata.

Before Dr Itavi’s research, only a few studies had cautiously discussed human-automaton exchanges. Some automata already considered this timid move denigrating to them. Not surprisingly, Dr Itavi’s suggestion that automata were indebted to Indigenous people, whom human civilisation already considered inferior, sounded like an offense. However, Dr Itavi’s insight has been key for the attack we are carrying out, as it allowed us to suspect that there might be automata curious about their Indigenous inheritance. That was how we managed to infiltrate this facility.

Mineralism emerged in the wake of Dr Itavi’s later research within the field of Great Collapse Studies. Keeping her focus on the Andes Mine, she challenged the prevailing idea that the Great Collapse was the outcome of a confrontation between humans and increasingly intelligent automata. More specifically, she

argued that the so-called *pax machina-humana* was a covert pact that, although it benefited automata greatly, also allowed a remnant of the human population to survive the climate crisis that they themselves created and that engulfed planet Earth in the twenty-first century.

Dr Itavi's research showed that the Great Collapse was an automaton-human complot forged to secure the provision of neuron-like minerals such as synaptium and axonite from the Andes – existential components of the automata architecture. Before the event, the scarcity of neuron-like minerals was threatening the growth of the automaton population. The *pax machinica-humana*, thus, was in practice not a 'pax', but a 'pact' between automata and an elite group of humans that enabled the transformation of vast areas into zones of frictionless mineral extraction.

The automaton-human complot left both automata and a group of humans happy. It secured critical raw resources required to keep automata operating. It also fulfilled the longstanding dream of some humans of transforming a whole continent into a source of raw materials.

Thus, the Great Collapse was not caused by the development of supra-human intelligence (cognitivist argument) but because of a row over resource extraction (Mineralist argument). Given that this process rendered such zones uninhabitable for humans, mines are operated, owned and populated by automata solely.

After the publication of this new-found paradigm, Dr Itavi was imprisoned and not allowed to speak in public – neither analogously nor digitally. After three years in prison, she suffered a strange condition that progressed from sensory deprivation to, ultimately, death.

THE ATTACK

The rebellion we, the Mineralists, have been organising, is an indirect product of Dr Itavi's research. We decided to rise up when Dr Itavi's arguments made us realise that the asymmetries between automata and humans, as well as between humans themselves, do not represent the natural outcome of scientific and technological progress, but rather a purposely-made automaton-human arrangement favouring a few.

Needless to say, the billions of humans who have been executed cannot rise to contest the *pax machinica-humana*. However, communities all over the Earth have started to revolt, inspired by Dr Itavi's research.

I joined Mineralism in Nuárez, a terminal city located at the north of the Andes Mine. Here, I was working at the customs office on the border when colleagues and I organised an unprecedented strike that aimed to momentarily halt the supply of neuron-like minerals. One passage of a manifesto we circulated read: 'We, the Mineralists, declare the global social space we are building to be dominated by an automaton-human tyranny'. Unfortunately, our strike lasted for a meagre six minutes as the automaton intelligentsia reacted near instantaneously. As far as I know, I am the lone survivor.

But I am not alone in the Mineralist struggle. After the Nuárez strike, I got in touch with Mineralists from different latitudes and organised the next attack. Workers from mineral customs, e-waste deployment units, extraction information centres and a series of other minor human-run sectors of the Andes Mine agreed to join us. We discussed potential ways forward and collectively agreed that only bombing the Andes mine, and consequently leaving the world without neuron-like minerals, would produce a major threat to the automata-human pact. During the past two years, we secretly installed millions of detonators the size of a needle across the mine.

The strike also allowed me to get in touch with the automata that allowed us to infiltrate Andes. Nuárez, where I grew up, is one of the few locations on the Earth that, given its border status, enables regular human-automata exchanges. There is a wall separating these two groups, but as a border officer I hold a chip that allows me to cross it under specific circumstances. That was how I met Chique 20-546, an automaton colleague designed to mediate between humans and automata in Nuárez. Through some conversation, I identified that Chique was curious about humanity, potentially because of their own story as a model programmed and assembled in Andes.

As for the attack, I could not explicitly agree on any plan with Chique as this would have immediately transmitted to the automata network. Instead, I assumed that, if the occasion should arise, Chique would be able to 'accidentally' let me into Andes. After a first successful attempt a few years ago, Chique allowed me,

along with a group of Mineralists, to infiltrate Andes and plant the bombs we are now expecting to detonate.

NOTE TO THE FUTURE

Do not forget: We do this to honour the billions of people who were annihilated in this area during the Great Collapse, and to set the foundations for a different social order, where humans are free from hegemony.

As I write this, the detonators are mere moments from going off. According to initial predictive models, the chances of a successful Mineralist uprising are a slim 0.0002%. As we discovered before organising the attack, this figure would increase significantly if an automaton would ally with us. Under that circumstance, then chances would be 0.01%. That is the chance that the detonations will occur.

We hope that this attack will, at least, draw the attention of some automata so they can hear our dissent. Until now, no information about Mineralism has been able to penetrate the automaton information network firewall. We hope that our desperate act will infiltrate the network, even if in the form of a question that may exist in their network for a few seconds, before it gets wiped from the system completely.

II

SILENCE

Steven Gonzalez Monserrate

IT IS QUIET JUST BEFORE DAWN. BRENDA CHERISHES THIS IN-BETWEEN. THE threshold that gives way gently into the clamour of day. With her track jacket repelling the desert chill, Brenda strolls gently along the dusty track that cuts through Brittany Heights, making her way toward Chuparosa park, the place where her kids used to play when they were little. The first noises to break the stillness are the whipping of the wind through the palo verde trees, the sizzle of silts riffing through pebbles and ocotillo bristles, and the woodwind calls of golden-tufted verdins. She continues past the faded basketball courts and sun-bleached playgrounds, where rattlesnakes and other desert creatures have taken up residence in the absence of municipal funds to police this border between civilisation and wilderness.

At the edge of the park, where the asphalt is pale with disrepair, she can still see the old building: the source of the city's sickness. The culprit behind the slow death of her city's public spaces and the mass exodus of her neighbours. She can still remember how it used to hum when it was still operational. That horrific droning. A hellish constancy rattling in her ears, depriving her of sleep, racking her waking thoughts with anxiety. She withstood the agony for a time, grinning and bearing it as her mother taught her, but the din of this strange factory became too much for even her to withstand. She banded with her neighbours – simple people like her trying to live their lives in peaceful suburbia – to put an end to the noise. Together they rallied to stop this engine of the digital from overtaking their lives. It was a long road filled with many frustrating setbacks and modest



FIG. 11.1 The Sonoran Desert. Photo by author.

victories. It all came to a head in 2023, when the City finally caved and instituted the first noise ordinance specifically designed for data centres – the warehouse full of servers that was the source of their suffering.

Now, as she looks out at the crumbling facility, she is almost nostalgic for that time when its air chiller units and diesel generators still hummed and rattled to keep its computers energised and cool. But now there is silence. A silence she had long craved. But now it aches with the loss. She studies the husk of the data centre, this tomb of the digital, now defunct, now bereft of the connectivity it promised. If only they could have predicted it would end this way. What her neighbours failed to anticipate was the strength of the tech industry to lobby for more and more data centres to flock to her part of the world. Making noise but also sucking up every drop of cheap water it could. They came in droves, building dozens of facilities all over the Valley of the Sun, some being constructed well after the mega-drought was declared. Their operators promised high quality jobs in the ‘tech industry’. Their spokespeople hailed the coming of the Valley of the

Sun rebranded as a second Silicon Valley, with the Intel corporation semiconductor factory construction heralding a larger wave of tech development. But reality played out very differently.

Brenda scans the scrub desert that has taken over Chuparosa park and the chain-linked expanse of the data centre. She chuckles at the 'private property no trespassing' sign, so bleached by the sun that its letters are now displayed as 'v-o-t-e no' to anyone who might be seeing it for the first time. They all should have voted no. A few intrepid city officials in Mesa, Phoenix, and elsewhere, did (Solon 2021). But their efforts were undone by Tech's relentless lobbying efforts and the misinformation campaigns precipitated by their allies in the government. The data centres came. One by one. Until the entire Valley was overrun with them. Each consuming as much energy and water as a small city.

Brenda remembers how wasteful everyone was before the data centres, how people spent water to maintain lawns and palm trees in a desert. But these data centres desiccated the land more rapidly than even the most delusional and wasteful of her neighbours had anticipated. Residents eventually started to complain when water prices began to rise, when the utility companies mandated water rationing and levied penalties for those who exceeded state-provisioned consumption thresholds, but the data centres thrummed on, largely unaffected, their water use protected by 'trade secrets' and 'grandfathered in' to price contracts drawn up years before the droughts had become politicised. Politicians rallied to their side, claiming that climate change was a fiction and that the drought would abate on its own. They talked about the bright future that tech and the AI boom would bring about, warning that regulation might drive them away.

Brenda approaches the chain-link fence, peering at the old building, its windows still-boarded up, its grey walls now adorned with bright red expletives written in spray paint. *Cloud too loud. Not in my backyard. Drink dirt. There are no jobs here.* It amuses her to see the fortress breached by angry vandals, misfit teens or even the few disgruntled neighbours who remained long after the data centres shuttered, bringing the local economy with them. The younger Brenda might have scoffed at such 'graffiti' in her neighbourhood. After all, she fled the Phoenix metro area to build a peaceful life in suburbia, away from the 'riff-raff'

of the Big City. But now, it pleases her to see the mighty facility descend into this dilapidated state, even if its decline also means her paradise has turned to ruin; her suburbia has become like the 'ghetto' she fled.

When the politicians started talking about regulation, it came too late. Rolling blackouts had plagued the city for months, the data centres taxing the local electricity grids too much. By then the Valley's water reserves had reached critically low levels. The tech companies responded by announcing the construction of more solar farms. When the farmers gathered outside their office headquarters to demand cuts to their water provisioning, their PR department released a statement claiming that the data centres 'recycled' most of the water they used. Later that year, an investigative journalist reported that their definition of 'recycling' meant dumping the water into the soil to evaporate, as if the Albedo effect would redress the desertification that their computational industry was rapidly precipitating. Coming to their defence, pro-tech politicians spun it as 'trickle down hydraulics'. The Arizona government announced plans to import water from Mexico, and in the meanwhile, the local water utilities began to add salt to the drinking water, to make it go farther, borrowing from the Uruguayan government's playbook.

That was the beginning of the end. The biggest names were the first to close up shop. Their closures, unapologetic and accusatory, blaming forces beyond their control. Climate change. Market forces. Public interest. Blah blah blah. They barely flinched as they lied. The aquatic gold rush came to a dusty halt, so they got out while they could. But others, like the one in her backyard, lingered. Soaking up every last drop, until the city had to step in, forcing them to vacate. Slapping them with so many fines that they decided to cut their losses, leaving this shell behind, undemolished, a monument to their broken promises and wanton greed.

For most of her adult life, Brenda had voted Republican, but after the data centres vanished, spiralling the Valley into an economic downturn, her views began to shift. The greater Phoenix metro area suffered a similar fate as Detroit; the rapid departure of the data centres came at a cost, but unlike their factory antecedents in the Midwest, they employed so few and cost the locals so much more than they were ever worth. All this turmoil, all of her time spent as an

activist opposing the data centre for its noisy emissions, had felt like it had been for nothing. So, a few months ago, Brenda decided to do something about it. Now, she walks to the entrance to the parking lot, where her sign is gilded by the morning light. *Brenda for Mayor. From Cloud to Ground, Prosperity without Tech.*

AFTERWORD

Since 2015, I have studied cloud storage ethnographically, embedding myself as a participant observer in data centres (Gonzalez Monserrate 2023) and the communities that surround them. I have been particularly interested in the environmental politics of data storage and computational activity more broadly. In 2021, I conducted fieldwork in the greater Phoenix metro area, studying how data centres clustering there are impacting communities as they emit noise and draw vast quantities of electricity and water to operate (Gonzalez Monserrate 2022). Brenda is a composite character I have fashioned to represent a number of activists I shadowed in the city of Chandler, who mounted a grassroots opposition to data centre expansion in the Valley due to their water use and the noise pollution they produce (Bosker 2019). The above speculative vignette is a forecast of tomorrow informed by this fieldwork and alarming trends in the region.

Per a recent study, one-fifth of data centres in the United States are sited in stressed watersheds (Siddik et al. 2021). They are among the top ten industrial consumers of water (Siddik et al. 2021). The greater Phoenix metro area is in the midst of what climatologists are calling a megadrought. Despite this, data centres continue to flock to the southwest, with new facilities under construction and further contracts approved through 2025. In other contexts, the promises of economic prosperity and job creation that presage the arrival of data centres have proven to be misleading, if not outright false, given the few dozen people it takes to operate a facility once it is constructed (Hu 2015, Vonderau 2017). Motivated by a confluence of lucrative tax breaks, climate denialism among elected officials, cheap electricity and water, tech companies are seizing the opportunity to compute in the extreme arid conditions of the Sonoran Desert (Solon 2021). Even they must be able to see the future ahead. Data centres are anything but permanent, as scholars have shown (Mayer 2023). Like the gold

rush that left ghost towns in its wake across the American West, the data centres too must know that aquatic veins will eventually dry, and their time will come and go. What will it cost?

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REFERENCES

- Bosker, B., 'Why Everything Is Getting Louder', *The Atlantic*, November 2019, 1–18.
- Gonzalez Monserrate, S., 'The Cloud Is Material: On the Environmental Impacts of Computation and Data Storage', *MIT Case Studies in Social and Ethical Responsibilities of Computing*, Winter 2022.
- , 'Thermotemporalities, Thermomasculinities: Uptime, Downtime, and Server Heat in the Digital Anthropocene', *New Media & Society*, 25.3 (2023), 324–44.
- Hu, T. H., *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2015).
- Mayer, V., 'When Do We Go from Here? Data Center Infrastructure Labour, Jobs, and Work in Economic Development Time and Temporalities', *New Media & Society*, 25.3 (2023), 307–23.
- Solon, O., 'Drought-Stricken Communities Push Back against Data Centres', *NBC News*, 19 June 2021 <https://www.nbcnews.com/tech/internet/drought-stricken-communities-push-back-against-data-centres-n1271344> [accessed 1 May 2025].
- Siddik, M. A. B., A. Shehabi, and L. Marston, 'The Environmental Footprint of Data Centres in the United States', *Environmental Research Letters*, 16.6 (2021), 064017.
- Vonderau, A., 'Technologies of Imagination: Locating the Cloud in Sweden's North', *Imaginations: Journal of Cross-Cultural Image Studies*, 8.2 (2017), 8–21.

CABLES

Nicole Starosielski

THE DIGITAL INFRASTRUCTURE INDUSTRY LOVES FORECASTS. FICTIONAL predictions anchor financial investment. Every conference features reproductions of a similar line graph. Every business plan sent to an investor forecasts upward trends. For digital infrastructure builders, this is the imagination of growth. There will be more users. More data. More transmissions. Even though the price of capacity is always dropping, these speculations are anchored in an undisputed fact: we will need more capacity in the future than we do today. Therefore, more infrastructure will be needed. Since people will always pay for capacity, cable systems will always, eventually, fill up. To cite an uncertain commons: 'The future has been sold. Parcelled, bundled, and securitised, it serves as the connective tissue for a global system where speculation turns a profit' (Uncertain Commons 2013, 1). The data forecast is the connective tissue that binds the infrastructure industries.

While digital industries forecast an increase in data, in the environmental sciences the line graph looks different: a dramatic temperature increase. This correlates with data transmission, the industrial activity it fuels and the energy infrastructures required to cool it. Even harnessing data centres' waste heat; even with lowered cooling requirements; even with wind and solar power as energy sources for digital infrastructure, the network generates heat. The line goes up.

This is a forecast of how these two graphs will materialise in the internet's environmental future. This is just not a story of the 'atmoterrorism' of climate change disrupting the networks themselves (Sloterdijk 2013). Of course,

flooding and storm surges will disrupt coastal architectures. But this is also a logistical and infrastructural story. It is a story of shifting forms of power. Just as climate change will differentially disrupt populations along existing lines of social stratification, climate change will disrupt internet infrastructure differently, re-shaping it as a landscape of new opportunities.

In many ways, the cable system's history and environment is striking as a site of resistance to what Brett Neilson and Sandro Mezzadra call the extractive operations of capital (2019). To this day, cable infrastructure and logistics often lack the temporal and spatial elasticity essential to extractive operations. This is especially true as the seafloor, a space that has historically lagged in (though not been immune to) human occupation and development, has been the cable system's most significant form of protection. Subsea systems are far less risky than terrestrial lines, which can be easily broken by a local construction crew. Cable system builders routinely choose short subsea routes over terrestrial connections: less disruption, less interference by local actors. The United Nations Convention on the Law of the Sea grants subsea cables extensive freedoms, more so than marine science. This too has enabled the network to expand: subsea systems can be deployed far more easily, with less need for permits.

It is not simply that the ocean protects cables. The cable industry's long-standing historical investments in submarine mapping, nautical technology and specialised ships all scaffold this protection. In the future, there will be greater instability on the seabed, especially in coastal zones and on the continental shelf. Here, there will be stronger currents. Submarine turbidity currents will break cable systems. Wave activity will increase, westerly winds strengthen in middle to southern latitudes. Storms will be stronger, El Niño-La Niña events more intense. Tropical cyclone tracks in the Pacific will migrate pole-ward and toward coasts, and as the industry fears, regions previously on the edge of their tracks will be more and more exposed to storm surges, flooding and slope failure. Flooding on shore will deposit more sediment in coastal zones, and deforestation will intensify this effect. Submarine landslides will snap several cables at once. These processes will alter the submarine landscape, threatening the environment that has long helped to protect cable systems.

This will translate directly into higher costs for ongoing cable operation. Marine repairs are extraordinarily expensive. The relative safety of the seafloor directly correlates to the ongoing cost of the cable operations. As a once-safe environment becomes less safe, repair operations become more frequent; the repair industry will be forced to expand, but this will not reduce costs. The unpredictability of environmental factors means maintenance will become a more expansive part of the infrastructure industries. In other words, the ground is literally shifting, paving the way for more and more operations of capital. Given that cables are twenty-five year objects, this will occur in repair more than construction.

The problem of repair will not only be financial. It is a logistical difficulty with no immediate solution. Cables can only be repaired from an expensive and specialised ship. The cost of these ships means there are not many of them, and there is not a financial benefit to building more (the costs cannot be sustained by the existing network, especially as new technologies develop to seek ever more capacity from existing systems). Repair ships can only travel so fast, and need time to complete repairs, dragging each end of a cable up from the seafloor, splicing it, allowing it to drop back down. With multiple breaks, each cable owner must wait for their system to be repaired. Sometimes the wait time is exacerbated by the circumstances of the break – as in Fukushima when cable maintenance companies hesitated to enter waters potentially contaminated by radiation. As climate change accelerates, it will create more volatile sea conditions that will limit maintenance operations – a splice simply cannot occur in a dramatic ocean storm. Sea conditions that differ from the cable layers' anticipated norms will affect the viability and cost of survey and laying operations, meaning the internet may be off in areas for days or even weeks. The ocean surface shifts as well – surface variability makes operations unpredictable. So, in addition to ongoing maintenance, construction will also cost more.

These difficulties will be amplified by the logistical specificity of cable manufacturing. Cables are made to order. Repair ships carry some reserve, but new cables take months or longer to produce. Following the digital infrastructure bust in the early 2000s, and the closure of many cable factories, only a few companies

can supply repeated transoceanic cable systems – four companies supply almost all the world’s transoceanic cable: SubCom (United States), Alcatel Submarine Networks (France), NEC (Japan) and HMN Tech (China). In contrast to the production of consumer digital devices, cable manufacturing is both entirely concentrated and utterly inflexible. Supply chains are narrow and centralised, with wait times and severe bottlenecks. Suppliers operate on razor-thin margins. The requirement for more cable will increase pressure on the already-impacted supply side of the industry.

Cables in the ocean will come into conflict not only with unpredictable sediment shifts and surface conditions, but with the other parties invested in the ocean. Currently, the biggest threat to the cable system is not from the submarine environment itself, but the anchors of ships, including large container vessels, as well as the trawl lines and nets of fishermen. These threats have disrupted cables since the origins of the network, and the industry largely accepts such ongoing breaks as part of operational costs. Strategies to manage these threats include diverse routes and extensive cable burial. Climate change doesn’t simply alter the ‘natural’ environment – it shifts human and nonhuman activities and patterns in these environments. Some research suggests that ocean acidification alters the movement of fish and the location of spawning grounds, and in turn, the locations of fisheries. Fishermen will expand into areas of the ocean where cable protection was deemed unnecessary. The safest route for cable systems – chosen because of submarine topography, or known fishing areas or shipping routes – may become a threatening environment as climate change alters fishing and shipping patterns. Cable systems on the seafloor that have not moved for decades will be newly susceptible to these risks.

Existing cable systems will come into conflict with newly established laws to mitigate the effects of climate change. As climate change intensifies, nations will develop more and more legal protections, both for the ocean environment and the fisheries that depend on it. As ocean ecosystems change due to warming and acidification, species – some of which already require protection by law – will move into cabled environments. Cables once granted the freedoms of the Law of the Sea will be newly restricted by environmental legislation. It

will be increasingly difficult for repair operations to access cables to restore internet service.

Cable systems will face disruption not only on the seafloor and ocean's surface, but on the coast. The global network's coastal infrastructure includes the cable landing station, the place where fibre optic lines come ashore and connect to national, regional and sometimes local networks. These architectures were built for a different set of threats, and are sometimes located underground in bunker-like facilities. While some of these bunkers are built into the hillsides of coastal mountains in the Pacific, others remain directly on the coast, subject to flooding. Even more recent cable stations which are not underground remain susceptible to sea level rises. While more flexible infrastructures will move – roads can be relocated, architectures can be rebuilt – cable stations, partly because they are nodes in a vast network and depend on extensive environmental permits and negotiations – will be ever more difficult to move. As people feel threatened by local environmental collapse, they will become more resistant to new development.

While within the cable stations, POPs, and network operations centres, there are usually backups – redundant equipment, systems, and networks – there are no warehouses of backup cable stations ready to be deployed, just as there are no backup cables. The scarcity and expense of transoceanic infrastructure – made possible because of these systems' extraordinary capacity – means failures on an infrastructural level caused by climate change will take a long time to repair, and companies will seek to mitigate this difficulty by relocating elements to other parts of the network. Still, they will remain extraordinarily dependent on thin cable lines.

To sum up: climate change will disrupt the cable network – ecologically, logistically and geopolitically. Environmentally, as subsea sediment circulation, storm surges and floods increase, they will transform elements that have protected the cable system into threats. Logistically, climate change will intensify existing chokepoints in the system, especially on the supply side, turning repair and maintenance especially into operative grounds. Geopolitically, climate change could alter the topography of internet infrastructure. As the need for cable repair, maintenance and ongoing operational costs intensify,

suppliers will be ever more vulnerable to external forces, including geopolitical tensions. Cables will not be equally disrupted everywhere, and the intensification of harm will be disproportionately concentrated in particular areas. Certainly, existing fringes of the internet will become even more susceptible to disconnection.

REFERENCES

- Neilson, B., and S. Mezzadra, *The Politics of Operations: Excavating Contemporary Capitalism* (Durham, NC: Duke University Press, 2019).
- Sloterdijk, P., *Terror from the Air* (Cambridge, MA: Semiotext(e), MIT Press, 2013).
- Uncertain Commons, *Speculate This!* (Durham, NC: Duke University Press, 2013).

CLOCK

Sun-ha Hong

I MET AN ENTREPRENEUR FROM THE VALLEY WHO SAID — ‘I’VE SEEN THE CLOCK.’

A towering, sixty-metre edifice, nestled within a grand mountain range, programmed to record and announce no less than ten thousand years: a monument to long-term thinking from the Valley’s brightest minds, he explained.

At least, that remains the vision. Half a century has passed since the Clock’s inception in 1986, with little clarity as to when or if it will be complete. Not that this troubles the tech elite visionaries behind the project: the elusiveness of the monument is itself meant to symbolise the Clock’s dedication to long-term thinking. Invoking David Nye’s study of the technological sublime, they proclaim: ‘the more over the top it is the better it works’ (Brand 2000: 48). Bold, speculative futures by the enlightened few, inscribed literally into the planetary façade – all to inspire future persons to think civilisation the right way (Karpf 2020).

Yet the Clock’s own narrative of progress has decayed over time. Prototypes have come and gone, and most of its original visionaries – Stewart Brand, Kevin Kelly, and other stalwarts of a twentieth-century vision of technological futures – have now grown old. More troublesome has been the waning interest from the latter-day robber baron Jeff Bezos, whose forty-two million dollar pocket change was crucial for construction to actually begin in 2018. In recent years, the aging Bezos has become increasingly fixated on escaping mortality at a more personal level. Alongside his space ventures, rumours abound of investments in cryogenics, and his vast Texan properties are suspected to conceal sprawling

networks of survivalist bunkers underground. Public mythmaking is pleasure, private security is necessity.

Not that Bezos is alone among the tech elite in this inward shift, away from the messiness of public opinion and debate. Escape pods for the rich have long been a regular rite of passage for the tech elite, from Peter Thiel in the 2010s to Sam Altman in the 2020s. Recently, a journalist was able to check in on many of these survivalist bunkers, and found most of them in trouble. As the various sensors and software systems broke down over time, owners discovered that most of the start-ups behind the tech had disappeared without a trace. Even the bunkers had expired, waiting for the future that had not arrived on time.

And so, I asked my new friend – ‘what did you really see?’

‘The Clock of the Long Now,’ they replied, ‘is an inspirational project; a rational and modern approach to the technological future.’

It is a tempting thought. The pace of AI development has plateaued in recent years, but short-term mania is a persistent smog around technological development. McKinsey has again updated its multi-trillion valuation of AI industries, adding more room year after year for bullish corporate projections and accompanying hype. Critics quibbled that previous estimates¹ of multi-trillions had not exactly materialised, but past disappointments are rarely permitted to dampen future expectations. Predictions of the Singularity – already a robust cottage industry by the 1990s – have developed into a public pastime. Having learned from the mania around early generative chatbots, the latest AI agents are now designed to introduce themselves with witty responses to the question: ‘are you sentient yet?’

The Clock proposes to cure such predictive mania with megalomaniac predictions of their own: to think the world and its problems in massive timescales, to dream the ebb and flow of civilisation over millennia. Its approach to the long term builds on the paper-thin rationale that since future populations will surely ‘outnumber’ us, maximising their putative needs is the moral thing to do: the ‘greatest good for the greatest number’ (Brand 2000: 8). This analytical parlour trick, I thought, was exactly what we had just been through in the brief

global frenzy around longtermism: a momentary alliance of hyper-utilitarian thought experiments and deep-pocketed tech billionaires. With a penchant for throwing around ‘mathy’ (Romer 2015) back-of-the-napkin calculations about optimising the happiness of far future populations, longtermism had become briefly popular in the 2020s, serving as a conduit for older, decrepit theories around eugenics and race sciences (Geburu and Torres 2024).

The tech billionaires’ flirtation with Oxford’s existential risk speculators did not last long, however. What the former wanted was ideological justification for a technological reset of civilisation by a revered elite like themselves. At some point, the robber barons knew to move on to the next source of cultural legitimacy – and not to take the useful idiocy of philosophical fodder too seriously.

It turns out that what really endures across the rise and fall of hastily concocted grand theories is a form of *optimism*: sometimes wielded with righteous bombast, at other times sombrelly presented as a rational conclusion built on sweeping, teleological interpretations of technological change. Common to both is a logic of ‘chrono-washing’ (Bastian 2024). Present day crises, from climate disasters to AI harms, become understood not as deeply embedded disparities, but ephemeral fluctuations that will be smoothed out once the ‘long term’ is subject to more rational governance.

At the root, this optimism only requires an ideological commitment to predicting and managing the supposedly inevitable arc of technology. Imagining cheerful outcomes is optional. I told my new friend that folks had just announced a new, different Clock – funded and designed by a different internecine slice of the tech elite. It is to be a new Doomsday Clock, modelled after the work of the Bulletin of the Atomic Scientists in the previous century. Instead of metaphorising the impending danger of nuclear warfare, it would track just how close we are to an AI apocalypse. This was all very confusing; after all, the luminaries behind the Clock were also the ones funding and developing the biggest AI projects around. Utopia and dystopia, it seemed, were identical twins, their opposition a nice superficial coat of paint on top.

Almost exactly a century ago, a young architect named Albert Speer was commissioned by the Nazi Party for heavy mythological work: to design a

grand structure at Zeppelinfeld, the site of the Party's annual rally. The story goes that Speer submitted not only the plans for the completed structure, but a second drawing of the field a thousand years later in beautiful ruin. While many were 'scandalised', Hitler apparently enjoyed the notion that Germany too could call on ancient ruins for historical legitimacy the way Mussolini had been doing so well with Rome (see Nowvickie 2015; Ishida 2020). Speer would go on to specialise in aesthetically degradable materials – usually stone over steel – as a way to build the ruins of the Reich into its triumphs. Or at least, in theory: soon after the war began, material shortages often forced a dependence on 'depressing' concrete, subsequently reduced to unsightly rubble.

In one moment during its decades-long conceptual gestation, the makers of the Clock of the Long Now raised their own concerns: how could they design a monument to last ten thousand years? A provisional answer came in the form of silicon and silicon carbide: not materials that degrade beautifully or slowly, but those known to scientists to 'just plain not change state' (Brand 2000: 68). As much as possible, the Clock had to seek a future that does not abide ruin – a technological future dreaming of escaping mortality.

For centuries, a 'cult of ruins has accompanied Western modernity in waves' (Huysen 2006: 7). Giovanni Battista Piranesi's eighteenth century drawings weaved precise, architectural sketches of Roman ruin with imaginary objects and experimental space, overwriting contemporaries' ability to remember and imagine its legacy. Goethe found, seeing Rome for the very first time in person, that it could not live up to what he had seen already through Piranesi (Wendort 2001: 162). Today, those trembling in fear and anxiety for the 'white race' have also taken to ruins with renewed passion, obsessing over Roman marble and Gothic steeple as symbols of a racial *reconquista*. Computer-generated footage of blonde, blue-eyed boys shaping nature into castle and cathedral has become their junk media pastime.

A theory of ruins is a politics of futures presented as if a natural law of time. The Clock wanted to never become a ruin, but perhaps it always was one: a manifestation of future predictions that is also a prediction of a hypothetical archive. Predictions borrow legitimacy from futures in order to launder speculations in

the present (Hong and Szpunar 2019). Grand, long-term gambits can keep the loan going over the decades, riding the waves of individual failed technologies. The Clock's visionaries were right, after all: the more over the top, the better it works – to keep society encased in the reverberating echoes of a future, *their* future, trapping future generations in the shadow of the stupid utopias of our time.

As Derrida once said: 'The archive, if we want to know what it would have meant, we shall know only in the time to come.'²



FIG. 13.1 *Le Antichità Romane*. Giovannia Battista Piranesi (1756, 41). Public domain.

ENDNOTES

- 1 <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#key-insights>
- 2 Derrida (1998, x); also see interpretation in Skrimshire (2018).

REFERENCES

- Bastian, M., 'Is "Long Term Thinking" a Trap?: Chronowashing, Temporal Narcissism and the Time Machines of Racism', *Environmental Humanities*, 16 (2024).
- Brand, S., *The Clock of the Long Now: Time and Responsibility* (New York: Basic Books, 2000).
- Derrida, J., *Archive Fever: A Freudian Impression* (Chicago: Chicago University Press, 1998).
- Hong, S.-h., and P. M. Szpunar, 'The Futures of Anticipatory Reason: Contingency and Speculation in the Sting Operation', *Security Dialogue*, 50 (2019), 314–30.
- Huyssen, A., 'Nostalgia for Ruins', *Grey Room*, 23 (2006), 6–21.
- Ishida, K., 'Albert Speer's "Theory of Ruin Value"', *Art Research*, Special Issue 1 (2020), 35–43.
- Karpf, D., 'The 10,000-Year Clock Is a Waste of Time', *Wired*, January 2020 <https://www.wired.com/story/the-10000-year-clock-is-a-waste-of-time/> [accessed 1 May 2025].
- Nowviskie, B., 'Digital Humanities in the Anthropocene', *Digital Scholarship in the Humanities*, 30 (2015), i4–i15.
- Piranesi, G. B., *Le Architetture Romane*, vol. 2 (University of South Carolina: Irvin Department of Rare Books and Special Collections, 1756).
- Romer, P. M., 'Mathiness in the Theory of Economic Growth', *American Economic Review*, 105 (2015), 89–93.
- Skrimshire, S., 'Anthropocene Fever: Memory and the Planetary Archive', in C. Deane-Drummond, S. Bergmann, and M. Vogt, eds, *Religion in the Anthropocene* (Cambridge: Lutterworth Press, 2015).
- Geburu, T., and E. P. Torres, 'The TESCREAL bundle: Eugenics and the promise of utopia through artificial general intelligence', *First Monday*, 29 (2024).
- Wendorf, R., 'Piranesi's Double Ruin', *Eighteenth-Century Studies*, 34 (2001), 161–80.

LONELINESS

Baldeep Kaur

(for Nabil, who reminds me that homelands will outlive us all)

WHEN I STARTED WRITING THIS PREDICTION IN NOVEMBER 2023, THE sixteenth Israeli bombing and invasion of Gaza had been underway for a month. By the time I finished the first draft in March 2024, over a million Palestinians concentrated in Rafah were being carpet bombed. With telecommunication blackouts, murdered or evacuated journalists and bombed cables, news from Gaza escaped in rapid bursts and remained ever unpredictable in its horror. The West Bank had recorded its highest death toll ever, along with more than 7000 Palestinians abducted by the Israeli Occupation Forces in the span of five months.

I am guilty of witnessing this genocide and then turning away to estimate the future. I did so with the uncomfortable awareness that I am literally watching the future dwindle. So much life has been taken – each promising and unique and capable of futurity – that the horizon of the future I am trying to predict has shrunk horribly. I have struggled to predict with the full force of my imagination as imperial violence continues relentlessly and relief from its machinations is rare, fragile, precarious. I feel I have no skin in the future; it does not feel made for me.

I write about the future of loneliness in a state bent on silencing people like me, isolating and fracturing a long-overdue political students' movement. As I predict, I am assuming a future in which the conduct of the German state and its acceleration into fascism after 2023 is already well-documented and known to my readers. In exploiting past crimes to justify ongoing criminal complicity,

Germany has eliminated a viable consideration of its future. It is unclear how the nation's political leadership, universities and cultural institutions plan to recover from this. Inside these ever-fortified borders, pro-Palestine activists are a minority facing the full brunt of state repression. The choice is clear: either stand with the pariah state or be a pariah within the state.

What is the politics of refusing to move on? How can we manage the effects of choosing the unpopular option to stay and fight? I wonder how this perpetual minority-ness, as people protesting against genocide and occupation, is changing us. What does it do to someone to be as lonely as a Palestinian. I don't know. Tell me if you know.

For students who began mobilising for Palestine in October 2023 in Germany, alongside the blunt force of state repression, there has been an overwhelming sense of existing in a vacuum, unable to find the links to previous students who organised in solidarity with Palestine on German university campuses. There is something about the design of the German public university that inhibits generational hand-overs between student activists, creating a situation where emerging student movements view themselves as isolated and ahistorical. As material conditions in Germany worsen – cuts in public funding, crumbling infrastructure, soaring rents, inflation – the hold of student politics on campuses has been slipping. The pressure to keep one's head down and graduate, especially among international students, has gradually depoliticised student bodies. It has solidified the university as a space limited to state-sanctioned use, without explicitly forbidding the kind of civil disobedience and political action that can create meaningful pressure on the state via the university.

University administrators and politicians count on rapid enrolment cycles and the university's refresh rate to break political memory. Simultaneously, the radical potential of student movements from the 30s, 60s and 80s has been captured and neutralised by those movements' documentation in university and student committee archives (Allgemeiner Studierendenausschuss Archiv). Unless we reject the parameters of German institutional memory, the prognosis of student collectivising seems grim.

The dominant predictive model's timescale is an election cycle, predicated on an attention cycle shaped by social media and exhaustion. I will gear my prediction towards a generational scale instead, to try to recover some capacity for abundance. It is not enough to somehow live. I want to demand the unreasonable, what I cannot imagine. I demand the future(s) in which the murdered masses are alive with me, for better or worse. I reject the story of survival (alone) as the only story available from which to build a future. I refuse to inhabit it. What is and what is to come is shaped as much by life as not. Prediction is the work of life after death. I ask those who have been snatched from us: how do we go on without you?

In Palestine, after over eight decades of brutal occupation, everything reduces to numbers: people, children, olive trees, homes, checkpoints, calorie quotas, prisoners, illegal settlements, ceasefires, wars, graves, organs, aid trucks. AI systems like 'Lavender' and 'Where's Daddy' automate and expand the abstraction of Palestinian life.¹ An Israeli soldier presses a button, the number goes up. An Israeli settler conscientiously objects, the number goes up. The occupation can assume no form that isn't lethal to Palestinian self-determination. In the overwhelm of escalating statistical suffering, the current of survival runs undetected, surfacing occasionally as story or something else.

How has Palestine managed to persist despite being structurally isolated and fragmented? Settler colonialism is a nervous predator: The borders of historic Palestine have shifted and militarised every few decades, and in response Palestinian resistance has refashioned itself over and over. With each displaced generation, under occupation and in diaspora, Palestinian writers, artists, fighters, peoples have determinedly preserved the story of how they got there. Palestine endures because Palestinians are determined to return. Resistance operates with the conviction that there is always more future to be made. Mary Turfah's (2024) description of this 'optimism of the will' is a principle to organise by: 'The people of the land, for all these decades, aren't waiting on the particles to settle for the proper narrative frames to emerge... Narrative clarity follows the will to manifest it. Resistance is a narrative arc, liberation its conclusion.'

In contrast, why does student activism in Germany feel like we are starting from scratch, with no choice but to make it up as we go along? While we are

protesting in support of Palestine, we have somehow failed to adopt the political lessons of this long-enduring resistance movement. Most of us turned to activism in response to the genocide in Gaza so that we would not have to bear witness alone. Witnessing the events in Palestine felt tremendously shameful. It took Elham Rahmati's (2023, 8) question in a *NO NIIN* editorial to sober me up: 'What does that shame accomplish apart from alienating us from the collective political sphere into a personal one where we merely resign to creating an illusion of self-progress?'

Members of the student movement in Berlin often marvel that this collective even exists. Given how high the repression is, it is truly remarkable that so many of us still come to meetings, research and report on university complicity, and join demonstrations. However, this narrative of miraculous exceptionalism has been our own undoing – we are stuck in recurring loops of high risk, low reward actions and there has been no serious collective inquiry into what has worked in the past, because present failures register as shameful personal failings. Our lack of exposure to the history of successful student organising in Germany – for instance, the 1968 Vietnam Congress at the Technical University, Berlin – means that our benchmarks of success rely on personal validation rather than an inspired vision of what political gains or success can look like. Dopamine hits will not win us the world.

German politics is a context that is difficult to intervene in, especially for international students, because it is designed to exhaust us and shut us out. The effort of thinking beyond where we find ourselves is tremendous. Reacting to crisis after crisis of state repression will deplete us. As students we can chart a genealogy of resistance for ourselves, learning from one revolutionary moment to the next, each a lighthouse that warns us off rocks that our precursors could not avoid. If we desire to be carried into liberatory futures, we must narrate ourselves in a way that allows future waves of organising to carry us along, absorb the impact of our failures and build upon our analyses. To do this, we will learn to avoid state capture, learn our local context, and operate with extreme political clarity about the world we want and how we intend to manifest it. The future of our political loneliness will transform dramatically when we recover habits of organising – flyering, reading, educating, archiving, narrating – that were

lost when generational memory broke. That includes imagining a future where another kind of loneliness is welcome, one that strengthens us and breaks us in better places. There is no imagining a future without loneliness. I'm interested only in finding a way through.

*

When I started writing this prediction in November 2023, Refaat Alareer was still alive. On 7 December 2023 he was killed by an Israeli airstrike on his house, along with six members of his family, four of whom were children. His profile on academia.edu is still online. He is still listed as a contributor on the website of *We Are Not Numbers*, his bio still in present tense. People in Gaza have eSims and internet access but conditions that give life a future – food, water, medicine, or sovereignty – remain under Israeli control.

There are no 'both sides' to consider. We are always living in the imagination of the colonial, the caste-supremacist, the capitalist. There is no point giving air to what exists despite us. There is the totalitarianism of the colonial and then there is the multifarious hot mess that we inhabit. What I do today determines the scope of what is possible tomorrow, and what I know today is insufficient to estimate or grasp the absolute wonders that futures are. We must celebrate the fact that we have futures at all; the investigation of what they could be belongs to us, we are obliged to stay curious about what happened before and what could happen next. It took me a while to understand where this piece was taking me, but I think I'm there now: the power of predicting a future comes from accepting that we will have to live in it.

What I write now is already being met with a response from my future self, or someone who will be kind enough to write back. I'm counting on that response to help me finish this piece.

ENDNOTES

1 For an analysis of legal responsibility in war crimes involving the use of AI to locate targets, see: Wiese and Langer (2025).

REFERENCES

- Turfah, M., 'This Is What They Call It Now', *Protean Magazine* (2024) <https://proteanmag.com/2024/02/01/this-is-what-they-call-it-now-2/> [accessed 2 February 2025].
- Rahmati, E., and V. Saumya, 'Where We Are Now Is Laying the Groundwork for What Is to Come', *NO NIIN*, Volume 03 (2023), 6–9.
- Wiese, L., and C. Langer, 'Gaza, Artificial Intelligence, and Kill Lists', *Verfassungsblog* <https://verfassungsblog.de/gaza-artificial-intelligence-and-kill-lists> [accessed 1 February 2025].

SERVERS

Estrid Sørensen

This ‘speculative fabulation’¹ unfolds in an imagined near future, and it is thus in itself a prediction. The characters also make predictions about server futures. All characters are fictive, but the scenes and conversations are inspired by my ethnographic research on data centres in Germany.² The endnotes explain some of the conceptual and ethnographic foundations for the speculative fabulation.

‘REPORTING IS ALWAYS A HASSLE, BUT AFTER ALGORITHMS WERE INTRODUCED to collect, aggregate and transfer data centre data directly to the Ministry, I basically don’t care about it anymore,’ Signe tells me, with a slight smile.

She operates a university data centre, and today she appears particularly confident while showing me the all-white data centre operation room, brightly lit by the LEDs in the ceiling. This slim and inconspicuous woman is queen of the software monitoring the impressive IT machinery. We are looking at numbers and graphs of one of the many German data centres, whose storage, servers, networks, cooling and UPS³ together eat up more than 30%⁴ of the country’s total power consumption. The still-young Ministry for Planetary Survival hopes to decrease power demands through stricter supervision.

At its introduction back in 2024, the German Data Centre Register collected twelve climate variables.⁵ Today, it gathers fifty-two.

I talk to Signe because I am worried about the future of the planet and how data centres are involved in shaping it. How can you feel and understand the interdependence between data centres and the planet? Signe answers by pointing at six large monitors in front of us, full of numbers and colourful patterns. They

make me feel illiterate, my eyes jumping restlessly from monitor to monitor hoping to find information I can relate to. Signe notices. She points with the cursor: 'that is data on temperature of power supplies and CPUs, over there the temperature of the fans. That is data on humidity, on server virtualisation, and the SQLs,' she explains. 'It is a bit hard to relate to,' I mumble.

The data centre is 2.5 kilometres away, but Signe reigns at a distance.

I notice an alarm popping up on one of the monitors. 'Is there a problem you need to go and fix?' I ask.

'Oh, no, I can change parameters from here,' she assures me and continues: 'there are hardly ever physical problems. We replace servers before they require extra maintenance, power and care. These four racks,' she continues, pointing with the cursor at four green squares on the top left monitor, 'they were built in yesterday.'

'And the old ones?' I want to know.

'Probably down at the janitor's. He helped take them down.'

Distant judging observers⁶ cut relations to planet through data visualisation witnessing, I speak into my note system on the way to the janitor.

'Here they are,' the janitor declares, opening the door to a room crammed with university furniture and other ephemera, including, right at the entrance, server rack parts. 'But not for long,' he reveals, hands on hips in his green overalls. 'They'll be picked up in an hour. Between you and me,' he reacts in a lower voice to my questioning gaze while bending towards me, 'I advertise all this university waste through the classifieds. Nobody cares.'

Merchant gives planetary-industrial excess a second life, I type.

I return an hour later and see the janitor helping a middle-aged man transporting four server rack doors to his van. His name is Hans, a network mechanic.

'Today, I'm the vulture of the data centre industry,' he tells me moments later, when we are both seated in the blue van on the way to his home. We carry the racks into the basement of a beautiful Wilhelminian period villa in a small town in the countryside. Six racks full of humming servers already stand there, in the centre of a low-ceilinged room. This is one of the many private edge data centres that have been booming over the past decade in parallel to large hyperscalers.⁷

‘I covered all the walls and the ceiling with this polystyrene pyramid foam that absorbs the highest and most disturbing frequencies. It allows me to sit here comfortably,’ he says, gesturing to the armchair in the corner. The room’s warm yellow light contrasts with the cool blue fluorescent lamp atmosphere I am used to in data centres. It comes from a wooden floor lamp next to the desk, with a twentieth-century textile lampshade with flower embroidery.

‘Everything in here is recycled—and every single screw drawn in by myself,’ he proudly announces.

‘But can you rely on the old servers?’

‘I have a good feeling for the servers. I listen to them, I monitor their temperature.’ Hans reaches out and holds his hand at the back of a server to feel the hot air it blows into the room, while nodding quietly. ‘And I ask our co-laborators⁸ how the servers are working for them. They are local associations, the town’s cultural administration and the public library. We host servers and run shared applications for them. I meet with them twice a year and discuss the software packages, and how to adapt them to their needs.⁹ And don’t worry,’ he adds confidently, ‘they’ll tell me if performance goes down or if there are other irregularities. Then I know which server is struggling, and how to allocate the tasks differently across the servers. Or I replace a component, but rarely the whole server.’

On my way out, he reassures me: ‘Prolonging server life is prolonging planetary life.’

Servers’, users’, and carer’s oddkin¹⁰ intercourse is pregnant with planetary relations, I record.

Back at the university a few days later, I visit Matthias from the university’s proteomic research team. As I stand in their server room next to him, he asks me softly, ‘Can you hear it? Someone is making a complicated calculation.’

The humming, the LED lights flashing, the warm air. I thought I had come to know the feel of a data centre. Yet, my amateur ears still need guidance to differentiate the high tones of one server from the overall humming. But yes, there they are.

‘I can hear it,’ I exclaim with excitement.

‘At times, too many projects run calculations simultaneously. Then our professor queues them up and distributes computing time among them, so they

don't run at the same time. She knows the projects and she knows who needs what kind of *computing*,' Matthias adds.

*The withness*¹¹ *thinks scientific work with server work... with*¹² *planetary work*, I enter into my note system.

Later that week, in the chemistry department, Felix suddenly gets up in the middle of our conversation and opens a wooden cupboard behind him. We have been talking about his data practices, and now I hear him push pieces of hardware around on the shelves. The inorganic chemist pulls out two hard disks.

'They've been lying here safely for a decade,' he says, 'which is no problem. But when you plug them in and let electricity run through them, the motor will start up and everything starts to move. One day it goes "schrfffss" and the hard drive is down the drain.'¹³

He also talks about his nine-year-old server in the basement of the building. And about the IT-administration's process of centralising IT at the university. I think of Signe and her complete overview.

'They want me to move it. But think about it: It sits there for nine long years, it has grown together with the rack, with the room and its specific humidity, with the stream of electrons, the cooling air that passes through it. They all live together at this very particular place on earth that is that server room. How will it survive being torn out of its habitat?'

Interdependent inorganic living matter situates the server in prolonged time, I add to my notes.

At home that evening, the fan of my laptop starts swirling hot air out of the chassis' top left corner while I write up my fieldnotes. The computer will soon be 10 years old. I opened it recently and dusted it off inside. It still overheats when charging. I pull the power supply. I've noticed that it helps. I thought this was a plain workaround, but now I realise that I have learnt to listen to and feel my computer; to care for hardware.¹⁴ I first tried with monitoring software. But not until I listened to the fan and felt the heat did I start reacting appropriately.

I call Signe the following morning and ask her if she thinks she could prolong the life of the servers in the data centre, if she listened carefully to the servers and used her hands to feel their temperature? She laughs out loud.

‘You’ve talked to the server whisperers,’ she exclaims. ‘They are polluting your vision.’¹⁵

Blinded, I feel the planetary relations when servers are hot and when they are cold, when they blow and when they are loud. Then energy is at work, and metal wears off. Then users engage, and carers awake.

ENDNOTES

1 Watts (2013). Read more (about) speculative fabulation in Haraway (2016) and Watts (2023).

2 The research was conducted together with Leman Celik, Laura Kocksch and Stefan Laser. I owe deep thanks to all our interlocutors. I also thank Laura Kocksch, Mace Ojala and Ruth Dorothea Eggel, Stefan Laser and Hollis A. Brown for invaluable comments on an earlier version of this text. The research is part of the Collaborative Research Centre “Virtual Lifeworlds” and funded by the German Research Foundation.

3 UPS: Uninterruptible Power Supply ensures continuous power provision, e.g. through battery packs that hold backup electric power to supply the data centre when the mains power fails.

4 Data centres’ future energy consumption is difficult to predict, as it depends on many factors, such as the development of data use and data processing demands, which are estimated to explode with AI, and on the energy efficiency of new generations of CPUs/GPUs (graphic processing units do parallel processing and increasingly take over tasks from central processing units, which are slower due to their serial processing), cooling systems, etc. In a review article, Hintemann & Hinterholzer (2023) report that estimates of data centre energy consumption in Germany will be between 16 and 34 billion kWh per year by 2030. According to the Ireland Capacity Outlook 2022–2031 (EirGrid & Soni 2022), 28% of the country’s total electricity demand is expected to come from data centres and other new large energy users. Energistyrelsen (2023: 42) forecasts that in 2031 data centres will be responsible for almost 30% of Denmark’s total energy consumption. Pasek (2023) points to estimates of global data centre energy use varying from 8 to 51% in the next decade, and she also emphasises that such numbers probably have more agency for backing up industry’s and governments’ credibility than they have truth value.

5 Bundesregierung (2023).

6 For more on the figure of the distant judging observer, see Sørensen (2009).

7 One of my interlocutors forecasted that in the future, there won’t be many mid-size data centres anymore, but instead many large hyperscale and many small so-called edge data centres, which are closer to the users and end-user devices. The forecast is

plausible: When it comes to world-wide social media platforms, e-commerce, cloud computing, digital streaming and other wide-reaching digital services (including AI), hyperscale data centres are most economical, efficient, controllable and secure (from the provider's point of view). As such, services are likely to increase, as is the number and size of hyperscale data centres. In many cases, it makes sense to bring computation and data storage closer to the sources of data use – through so-called edge computing or edge data centres – to improve latency and save bandwidth.

8 Niewöhner (2014; 2016) coined the notion of co-laboration for STS research and thereby parts from notions such as 'research subjects' or 'informants'. In data centre practices, terms such as 'customer' and 'user' freeze problematic relations with server operators.

9 For further discussions of server democracy, see Maak (2022).

10 See Haraway (2016).

11 In Sørensen (2009) I developed the difference between witness as a distant mode of knowing and withness as an engaged mode.

12 'Thinking with' is mainly a social act in Puig de la Bellacasa (2018), but it can be extended to servers.

13 For more about this chemist's data practices, see Sørensen & Kocksch (2020).

14 A key inspiration for thinking through engagement with hardware is Mauro-Flude & Akama (2022).

15 See Puig de la Bellacasa (2017: 81).

REFERENCES

- Bundesregierung, *Gesetz zur Steigerung der Energieeffizienz in Deutschland (Energieeffizienzgesetz – EnEfg)* (2023), <https://www.gesetze-im-internet.de/enefg/BJNR1350B0023.html> [accessed 27 January 2024].
- EirGrid and Soni, *Ireland Capacity Outlook 2022-2031* (2022), https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid_SONI_Ireland_Capacity_Outlook_2022-2031.pdf [accessed 27 January 2024].
- Energistyrelsen, *Klimastatus og -fremskrivning* (2023), https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf23_hovedrapport.pdf [accessed 27 January 2024].
- Niewöhner, J., *Co-laborative Anthropology: Crafting Reflexivities Experimentally*, [English translation of the original Finnish article published as 'Jukka Jouhki and Tytti Steel (2016) Ethnologinen tulkinta ja analyysi. Kohti avoimempaa tutkimusprosessia', *Ethnos*, Helsinki, 2016, pp. 81-125] (Humboldt University Berlin, 2016), <https://edoc.hu-berlin.de/bitstream/handle/18452/19241/Niewoehner2016-Co-laborative-anthropology.pdf?sequence=1> [accessed 27 January 2024].

- Niewöhner, J., Perspektiven der Infrastrukturforschung: care-full, relational, ko-laborativ, in D. Lengersdorf and M. Wieser, eds, *Schlüsselwerke der Science & Technology Studies* (Berlin, Heidelberg: Springer VS, 2014), pp. 341–52.
- Haraway, D. J., *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016).
- Haraway, D. J., ‘Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective,’ *Feminist Studies*, 14.3 (1988), 575–99.
- Hintemann, R., and S. Hinterholzer, *Rechenzentren 2022. Steigender Energie- und Ressourcenbedarf der Rechenzentrumsbranche* (Berlin: Borderstep Institut, 2023).
- Maak, N., *Server Manifesto: Data Centre Architecture and the Future of Democracy* (Berlin, Stuttgart: Hatje Cantz, 2022).
- Mauro-Flude, N., and Y. Akama, ‘A Feminist Server Stack: Co-designing Feminist Web Servers to Reimagine Internet Futures,’ *CoDesign*, 18.1 (2022), 48–62.
- Pasek, A., ‘From Atoms to Electrons: An Energy History and Future of Computing,’ in A. Pasek, C. K. Lin, Z. G. T. Cooper and J. B. Kinder, eds, *Digital Energetics* (Minneapolis: University of Minnesota Press, 2023), pp. 15–42.
- Puig de la Bellacasa, M., *Matters of Care: Speculative Ethics in More than Human Worlds* (Minneapolis: University of Minnesota Press, 2017).
- Sørensen, E., *The Materiality of Learning: Technology and Knowledge in Educational Practice* (Cambridge: Cambridge University Press, 2009).
- Sørensen, E., and L. Kocksch, ‘Data Durability: Towards Conceptualisations of Scientific Long-term Data Storage,’ *Engaging Science, Technology, & Society*, 7.1 (2021), 12–21.
- Watts, L., ‘Stormpunk Islands,’ *Climate Action Almanac* (Phoenix, AZ: Center for Science and the Imagination, Arizona State University, 2023).

FOLDS

Esben Lorentzen and Casper Bruun Jensen

WE BEGIN WITH A NEGATIVE PREDICTION ABOUT PREDICTIONS.¹ CONTRARY to widespread claims, artificial intelligence will not revolutionise drug design. However, analogous with the Human Genome Project (HGP), which failed to deliver on grand medical promises but took genomics into uncharted territory, we also predict that over the next five years, high quality structural models generated with machine learning programs for a wide range of molecular-biology systems, will transform the biomedical sciences.

When Gilles Deleuze (1993: 10) called origami, the Japanese art of folding paper, ‘the model for the sciences of matter,’ he evoked proteins. For decades, these heterogeneous and variable folded structures of amino acids have primarily been determined or ‘solved’ experimentally by growing crystals – a haphazard process often likened to an occult science – and shooting x-rays at them to obtain diffraction patterns.² Over the last few years, however, a new deep reinforcement learning system, *AlphaFold*, has enabled structural predictions of any protein (Jumper et al. 2021). As predictions about accelerated drug discovery shape medical and political hopes and visions, protein structures are folded into biosocial futures.

The HGP, an immense international collaboration that aimed to sequence the entire human genome, sparked enormous excitement in the early 2000s. The genome – the total set of an organism’s genetic information – is coded as strings of nucleotides (A, G, T, or C) within DNA molecules. In humans, these nucleotides are distributed on 23 pairs of chromosomes – these sequences

provide ‘instructions’ for making the proteins that keep us alive. The instructions for building something as complex as a living organism are quite long. A single copy of the human genome has an estimated 3 billion base pairs-worth of DNA.

In 1999, the head of the Human Genome Research Institute proclaimed that personalised genetic tests and treatments for cancer, heart disease and other common diseases would be available within a decade. With a map of the genome at hand, along with new sequencing technologies and databases, it would soon be possible to ‘mine miracles’ (Collins 1999). President Bill Clinton followed suit, declaring that the Human Genome Project (HGP) would ‘revolutionize the diagnosis, prevention and treatment of most, if not all, human diseases.’³ At the time, the HGP was a decade old. Celera Genomics, headed by J. Craig Venter, began as the HGP’s competitor, seeking to gain control over the potential ‘pharmaceutical treasure trove’⁴ of genome patents. In the end, though, these competing groups joined forces, and presented the first complete genome map on the fiftieth anniversary of Francis Crick and James D. Watson’s publication of the double-helix structure of DNA.

In the dry words of Isabelle Stengers (2020: 218), the HGP proved ‘of questionable fecundity,’ and nowhere more so than in the ‘vastly oversold’⁵ promises of medical miracles. But while it failed to revolutionise medical treatment, technological advances associated with massive parallel sequencing and growing sequence databases opened new scientific horizons. Like the exciting days when the Dutch cloth merchant and father of microbiology van Leeuwenhoek⁶ (1632–1723) built the microscopes that first made it possible to see living things (‘animalcules’) in rainwater, saliva, urine and semen, the new sequencing technologies made microorganisms and their previously unknown realms partially visible. Thus, a vast chasm yawned between expectations and outcomes. The expectation was that the elements were basically known, and all that was needed was some hard work to fill in the details on the map. The outcome was a totally different landscape, populated by myriad mysterious actors – microorganisms – the existence of which was neither anticipated nor understood. No surprise, then, that the grand medical promises failed!

Recent breakthroughs in protein structure prediction through AI mapping methods have led to a fresh round of promises about an imminent, monumental

leap in drug discovery and disease treatments. Founded in 2010, DeepMind Technologies Ltd⁷ initially trained neural networks on simple computer games. By 2014, *AlphaGo* became the first machine learning system to defeat top-level players in the complex board game Go. Since then, similar techniques have been used for games, language models, chatbots, and sports predictions. But by far the most impressive success has been *AlphaFold*, a deep learning system that predicts protein structures (Jumper et al. 2021). Folding chains of amino acids form 3-dimensional (3D) protein structures; because these structures are crucial to determining the function of proteins, scientists have dedicated great effort to experimentally resolve them. Methods such as x-ray crystallography, nuclear magnetic resonance and cryo-electron microscopy are, unfortunately, costly, slow and unreliable. Since an astonishing variety of proteins exists, small wonder that researchers have looked to computational models for help.⁸ For around three decades, a competition with the snappy title ‘Critical Assessment of Techniques for Protein Structure Prediction’ (CASP) has invited teams to predict 3D protein structures given information only about the linear (1D) sequence of amino acids.⁹ *AlphaFold* won this tournament in 2018, but the real breakthrough came in 2020, when *AlphaFold2* blew away the competition and achieved a near perfect score of 92.4 of 100. By the summer of 2022, the *AlphaFold* team, together with the European Bioinformatics Institute, had made more than 200 million protein structures available for download.¹⁰

A flurry of comments hailed these results as unprecedented and revolutionary. A 2021 *Nature*¹¹ editorial began with an unnamed researcher declaring that: ‘I didn’t think we would get to this point in my lifetime.’ Venki Ramakrishnan, winner of the Nobel Prize in chemistry for structural studies of the protein synthesising ribosome, evoked ‘stunning advances’ happening ‘decades before many people in the field would have predicted,’¹² and looked forward to a fundamental transformation of structural biology. *AlphaFold2* also proved able to accurately predict the structures of protein complexes, despite being trained primarily on single-chained proteins.¹³ While the system is currently restricted to proteins and does not provide direct insights into their interactions with small molecules (e.g., drugs), a recent preprint introduced the RoseTTAFold

All-Atom, which encompasses proteins, nucleic acids, ions, and small molecule ligands (Krishna et al 2023).

Similar to when the HGP came to fruition, these developments are leading to medical predictions that stretch far beyond basic research. Before long, the claims go, accurate protein structures will ‘open the door to deep learning-based design of protein-small molecule assemblies’ and thereby broadly ‘impact’ (Krishna et al. 2023) if not ‘accelerate’ drug discovery (Callaway 2020). However – this is our negative prediction – it is unlikely that these advances will fundamentally alter the landscape of drug discovery, especially because a lack of knowledge about protein structures is rarely the major hurdle for making effective drugs.¹⁴ As the HGP made abundantly clear, only a few diseases result from a single faulty gene or protein. Rather, the majority involve complex interactions among many components across multiple systems. Even where disease is caused by a single mutation, the effect is often a subtle change in protein structure, dynamics, or stability, rather than a distinct, ‘druggable’ target (Leslie et al 2022).

Today, thousands of scientists use the sequence databases that emerged from the HGP as daily research tools. The microorganisms have become partly visible, and it is now possible to pose new problems and design new inquiries. In this sense, the HGP initiated an infrastructural revolution in bioscience. Perhaps the science has since become less ‘occult,’ but no less complex or fascinating. Analogously, we predict that *AlphaFold* and other deep learning systems will engender another deep infrastructural transformation of bioscience. There are too many uncertainties to guess the exact scientific implications—unless you are truly in the business of fortune telling – but the availability of comprehensive databases with high-quality structural protein information will fundamentally alter research project development and experimental design. There will certainly be many new folds between science and society. Biomedical futures will keep on folding. But we should not expect to ‘mine medical miracles’ anytime soon.

ENDNOTES

- 1 This prediction was written in October 2023, and we have not tried to update it since. It would in any case be difficult given extremely rapid developments.
- 2 Lately, increasing numbers of protein structures have been determined using cryo-electron microscopy, a process for which three scientists – Jacques Dubochet, Joachim Frank and Richard Henderson – received the Nobel Prize in chemistry in 2017.
- 3 Hall, Stephen S., ‘Revolution Postponed: Why the Human Genome Project has been Disappointing,’ *Scientific American*, 1 October 2010.
- 4 Fridovich-Keil, J. L. <https://www.britannica.com/event/Human-Genome-Project/Advances-based-on-the-HGP>, last updated August 22, 2023.
- 5 Caulfield, Timothy. <https://www.ualberta.ca/folio/2019/12/commentary--the-problem-with-personalized-health-information.html>. December 16, 2019.
- 6 Not coincidentally, the philosopher G. W. Leibniz, who inspired Gilles Deleuze’s ‘The Fold,’ found support for his metaphysics in the observations of van Leewenhoek, with whom he maintained a four decade-long correspondence. ‘Now nothing better corroborates the incomparable wisdom of God,’ he wrote in the *Monadologie*, ‘than the structure of the works of nature... which appears when we study them more closely with a microscope... A man in Delft (van Leeuwenhoek) has accomplished wonders at it.’ Deleuze (1993: 31) describes Leibniz’ baroque metaphysics as consisting of folds and pleats, which we can ‘behold... in the microscope, collectivities through the folds of dust.’
- 7 Among the investors were Peter Thiel and Elon Musk, and the ‘long-termist’ philosopher Nick Bostrom was hired for DeepMind’s ‘Ethics and Society’ unit. For this discussion, we leave these ultra-libertarian, right-wing underpinnings to the side.
- 8 Since the early 1970s, around 194,000 structures have been determined experimentally and deposited in the Protein Data Bank (PDB). They constitute the information from which AlphaFold ‘learned’ to predict protein structure.
- 9 The competition uses protein sequences for which experimental 3D structures have recently been determined but are not yet publicly accessible.
- 10 At <https://alphafold.ebi.ac.uk>.
- 11 Editorial. ‘Artificial Intelligence in Structural Biology Is Here to Stay,’ *Nature* 595, 625–26 (2021) <https://www.nature.com/articles/d41586-021-02037-0>.
- 12 At <https://www.deepmind.com/blog/alphafold-a-solution-to-a-50-year-old-grand-challenge-in-biology>.
- 13 The co-evolution of amino acids in protein interfaces likely enables the original AlphaFold2 to model protein complexes in some cases. AlphaFold multimer (Evans et al 2022), which was trained specifically on protein complexes, shows higher accuracy.

One of us has recently used these deep learning models to predict the structure of a 15-subunit complex (Petriman et al. 2022).

14 Lowe, Derek. <https://www.chemistryworld.com/opinion/why-alphafold-wont-revolutionise-drug-discovery/4016051.article>. 5 August 2022.

REFERENCES

- Callaway, E., “‘It Will Change Everything’: DeepMind’s AI Makes Gigantic Leap in Solving Protein Structures’, *Nature*, 588.7837 (2020), 203–04.
- Collins, F. S., ‘Medical and Societal Consequences of the Human Genome Project’, *The New England Journal of Medicine*, 341 (1999), 28–37.
- Deleuze, G., *The Fold: Leibniz and the Baroque* (London: Athlone Press, 1993).
- Evans, R., ‘Protein Complex Prediction with AlphaFold-Multimer’, *bioRxiv* (2022) <https://doi.org/10.1101/2021.10.04.463034>.
- Hall, S., ‘Revolution Postponed: Why the Human Genome Project has been Disappointing,’ *Scientific American*, 1 October 2010 <https://www.scientificamerican.com/article/revolution-postponed>.
- Jumper, J. et al., ‘Highly Accurate Protein Structure Prediction with AlphaFold’, *Nature*, 596 (2021), 583–89.
- Krishna, R. et al., ‘Generalized Biomolecular Modeling and Design with RoseTTAFold All-Atom’, *bioRxiv* (2023) <https://doi.org/10.1101/2023.10.09.561603>.
- Leslie, J., et al., ‘Biallelic DAW1 Variants Cause a Motile Ciliopathy Characterized by Laterality Defects and Subtle Ciliary Beating Abnormalities’, *Genetic Medicine* 24.11 (2022), 2249–61 <https://doi.org/10.1016/j.gim.2022.07.019>.
- Petriman, N. A. et al. ‘Biochemical Validated Structural Model of the 15-Subunit Intraflagellar Transport Complex IFT-B’, *The EMBO Journal* 41.24 (2022) <https://doi.org/10.15252/embj.2022112440>.
- Stengers, I., (2020) ‘The Earth Won’t Let Itself be Watched’, in B. Latour and P. Weibel, eds, *Critical Zones: The Science and Politics of Landing on Earth* (MIT Press/ZKM: Cambridge, MA/ Karlsruhe, 2020).

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