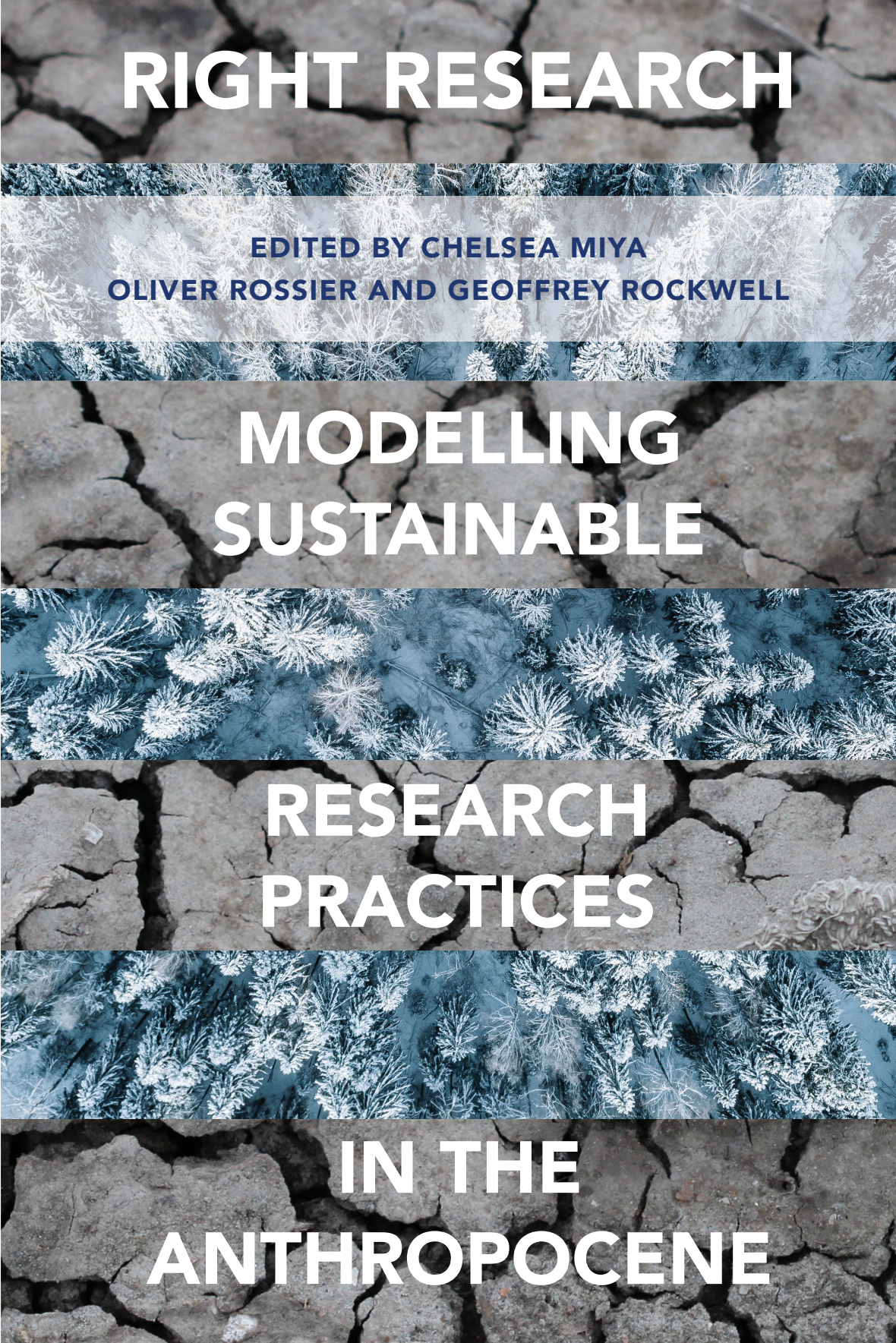
RIGHT RESEARCH
EDITED BY CHELSEA MIYA
OLIVER ROSSIER AND GEOFFREY ROCKWELL
MODELLING
SUSTAINABLE
RESEARCH
PRACTICES
IN THE
ANTHROPOCENE

RIGHT RESEARCH

Right Research

Modelling Sustainable Research Practices in the Anthropocene

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This book is dedicated to Doris and Peter Kule for their support for the advancement of social sciences, humanities and arts research. Their gift established the Kule Institute for Advanced Study at the University of Alberta that brought us together.

We are also deeply grateful to the researchers and support teams that made the Around the World conference series such a success over the years.

And we also dedicate this to future scholars, for everything you will do to help weave together our civil society to face the shared challenges of climate change.

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Contributor Biographies

Jonathon Allen is an Adjunct Professor in the School of Humanities and Communication Arts at Western Sydney University (WSU). Jonathon has twenty-five years' university teaching, research, management and governance experience, the last half of which has been in significant leadership and governance roles at Western Sydney University, including Head of The Academy, Provost of Penrith Campus, Director of Academic Program for Visual Communication Design in the School of Humanities and Communication Arts, and Associate Head of School of Engineering. His research, teaching and engagement interests typically see him work in collaboration with other disciplines, to progress design's role in bringing together arts, science and technology with a strong social conscience. He has a broad range of research outputs, including traditional publications (book chapters, journal and conference papers), exhibitions and prototypical artefacts, and has a particular interest in material intelligence (smart materials, intelligent use of materials, and in the hidden stories of sourcing and selecting materials); the application of design thinking to address pressing concerns related to food security, climate change, and health; and in the use of Augmented Reality to interact and engage with the physical world.

Terry Anderson, PhD, is a Professor Emeritus and former Canada Research Chair in the Centre for Distance Education and the Technology Enhanced Knowledge Research Centre at Athabasca University. Terry has published widely in the area of distance education and educational technology and has co-authored or edited ten books and numerous papers. Much of Terry's research work revolves around studying interaction amongst and between students, teachers and content. He claims to have organized (in 1992) the first virtual conference ever held using a variety of networks that preceded the Internet.

Doug Barlage has been a Professor in nanoelectronics for the past sixteen years. Prior to this, he was an engineer with Intel where he played a critical role in producing the first production high-k gate dielectric transistor and the first trigate transistor. For his role in demonstrating the functional transistors with gate dimensions below 30nm, he was in the MIT TR-35 class of 2002.

Jessie Beier is an Edmonton-based teacher, artist, writer and conjurer of strange pedagogies for uncertain futures. Working at the intersection between speculative philosophy, artistic production and radical pedagogy, Jessie's research-creation practice explores the potential for visual and sonic ecologies to mobilize a break from orthodox referents and habits of repetition, towards more eco-logical modes of thought. Beier is currently completing her PhD at the University of Alberta, where she also teaches as an undergraduate instructor in the Department of Secondary Education and the Department of Women's and Gender Studies.

Eric Benson is an Associate Professor of Graphic Design at the University of Illinois. He has worked as a professional designer for such companies as Razorfish and Texas Instruments. His research as a professor explores how design can be sustainable and consequently how to teach it. Eric has a BFA in Industrial/Graphic design from the University of Michigan and an MFA in Design from the University of Texas.

Karin Bolender (aka K-Haw Hart) is an artist-researcher who seeks 'untold' stories within muddy meshes of timeplaces. Under the auspices of the Rural Alchemy Workshop (R.A.W.), she explores dirty words and knotty wisdoms of earthly bodies-in-places through durational performance, writing, video, sound, and experimental books arts. Karin earned an MFA in Interdisciplinary Arts from Goddard College and a PhD in Environmental Humanities from the University of New South Wales in Sydney, Australia. She has lived and moved with a family herd of mammals and others on the semi-rural fringes of several university towns in the U.S. Southeast and West and presently makes a home in a small timber and rodeo town near a state university in the Willamette Valley/Champinefu Kalapuya territory in Oregon. 3Ecologies/punctum

books published *The Unnaming of Aliass*, which reckons with two decades of barnyard becomings, in 2020.

Nick Byrd is a philosopher-scientist studying how differences in reasoning style relate to differences in judgments, decisions, and well-being. For example, Nick examines how reflection double checks our intuitions, how our evaluations of arguments and evidence can be biased, how our tendency to unreflectively accept our initial intuition predicts many of our philosophical beliefs, how our sense of identity influences our reasoning, how to debias our reasoning, and how our happiness can be influenced by our beliefs *about* happiness. Nick's graduate coursework in cognitive science and philosophy was completed at University of Colorado and Florida State University. Institutions like the US Intelligence Community, the John Templeton Foundation, and universities have funded Nick's research. You can find out more about Nick's research on byrdnick.com, social media, *Psychology Today*, the American Philosophical Association blog, podcasts, radio segments, and other venues.

Hart Cohen is Professor in Media Arts in the School of Humanities and Communication Arts at Western Sydney University, Australia. Dr Cohen is a member of the Institute for Culture and Society and supervises a number of MA (research), DCA and PhD students. He has published widely in the field of visual anthropology, communications and film studies. Hart has directed three Australian Research Council Projects related to the Strehlow Collection held at the Strehlow Research Centre in Alice Springs. He is the co-author of the award-winning book, *Screen Media Arts: An Introduction to Concepts and Practices* for Oxford University Press (2009), as well as the founding editor of *The Global Media Journal* (Australian Edition). His most recent book is *The Strehlow Archive: Explorations in Old and New Media* (Routledge).

Ted Dawson is an Assistant Professor of Practice in German studies and faculty affiliate at the Center for Digital Research in the Humanities at the University of Nebraska-Lincoln. He researches and teaches Austrian and German literature and culture from the nineteenth century to the present, focusing especially on environmental humanities, digital humanities and sound and media studies. Before coming to Nebraska,

he was Visiting Assistant Professor at the University of Maryland, where he helped establish an interdisciplinary environmental humanities research community.

Petra Dolata is an Associate Professor in the Department of History at the University of Calgary, Canada. From 2014-2019 she was Canada Research Chair (Tier II) in the History of Energy. She holds an MA degree in American Studies from Ruhr-Universität Bochum, where she also received her PhD in International Relations with a study on U.S.-German (energy) relations in the late 1950s and early 1960s which was published in 2006 with VS Verlag (*Die deutsche Kohlenkrise im nationalen und transatlantischen Kontext*). She is the co-convenor of the Energy In Society research group at the Calgary Institute for the Humanities. Petra's current research focuses on European and North American energy history after 1945 as well as the history and politics of the Canadian and circumpolar Arctic. She has published on Canada's natural resources, foreign and Arctic policies, and the concept of energy security.

Christa Donner is an artist, mother, curator and organizer who investigates the human/animal body and its metaphors through a variety of media, from large-scale drawing and installation to guided visualizations and small-press publications. Her practice often incorporates social exchange and collaboration rooted in personal narrative and sensory experience. Christa's work is exhibited widely, including projects for the Max Planck Institute for the History of Science (Berlin, Germany), The Worldly House at dOCUMENTA 13 (Kassel, Germany); BankArt NYK (Yokohama, Japan); Chiaki Kamikawa Contemporary Art (Paphos, Cyprus); the Museum Bellerive (Zurich, Switzerland), ANTI Festival of Contemporary Art (Kuopio, Finland), the Centro Columbo Americano (Medellin, Colombia), and throughout the United States. Her work can be found at www.christadonner.com.

Lai-Tze Fan is an Assistant Professor at Waterloo University, Canada, and a Faculty Researcher of the Critical Media Lab. She researches digital storytelling, media theory and infrastructure, research-creation or critical making, and systemic inequalities in the design of tech and tech labour. She makes digital and material art about e-waste and

crafts. She is the Co-Editor of 2020 collection *Post-Digital: Dialogues and Debates* from electronic book review, and her research appears in *Mosaic*, *Convergence*, *Digital Studies*, and elsewhere. Fan serves as an Editor and the Director of Communications for *electronic book review*, one of the oldest academic journals on the Internet, and Co-Editor of the digital review.

Priscilla Ferronato is a Lead User Experience Researcher and PhD candidate in Informatics at University of Illinois Urbana Champaign with over five years of experience in qualitative user experience research. Currently, she works with a fintech leading the research on the future of automation in finances and its impact on human behavior. Her PhD dissertation investigates the influence of individual differences on the formation of trust in autonomous systems.

Alison Gill is Senior Lecturer in Design at Western Sydney University. Alison's research interests in design philosophy, cultural theory and socio-material studies are evident in publications about social practices of repair, alternative conceptions of use and visual narratives; sports product advertising; deconstruction fashion; audience/user practices and sustainable design education. Her current research projects investigate cultures of everyday resourcefulness like sharing, reuse, customization, and repair to encourage transitions to more sustainable economies.

Amanda Starling Gould, PhD (she/her) is currently the Senior Program Coordinator for Educational Programs & Digital Humanities at the Duke University John Hope Franklin Humanities Institute. She directs the Duke Story+ Interdisciplinary Humanities Research program, consults on digital humanities projects and innovative pedagogical interventions for Duke's Humanities Labs and Digital Humanities Initiative, and collaborates with partners across Duke (and beyond) to design creative—and sometimes remote—research and storytelling experiences. She teaches graduate and undergraduate classes on environmental humanities, critical digital practice, redesigning futures, and 'learning to fail'.

Maryella Hatfield is a Lecturer in Screen Media (SoHCA) at Western Sydney University. She is also a filmmaker, and the director of *The Future*

Makers, which tells the story of key Australians leading the way on the world stage in renewable energy (broadcast on Discovery Channel, 2008-2010). A graduate from the AFTRS in directing, her work has been shown with a range of international festivals and broadcasters. *Eden*, a short environmental documentary, was highly commended in the Dendy Awards. *Range of Experience* was nominated for an AFI Award, and was screened in numerous festivals including Sydney and Melbourne Film Festivals, LA Women in Film Festival, Portugal's Fantasporto Festival, Flickerfest et al. She worked as an independent director/producer over many years, and brings this experience to her work in higher education. The Living Lab project at South Vineyard Creek was highly commended in the Australasian Green Gowns Awards in 2020.

Mél Hogan is the Director of the Environmental Media Lab (www.environmentalmedialab.com) and an Associate Professor in Communication, Media and Film at the University of Calgary. Her work on data storage and cloud imaginaries has been published in journals like *Ephemera*, *First Monday*, *Television and New Media*, *Big Data and Society*, *Culture Machine* and the *Canadian Journal of Communication*, among others. Website: www.melhogan.com; Twitter @mel_hogan /@EnvMediaLab

Joshua Korenblat is an Assistant Professor of Graphic Design at the State University of New York (SUNY) at New Paltz. Prior to joining the Art Department faculty at SUNY New Paltz, Joshua worked as an art director, artist, writer and educator. Joshua has an MFA in Interdisciplinary Visual Art from the Maryland Institute College of Art, an MA in Teaching from Brown University and an MA in Writing from Johns Hopkins University. Also, Joshua has a dual-degree BFA and BA from Washington University in St. Louis. From 2007 until 2014, Joshua was on the Graphic Design faculty of the Boston University Center for Digital Imaging Arts, Washington, DC campus. Professionally, Joshua has seven years of experience in the Art Department at *National Geographic Magazine* and *Science News*. In 2012, Joshua helped to co-found Graphicacy, a data visualization design firm based in Washington, DC. Today, Joshua works as an Art Director with the team at Graphicacy.

Kristine Kowalchuk is an Adjunct Professor with the Department of English and Film Studies at the University of Alberta, and an instructor of English and Ethics at the Northern Alberta Institute of Technology (NAIT). Her research focuses on ecological humanities, including writing on food and farming systems. In 2017 she published *Preserving on Paper: Seventeenth-Century Englishwomen's Receipt Books* through the University of Toronto Press.

Michael Leung is an artist/designer, researcher and visiting lecturer. He was born in London and moved to Hong Kong in 2009 to complete an MA in Design. His projects range from collective urban agriculture projects such as The HK FARMers' Almanac 2014-2015 to Pangkerchief, a collection of objects produced by Pang Jai fabric market in Sham Shui Po. Michael is a Visiting Lecturer at Hong Kong Baptist University where he teaches Social Practice (MA). His research focuses on Insurrectionary Agricultural Milieux, rhizomatic forms of agriculture that exist in local response to global conditions of biopolitics and neoliberalism.

Abby Mellick Lopes is an Associate Professor in Design Studies at University of Technology, Sydney. Abby's collaborative research focuses on the relationship between design and social arrangements to support the transition to more sustainable cultures and economies, with recent projects tackling the social impacts of heat and development trends on the urban commons; civic trust in drinking water; and food and waste economies and cultures of repair, with a particular focus on the communities of Western Sydney. Abby has published in *Design Studies*, *Design and Culture*, *Cultural Studies Review*, *ACME*: an international e-journal for critical geographies and elsewhere, and written several book chapters on design, sustainability and transdisciplinarity. Her work has been presented in the UK, the USA, Canada, Cyprus, Spain, Malaysia and China.

Natalie S. Loveless is Associate Professor, Contemporary Art and Theory, at the University of Alberta, where she directs the Research-Creation and Social Justice CoLABoratory and co-leads the Faculty of Arts' Signature Area in Research-Creation. Loveless is author of *How to Make Art at the End of the World: A Manifesto for Research-Creation* (Duke UP 2019), editor of *Knowings and Knots: Methodologies and Ecologies in*

Research-Creation (University of Alberta Press 2019), and co-editor of *Responding to Site: The Performance Work of Marilyn Arsem* (Intellect Press 2020). Loveless has held fellowships and visiting positions in the Centre for Interdisciplinary Studies in Society and Culture (CISSC) at Concordia University (Montreal), the Centre for the Humanities at the University of Utrecht, and Western University (London, Ontario). In 2020 she was elected to the Royal Society of Canada (College of New Scholars, Artists, and Scientists) for her scholarship at the intersection of research-creation and social and ecological justice.

Chelsea Miya is a PhD Candidate and CGS SSHRC fellow in English and Film Studies at the University of Alberta where her work focuses on the cultural history of data. She is a researcher and podcaster with the SpokenWeb, a multi-institutional interdisciplinary project dedicated to the discovery, preservation, and analysis of sonic artifacts.

Howard Nye is an Associate Professor in the Department of Philosophy at the University of Alberta. He works primarily in the areas of normative ethics, practical ethics, and metaethics, and has related interests in political philosophy, the philosophy of mind, and decision theory. One line of Howard's current research investigates challenges to the common assumption that life is less of a morally important benefit to beings who lack the intellectual abilities of typical human adults. Another line of his research concerns the ethics of collective action, focusing on the argument that individual actors and institutions should reduce their contributions to harmful practices because their contributions have small chances of making very important differences. A third line of Howard's research investigates what it takes for an entity to have beliefs, desires, and sensations that represent or are about the world in a sense that admits of genuine, underivative error, with applications to the sentience and mental lives of various non-human animals, intellectually less able humans, and possible future artificial intelligence systems.

Leanne Olson is an artist, educator and writer. She has maintained a near two decade self-taught and community engaged art practice since completing a BA in Film Studies in 2003 at the University of Alberta. In 2019, she returned to campus and is an MFA candidate at the University of Victoria. Olson's work focuses on land and water bodies that are tasked

with jobs, such as landfills, sulphurous springs, and recreational lakes. Her practice includes repeat visitation and empathic documentation of these sites as they are entangled in massive change. The subjects in her images are often micro captures of ecosystems adapting to human odds and responding to the effects of time. Olson received international media coverage for her recent exhibition at the Mitchell Art Gallery at MacEwan University and for her 2018 residency with the Edmonton Waste Management Centre.

Allison Paradise has inspired thousands of people to see themselves, their relationship to others, and their relationship to the planet in a new way. She is the founder and former CEO of My Green Lab, a non-profit organization with a mission to build a culture of sustainability through science. Under her leadership, My Green Lab established the first-ever sustainability criteria for laboratory operations and products, transforming an industry half the size of the automotive industry into a paragon of sustainability. My Green Lab was founded on the philosophy of questioning our own behavior, and this continues to be the guiding philosophy behind her most recent project, Open Spaces, Open Minds (OSOM). In her work at OSOM, Allison empowers children and adults to question, explore, and connect with themselves and nature with true curiosity and joy. Allison is a frequently invited speaker at sustainability events and scientific meetings. She holds degrees in neuroscience from Brown and Harvard.

Geoffrey Rockwell is a Professor of Philosophy and Digital Humanities, Director of the Kule Institute for Advanced Study and Associate Director of the AI for Society signature area at the University of Alberta. He publishes on textual visualization, text analysis, ethics of technology and on digital humanities including a co-authored book, *Hermeneutica*, from MIT Press (2016). He is co-developer of Voyant Tools (voyant-tools.org), an award-winning suite of text analysis tools.

Oliver Rossier has a BA in History and Political Science, and an MA in Communications and Technology, both from the University of Alberta. He has over twenty years of post-secondary administrative experience, facilitating collaborative research projects and strategic initiatives. He is committed to helping research teams find the right tools and techniques

to navigate transitions caused by the tandem tsunamis of COVID-19 and significant budget reductions.

Gem Shoute has a PhD in electrical engineering from the University of Alberta. She is the Co-Founder and CEO of Synthergy, a company which aims to improve the efficiency and sustainability of the nano-manufacturing technique used to make semiconductors and advanced coatings.

Francesca Sidoti is a PhD candidate at the Institute for Culture and Society at Western Sydney University. Her research focuses on the role of place, particularly in the lives of young adults in regional New South Wales.

Scott Smallwood is a sound artist, composer, and performer who creates works inspired by discovered textures and forms, through a practice of listening, field recording, and improvisation. In addition to composing works for ensembles and electronics, he designs experimental instruments and software, as well as sound installations and audio games, often for site-specific scenarios. Much of his recent work is often concerned with the soundscapes of climate change, and the dichotomy between ecstatic and luxuriating states of noise and the precious commodity of natural acoustical environments and quiet spaces. He performs as one-half of the laptop/electronic duo Evidence (with Stephan Moore) and has collaborated with many artists and ensembles including Continuum Ensemble, Ensemble SurPlus, Seth Cluett, Mark Dresser, Cor Fuhler, John Butcher, Pauline Oliveros, Cindy Baker, Jen Mesch, Sean Caulfield, Sydney Lancaster, Yanira Castro, Marilène Oliver, and many others. He teaches as an associate professor of composition at the University of Alberta, where he also serves as the director of the Sound Studies Institute.

Deb Verhoeven is currently the Canada 150 Research Chair in Gender and Cultural Informatics at the University of Alberta. Previously she was Associate Dean of Engagement and Innovation at the University of Technology Sydney, and before this she was Vice Chancellor's Library Fellow and Professor of Media and Communication at Deakin University. Between 2008 and 2011 she was Inaugural Deputy Director of the National Film and Sound Archive of Australia. She currently serves

on the boards of the Canadian research infrastructure organisations CANARIE and NDRIO.

Andrew S. Yang works across the naturalcultural flux by way of the visual arts, natural sciences, and expanded research. His projects have been exhibited from Oklahoma to Yokohama, including the 14th Istanbul Biennial, the Museum of Contemporary Art Chicago, the Spencer Museum of Art, and the Smithsonian Museum of Natural History. His writings have appeared in *Leonardo*, *Biological Theory*, *Art Journal*, and in the forthcoming books *Kinship: Belonging in a World of Relations* and the *Routledge Handbook of Art, Science, and Technology Studies*. He was recently inaugural artist-in-residence at Yale-NUS College in Singapore, is a Research Associate at the Field Museum of Natural History, and an Associate Professor at the School of the Art Institute of Chicago.

Editors' Preface

Educational institutions have long been at the fore of social and political change, a fact that was reaffirmed by the historic student-led Global Climate Strikes in the fall of 2019.[1] Universities help to generate ideas and foster critical thought. That is why, in the face of the current climate emergency, the academy is uniquely positioned to take action. This collection—*Right Research: Modelling Sustainable Research Practices in the Anthropocene*—asks what responsibility do we, as educators and researchers have, in 'righting' our relationship to the environment? What does it mean to 'do research' sustainably? How can we reflect on and adjust our own institutional practices?

This anthology was inspired by an annual virtual conference at the University of Alberta, whose innovative online format was specifically chosen to minimize its carbon footprint. Organized by co-editors Chelsea Miya, Oliver Rossier, Geoffrey Rockwell and others, the Around the World (AtW) econference ran for six years between 2013 and 2018 and resulted in the production of an econference handbook and the establishment of a special virtual conference grant program to fund econferences at the University. The theme of the final AtW conference was 'Sustainable Research: Modelling Nearly Carbon-Neutral Practices in the 21st Century.' Researchers from around the world came together to discuss sustainable research in its many forms and to address the question of how we as an academic community can work together to learn how to better mobilize ideas without flying so many people. We

1 Eliza Barclay and Brian Resnick, 'How big was the global climate strike? 4 million people, activists estimate', *Vox* (September 22, 2019), https://www.vox.com/energy-and-environment/2019/9/20/20876143/climate-strike-2019-september-20-crowd-estimate; Matthew Taylor, Jonathan Watts and John Bartlett, 'Climate crisis: 6 million people join latest wave of global protests', *The Guardian* (September 27, 2019), https://www.theguardian.com/environment/2019/sep/27/climate-crisis-6-million-people-join-latest-wave-of-worldwide-protests

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also called attention to the geographical, financial as well as legal and/or political barriers that limit scholarly dialogue by excluding researchers from participating in traditional conferences. We asked how we might consider alternative or hybrid formats that are more inclusive and ultimately more sustainable.

The works in this collection were inspired by the conference theme of sustainable research, but also extend the conversation beyond the original event. There has been increasing interest in scholarship that foregrounds the role of academia in fighting climate change. Recent scholarly works include Julian Keniry's *Ecodemia* (1995), Geoffrey Chase and Peggy Bartlett's *Sustainability on Campus* (MIT, 2004), Mitchell Thomashow's *The Nine Elements of a Sustainable Campus* (MIT, 2014), Patrizia Lombardi and Giulia Sonetti's *News from the Front of Sustainable University Campuses* (Edizioni Nuova Cultura, 2017), Walter Leal Filho et al.'s *Towards Green Campus Operations* (Springer 2017) and *Sustainability on University Campuses* (Springer 2019) and Ken Hiltner's *Writing a New Environmental Era* (Routledge, 2019). The demand for research in this area reflects both the urgency of the current climate emergency and academics' growing desire to reflect on their own practices and take the lead in modelling solutions.

What sets this anthology apart from similar collections is not only its interdisciplinarity, but its embrace of non-traditional formats. In order to reflect the diverse ways that sustainable-thinking manifests in research, particularly in practices of research-creation, these 'interventions' include not only academic articles, but also creative works, personal reflections, and dialogues.

Section One: Re-defining Sustainability challenges our assumptions about how sustainability is defined, measured, and practiced. Howard Nye makes an ethical argument for why our individual actions still have meaningful impact. Petra Dolata exposes the complex and contradictory history of sustainable thinking as it arose in connection with the unsustainable practices of the energy sector. Kristine Kowalchuk and Amanda Starling Gould each argue that the humanities has a unique role 'righting' our relationship to the environment. Doug Barlage and Gem Shoute consider the carbon impact of the digital revolution. The section concludes with a dialogue between Mél Hogan and Deb Verhoeven on the ecological promise of DNA computing.

Section Two: Art in/and the Anthropocene showcases artist-researchers whose work responds to and engages with the impact of humans on our environment. Joshua Korenblat offers a new approach to data visualization informed by Goethe's 'tender empiricism'. Eric Benson and Priscilla Ferronato experiment with ways of incorporating systems thinking into design education. Michael Leung's photo essay documents the struggle of rural farmers in China and India to maintain their connection to the land even as they are being forcibly displaced by developers. Lai-Tze Fan reflects on the makings of the 'e-waste peep show,' an installation that offers a voyeuristic glimpse of labour conditions inside an e-waste dumpsite. The section concludes with a series of interludes that reflect on creativity in the face of climate catastrophe; series editor Natalie Loveless is joined by artists Andrew S. Yang, Karin Bolender, Christa Donner, Scott Smallwood, Leanne Olsen and Jessie Beier.

Section Three: Sustainable Campuses investigates how academic spaces can model eco-conscious behaviour. The section begins at the intersection of virtual and physical space: Ted Dawson's case study of digital centres asks how researchers can become more conscientious of the environmental impacts of computer technology. My Green Labs founder Allison Paradise then reflects on the push to help science laboratories kick unsustainable habits. Hart Cohen is joined by Abby Mellick Lopes, Jonathon Allen, Maryella Hatfield and Alison Gill in a survey of experimental eco-initiatives at Western Sydney University, the result of making a culture of sustainability and 'repair' central to the university's mandate. Of course, academic spaces include not only environments for conducting research but also environments for exchanging and disseminating ideas. With that in mind, the section on sustainable campuses closes with a trio of articles—by authors Terry Anderson, Nick Byrd, and Oliver Rossier, Chelsea Miya, and Geoffrey Rockwell—on 'greening' academic gatherings by moving conferences online.

SECTION ONE:
RE-DEFINING SUSTAINABILITY

1. Why Should We Try to Be Sustainable?

Expected Consequences and the Ethics of Making an Indeterminate Difference

Howard Nye

Why should we refrain from doing things that, taken collectively, are environmentally destructive, if our individual acts seem almost certain to make no difference? According to the expected consequences approach, we should refrain from doing these things because our individual acts have small risks of causing great harm, which outweigh the expected benefits of performing them. Several authors have argued convincingly that this provides a plausible account of our moral reasons to do things like vote for policies that will reduce our countries' greenhouse gas emissions, adopt plant-based diets, and otherwise reduce our individual emissions. But this approach has recently been challenged by authors like Bernward Gesang and Julia Nefsky. Gesang contends that it may be genuinely impossible for our individual emissions to make a morally relevant difference. Nefsky argues more generally that the expected consequences approach cannot adequately explain our reasons not to do things if there is no precise fact of the matter about whether their outcomes are harmful. In the following chapter, author Howard Nye defends the expected consequences approach against these objections. Nye contends that Gesang has shown at most that our emissions could have metaphysically indeterministic effects

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that lack precise objective chances. He argues, moreover, that the expected consequences approach can draw upon existing extensions to cases of indeterminism and imprecise probabilities to deliver the result that we have the same moral reasons to reduce our emissions in Gesang's scenario as in deterministic scenarios. Nye also shows how the expected consequences approach can draw upon these extensions to handle Nefsky's concern about the absence of precise facts concerning whether the outcomes of certain acts are harmful. The author concludes that the expected consequences approach provides a fully adequate account of our moral reasons to take both political and personal action to reduce our ecological footprints.

1. Environmental Destruction and the Ethics of Collective Action

Why should we try to reduce our destructive impacts on the environment, when it can seem that the effects of our individual acts are too small to make an ethically important difference? As Walter Sinnott-Armstrong puts the challenge, why, for instance, should one seek to reduce one's emissions of greenhouse gases [GHGs] by cycling and taking public transit instead of driving, if it seems that 'Climate change occur[s] on such a massive scale that my individual driving makes no difference to the welfare of anyone'?[1]

This is an instance of a general ethical problem about collective action, which is of great practical as well as theoretical importance. The view that our own reductions of GHG emissions will have too small of an effect to make an important difference appears to be the last line of defense of those inclined to oppose action to address climate change—if at any point they do tire of denying the overwhelming

1 Walter Sinnott-Armstrong, 'It's not my fault: Global warming and individual moral obligations', in *Perspectives on Climate Change: Science, Economics, Politics, Ethics*, ed. by Walter Sinnott-Armstrong and Richard Howarth (Amsterdam: Elsevier, 2005), pp. 285–307 (p. 301), https://doi.org/10.1016/S1569-3740(05)05013-3.

evidence that the climate is changing, that the change is anthropogenic, and that the change is extremely harmful.[2] But even those who accept the overwhelming evidence for harmful anthropogenic climate change and agree that we should do something about it at the level of social policy can (like Sinnott-Armstrong) be sorely tempted—including as a rationalization for personal inaction—by the thought that individual attempts to act in less environmentally destructive ways are futile.

The theoretical importance of such problems of collective action concerns whether in general there are moral reasons in these cases for individuals to act, and what sort of moral theory best accounts for this. For instance, according to the

> **Expected consequences approach**: in *collective action cases* where our acts together are collectively harmful (or beneficial), our individual acts do in fact have a chance [often small] of causing harm (or benefit) [often large] to others. As such, the moral importance of avoiding this risk of harm (or securing this chance of benefit) typically outweighs the possible benefits to us of performing (or failing to perform) these acts.[3]

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2 For an authoritative guide to this overwhelming evidence see IPCC 2014, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. by Core Writing Team, R.K. Pachauri and L.A. Meyer (Geneva: IPCC, 2014), https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf. For discussion of the 'it won't make a difference if we reduce our emissions' objection by those who oppose action on climate change, see e.g. Michael Mann, *The Hockey Stick and the Climate Wars: Dispatches from the Front Lines* (New York: Columbia University Press, 2012), https://doi.org/10.7312/mann15254. A vivid recent example of this rationale for inaction is the National Highway Traffic Safety Administration's defense of its fuel efficiency rollbacks on the grounds that other actors' GHG emissions will cause harmful climate change regardless of what the NHTSA does (National Highway Traffic Safety Administration, *Draft Environmental Impact Statement for The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021–2026 Passenger Cars and Light Trucks* (2018), pp. 5–30, https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ld_cafe_my2021-26_deis_0.pdf.

3 Defenders of this approach include Peter Singer, 'Utilitarianism and vegetarianism', *Philosophy and Public Affairs*, 9 (1980), 325–337 (pp. 335–336); Derek Parfit, *Reasons and Persons* (New York: Oxford University Press, 1984), pp. 73–86, https://doi.org/10.1093/019824908x.001.0001; Gaverick Matheny, 'Expected utility, contributory causation, and vegetarianism', *Journal of Applied Philosophy*, 19 (2002), 293–297, https://doi.org/10.1111/1468-5930.00223; Alastair Norcross, 'Puppies, pigs, and people: Eating meat and marginal cases', *Philosophical Perspectives*, 18 (2004), 229–245 (pp. 231–233), https://doi.org/10.1111/j.1520-8583.2004.00027.x; Shelly Kagan,

If this is correct, then we can explain our moral reasons to omit being complicit in harmful practices and contribute to beneficial practices in terms of familiar principles of non-maleficence not to harm others, beneficence to benefit others, and responsible decision-making under conditions of uncertainty. We need not add any fundamentally distinct ethical principles to those acknowledged by moral theories like Rossian pluralism, according to which there is a plurality of basic moral reasons to act, including non-maleficence and beneficence;[4] and act consequentialism, according to which our moral reasons to do something are proportional simply to the amount of good it will do.[5] Nor need we find any fundamentally new principles of responsible decision-making under conditions of uncertainty beyond the teachings of standard decision theory, according to which (very roughly) we should weigh in favour of an act the benefits it may bring in proportion to their magnitude and likelihood of occurring (its 'expected benefits'), and weigh against it the harms it may produce in proportion to their magnitude and likelihood of occurring (its 'expected harms').[6]

Advocates of the expected consequences approach have argued convincingly that it provides a plausible account of the moral case

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'Do I make a difference?', *Philosophy and Public Affairs*, 39 (2011), 105–141, https://doi.org/10.1111/j.1088-4963.2011.01203.x; Avram Hiller, 'Climate change and individual responsibility', *The Monist*, 94 (2011), 349–368, https://doi.org/10.5840/monist201194318, and 'Morally significant effects of ordinary individual actions', *Ethics, Policy and Environment*, 14 (2011), 19–21, https://doi.org/10.1080/21550085.2011.561588; John Broome, *Climate Matters: Ethics in a Warming World* (New York: W. W. Norton & Co., Inc., 2012), pp. 73–78; and Christopher Morgan-Knapp and Charles Goodman, 'Consequentialism, climate harm, and individual obligations', *Ethical Theory and Moral Practice*, 18 (2015), 177–190, https://doi.org/10.1007/s10677-014-9517-9.

4 See e.g. W. D. Ross, *The Right and the Good* (Oxford: Clarendon Press, 1930), pp. 16–64.

5 See e.g. Henry Sidgwick, *The Methods of Ethics*, 7th edn (London: Macmillan and Co., Limited, 1907), pp. 337–361 (373–390, and 418–459); and Shelly Kagan, *The Limits of Morality* (Oxford: Oxford University Press, 1989), https://doi.org/10.1093/0198239165.001.0001.

6 Classic statements of which include Frank P. Ramsey, 'Truth and probability' (1926), reprinted in *Decision, Probability, and Utility: Selected Readings*, ed. by Peter Gärdenfors and Nils-Eric Sahlin (New York: Cambridge University Press, 1988), pp. 19–47, https://doi.org/10.1017/cbo9780511609220; John von Neumann and Oskar Morgenstern, *Theory of Games and Economic Behavior* (Princeton: Princeton University Press, 1944), pp. 15–31, https://doi.org/10.1515/9781400829460; and Leonard J. Savage, *The Foundations of Statistics* (New York: Dover Publications, Inc., 1954).

for individual acts that can help to reduce our ecological footprints. As I discuss below, these include voting for policies that will reduce our countries' GHG emissions, eating plant-based diets, reducing our air-travel and car-travel by substituting econferences for in-person conferences, and walking, cycling, and taking public transit instead of driving. But this account has recently been challenged by Bernward Gesang, who contends that it may be not only unlikely but genuinely impossible for our individual GHG emissions to make a difference to morally important outcomes.[7] Moreover, Julia Nefsky has challenged the general adequacy of the expected consequences approach by arguing in effect that it cannot explain our reasons not to do things in certain collective action cases where there is no precise fact of the matter about whether their outcomes are harmful.[8]

In this chapter I defend the expected consequences approach against these challenges. I argue that Gesang has shown at most that our emissions could have metaphysically indeterministic effects that lack precise objective chances. But the expected consequences approach has been extended to cases of indeterminism and imprecise probabilities by authors like Krister Bykvist and Susanna Rinard.[9] I show how these extensions vindicate the application of the expected consequences approach to the scenario that Gesang attempts to describe. Moreover, I argue that these extensions of the expected consequences approach can be used to respond to Nefsky's challenge by appropriately explaining our reasons not to do things in collective action cases where there are no precise facts about whether their outcomes are harmful. I conclude that these extensions of the expected consequences approach enable it to provide a fully adequate account of our moral reasons to take both political and personal action to reduce our ecological footprints.

7 Bernward Gesang, 'Climate change—do I make a difference?', *Environmental Ethics*, 39 (2017), 3–19, https://doi.org/10.5840/enviroethics20179261.

8 Julia Nefsky, 'Consequentialism and the problem of collective harm: A reply to Kagan', *Philosophy and Public Affairs*, 39 (2012), 364–395, https://doi.org/10.1111/j.1088-4963.2012.01209.x.

9 Krister Bykvist, 'Normative supervenience and consequentialism', *Utilitas*, 15 (2003), 27–49, https://doi.org/10.1017/s0953820800003757; Susanna Rinard, 'A decision theory for imprecise probabilities', *Philosophers' Imprint*, 15 (2015), 1–16, http://hdl.handle.net/2027/spo.3521354.0015.007.

2. The Expected Consequences Approach to Collectively Destructive Acts

One of the great advantages of the expected consequences approach is that it explains our moral reasons in collective action cases in terms of extremely plausible general principles of non-maleficence, beneficence, and standard decision theory's injunction to weigh acts' expected harms against their expected benefits. These entail that there can be a decisive moral case against performing an act because it carries a small risk of causing a great deal of harm in return for relatively small expected benefits. This seems to be an excellent explanation of why there is a decisive moral case against such acts as speeding through residential areas when late for work, bouncing a ball around a nuclear missile's launch button just for fun, and shooting into an occupied building just for target practice.

At the same time, these principles provide an extremely plausible and helpful way to determine when an act that would otherwise be wrong in virtue of its risks becomes permissible, namely when its expected benefits are great enough in comparison to its expected harms.[10] There is, for instance, no decisive moral case against—but plausibly one in favour of—such acts as driving at high speed through a residential area and shooting into an occupied building if these are the only ways to rush someone in need of urgent care to the hospital or diffuse a bomb about to explode and kill someone.

The expected consequences approach can be applied straightforwardly to the collective action case of voting. Consider the *Simpsons*-inspired case of

> *Voting for Kang*. It is revealed that one of the major party candidates for president in the United States is actually an evil alien named

10 This can be true whether or not one subscribes to the view that there are constraints on harming, or that certain harmful upshots of our conduct are in themselves harder to justify than certain of their failures to have beneficial upshots. One must only avoid the extremely implausible view that there is an absolute prohibition on harmful upshots that translates into an absolute injunction to avoid any risk of harm no matter how small in return for any chance of benefit no matter how great (see e.g. See Kagan (1989), pp. 87–91; and Frank Jackson and Michael Smith, 'Absolutist moral theories and uncertainty', *The Journal of Philosophy*, 103 (2006), 267–283, https://doi.org/10.5840/jphil2006103614.

> Kang who will enslave and torture everyone in the country (with no benefits to anyone other than US citizens) if and only if he wins the election. The other candidate (unlike in 'Citizen Kang') is a typical politician who will maintain the status quo. Kang has, however, rigged voting booths to pay out $50 to everyone who votes for him.

It seems clear that one has decisive moral reason to forgo the $50 and omit voting for Kang—and indeed vote against him. As Derek Parfit showed, this intuition can be justified by the expected consequences approach.[11] Updating Parfit's calculations, there are about 326 million US citizens, and the average probability of one's vote deciding a presidential election is one in 60 million.[12] The expected harm to others of voting for Kang is thus $(1/60 \text{ million}) \times h \times (326 \text{ million}) = 5.43 \times h$, where h is the per-citizen harm inflicted by Kang. Very clearly, the certain benefit of $50 to you (which we may assume can be spent before Kang takes power if he wins) is absolutely trivial in comparison to the per-individual harm inflicted by Kang on one other individual—let alone an expected harm more than five times as great.

To appreciate the expected benefit of voting for sustainable policies, we can consider a more realistic scenario of an election between Superior and Inferior. If Superior wins, she will implement a Green New Deal that will reduce the emissions of the US to net zero by 2050 while benefitting most workers by providing jobs and stimulating aggregate demand. If Inferior wins she will maintain the status quo on US emissions. While the Green New Deal's economic benefits would

11 Parfit (1984), pp. 73–74.

12 Andrew Gelman, Nate Silver and Aaron Edlin, 'What is the probability that your vote will make a difference?', *Economic Inquiry*, 50 (2012), 321–326, https://doi.org/10.1111/j.1465-7295.2010.00272.x; see also Pierre-Antoine Kremp and Andrew Gelman, 'What is the chance that your vote will decide the election?', https://pkremp.github.io/pr_decisive_vote.html. Depending upon one's state of residence, one's vote will have a greater or lesser chance of deciding the election. For instance, if one votes in Colorado, Michigan, Connecticut or Wyoming, one's chance of deciding the election will be respectively one in 1 million, 3 million, 40 million or 30 billion. This, of course, assumes that voting patterns in the election between Kang and his opponent would follow those of other elections. One could, purely hypothetically, imagine this being so due to a distribution of propensities to be more concerned about getting the $50 or more concerned about voting against Kang that are isomorphic to current partisan voting patterns.

be substantial, expected differences in lives lost due to climate policy alone are likely to be enormous. For instance, as I will discuss more below, John Nolt estimates that the expected harm of an average US citizen's current lifetime GHG emissions is 1–2 human lives lost.[13] Since Superior will zero-out the emissions of all 326 million US citizens, the expected benefit of voting for her due simply to her climate policy will be one's 1/60 million chance of deciding the election times the 326 to 652 million lives that can be expected to be saved by this policy, or 5.43 to 10.87 lives. Very clearly, the costs to oneself of voting are absolutely trivial in comparison to the moral importance of saving more than five to ten lives!

Indeed, even if one lives in Wyoming and we take the more conservative estimate of Superior's saving only 326 million lives, the expected benefit of one's voting for her would still be (1/30 billion)×(326 million) = 0.0109 lives which (assuming a life expectancy of 80 years) is 317.31 days of life. Again, the cost to oneself of voting seems completely trivial in comparison to someone else's being deprived of 317.31 days of life. Even if Superior would, rather than eliminate US emissions, simply reduce them by 10% or just 1%, the expected benefits of a vote for Superior in Wyoming due simply to this policy would still be 31.73 or 3.17 days of life. Since the costs to oneself of voting are clearly less important than someone's not being deprived of a month or even three days of life, it would still clearly be worthwhile to vote for Superior, even in Wyoming.[14]

13 John Nolt, 'How harmful are the average American's greenhouse gas emissions?', *Ethics, Policy and Environment*, 14 (2011), 3–10, https://doi.org/10.1080/21550085.2011.561584.

14 Those who are inclined to find it too fanciful for an election to be decided by a single vote should consider the very real-world case of the 2017 election in Virginia's 94th House of Delegates district, where the vote was exactly tied, and control of the House depended upon a single seat. See e.g. Emily Tillett, 'Virginia election results 2017: Republican David Yancey wins Virginia House seat', *CBS News* (January 4, 2018), https://www.cbsnews.com/news/virginia-election-results-lottery-drawing-house-of-delegates-david-yancy-winner-virginia-house-seat/. Had one more voter voted for the Democrat, the seat would have been won, and instead of the Republicans winning a drawing by lot that led to them holding a 51 to 49 seat majority, control of the House would have been shared. There are records of at least 64 similar elections between 1822 and 2018, 21 of which were tied and would have been decided by a singe additional vote, and 43 of which were in fact decided by a single vote. See references to records compiled at 'List of close election results',

Voting is a paradigm example of what Shelly Kagan calls a *triggering case*, where if a certain threshold of individual contributions is crossed this triggers a morally important effect. In such cases, if one's act is part of a cohort that falls short of the triggering number or adds to the surplus above the triggering number, then it (as well as the other members of the cohort) makes no difference to the effect. But if one's act is part of a cohort that exactly crosses the threshold and triggers the effect, then it (as well as the other acts) makes all of the difference to it. To a first approximation voting is a triggering case where one's act has a chance of crossing only a single triggering threshold.[15] There are, however, many important cases in which one's act has a chance of being a part of several cohorts each of which exactly cross different thresholds that trigger morally important effects.

For instance, as Peter Singer, Gaverick Matheny, Alastair Norcross, and Kagan argue, purchasing animal products instead of plant-based alternatives is an instance of a triggering case where one's purchase has a small chance of crossing many thresholds, each of which would result in a great deal of harm to animals and the environment.[16] Given the price mechanism in a market economy, there must be some number N (e.g. 10,000) of additional chicken purchases that causes N more chickens to be bred, tortured, and killed—at the expense of much more land, grain, and water inputs, polluting waste, and unsequestered GHG

Wikipedia, The Free Encyclopedia (October 9, 2020), https://en.wikipedia.org/wiki/List_of_close_election_results.

15 In reality, votes can matter beyond their effect on actually electing candidates by adding to or taking away from margins of victory or defeat, which can affect the extent to which politicians take themselves to have mandates, take certain policies to be favoured by likely voters, and take themselves to be likely to be elected or re-elected if they behave in the way the winning or losing candidate did. How individual votes affect perceptions of margins might not be straightforward, but one way this could work is for votes to have chances of creating totals that round to certain significant digits that stick in the minds of the relevant decision makers in ways they would not have had they been one vote short of this rounding threshold. Since there are presumably many different such totals that matter to many different such decisions makers, voting is to a more accurate approximation a triggering case with one triggering threshold of great significance and several other triggering thresholds of somewhat lesser significance.

16 Singer (1980), pp. 335–336; Matheny (2002); Norcross (2004), pp. 232–234; and Kagan (2011), pp. 110–127.

emissions—than the consumption of plant-based alternatives.[17] In *N*-1

17 On the torture of chickens in the meat industry and the much greater inputs and polluting outputs of animal agriculture, see e.g. Peter Singer and Jim Mason, *The Ethics of What We Eat: Why Our Food Choices Matter* (New York: Rodale Press, 2006); Richard Oppenlander, *Food Choice and Sustainability: Why Buying Local, Eating Less Meat, and Taking Baby Steps Won't Work* (Minneapolis: Langdon Street Press, 2013); Food and Agriculture Organization of the United Nations, *Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities* (Rome: FAO, 2013), http://www.fao.org/3/i3437e/i3437e00.htm; Joseph Poore and Thomas Nemcek, 'Reducing food's environmental impacts through producers and consumers', *Science* 360 (2018), 987–992, https://doi.org/10.1126/science.aaq0216; and Alon Shepon et al., 'The Opportunity Cost of Animal Based Diets Exceeds All Food Losses', *Proceedings of the National Academy of Science* [*PNAS*] 115(15) (2018), 3804–3809, https://doi.org/10.1073/pnas.1713820115.

If one is tempted to think that bringing chickens into existence and killing them is justified on the grounds that it benefits the chickens on net, one should note that: (i) due to the much greater ecological use and damage of producing chickens instead of plant-based alternatives, far more wild animals who would likely live much better lives are caused to exist by the consumption of plant-based alternatives, and (ii) the view that it is OK to support the practice of bringing beings into existence and killing them on the grounds that this benefits them on net entails that one would be justified in supporting similar practices of bringing into existence human children for the purpose of torturing or killing them on the grounds that this would benefit them on net. More plausibly, coming into existence is not a morally important benefit but a precondition for morally important benefit and harm, and bringing someone into this state gives one a special obligation to ensure that she will not come to harm such that if one cannot discharge this obligation one should not bring her into existence. For related ideas about the ethics of causing beings to exist and the genesis of special obligations, see Melinda Roberts, 'The asymmetry: A solution', *Theoria*, 77 (2011), 333–367, https://doi.org/10.1111/j.1755-2567.2011.01117.x; and Seana Shiffrin, 'Wrongful life, procreative responsibility, and the significance of harm', *Legal Theory*, 5 (1999), 117–148. https://doi.org/10.1017/s1352325299052015.

Producers make production decisions on the basis of the anticipated future prices of products (as well of course as costs of production including the opportunity costs of inputs), a large input to which are present prices. One way in which one's purchases can affect the price of a product and thus the likelihood of greater amounts of it being produced is explained by the theory of marginal pairs pioneered by Eugen Böhm-Bawerk, *The Positive Theory of Capital*, trans. by William Smart (1889, reprinted in New York: G. E. Stechert & Co., 1930), pp. 198–213; and developed by Murray Rothbard, *Man, Economy, and the State* (Princeton Van Nostrand, 1962; reprinted in Auburn: Ludwig von Mises Institute, 2001), pp. 106–126. According to this theory a product's equilibrium price is determined to be somewhere in the range between, on the high end: (1) the lesser value of (a) the greatest amount that the *last buyer* (who is willing to pay the least for the product among those who actually buy it) is willing to pay for it, and (b) the lowest amount that the *first excluded seller* (who is willing to accept the least for the product among those who are unwilling to sell it) would have been willing to accept for it; and, on the low end, (2) the greater of (c) the lowest amount that the *last seller* (who is least willing to accept less for the product among those who actually sell it) would have

out of N cases, one's purchase will not make the crucial difference between being part of a cohort that does not as opposed to does cause another N chickens to be destructively tortured and killed, but in 1 out of N cases one's act will make this crucial difference. So the expected harm of one's act of purchasing a chicken is $(1/N)\times N\times h = h$, where h is the harm done to a chicken by being tortured and killed together with the environmental cost of doing this to her. The act thus has the same expected harm, and is as morally important to avoid, as directly torturing and killing one chicken and causing the attendant ecological damage for the mere taste pleasure of eating her.[18]

Animal products are responsible for at least 14.5% of GHG emissions—more than all transportation exhaust—and eliminating them from our diets is the easiest and most effective single thing that most of us can do to reduce our carbon footprints.[19] John Broome, Avram

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been willing to accept for it, and (d) the greatest amount that the *first excluded buyer* (who is willing to pay the most for the product among those who are unwilling to buy it) would have been willing to pay for it. If one would have been the last buyer had one bought the product, then one's abstention may (i) decrease the upper limit of the equilibrium price by causing the former first excluded buyer to become the new last buyer who is willing to pay the least for the product, and thus also (ii) decrease the lower limit of the equilibrium price by causing the former second excluded buyer to become the new first excluded buyer who is only willing to pay less for the product.

18 The expected benefits are at most taste pleasure, since plant-based diets are at least as healthy (and in practice often healthier—see e.g. Academy of Nutrition and Dietetics, 'Position of the Academy of Nutrition and Dietetics: Vegetarian diets', *Journal of the Academy of Nutrition and Dietetics*, 116 (2016), 1970–1980, https://doi.org/10.1016/j.jand.2016.09.025)—and equally nutritious plant-based substitutes like legumes and grains are actually less expensive (cf. e.g. Mary Flynn and Andrew Schiff, 'Economical healthy diets (2012) including lean animal protein costs more than using extra virgin olive oil', *Journal of Hunger & Environmental Nutrition*, 10 (2015), 467–482, https://doi.org/10.1080/19320248.2015.1045675).

19 See e.g. FAO UN, *Tackling Climate Change Through Livestock*; and Gidon Eshel and Pamela Martin, 'Diet, energy, and global warming', *Earth Interactions*, 10 (2006), 1–17, http://doi.org/10.1175/ei167.1. Eshel and Martin find that on average going vegan reduces one's carbon footprint by about 1.5 tonnes CO2 equivalent, about 50% more than switching from a standard car to a hybrid, which reduces it on average by about 1 tonne. 14.5% is actually an extremely conservative estimate of the contribution of animal agriculture to anthropogenic climate change, since among other things it uses a low estimate of the effects of methane emissions from livestock and underestimates the destructive impacts of animal agriculture on carbon sinks; see e.g. Julie Wolf, Ghassem Asrar and Tristram West, 'Revised methane emissions factors and spatially distributed annual carbon fluxes for global livestock', *Carbon Balance and Management*, 12 (2017), 1–24, https://doi.org/10.1186/s13021-017-0084-y; Robert Goodland and Jeff Anhang, 'Livestock and climate

Hiller, Christopher Morgan-Knapp, and Charles Goodman have argued convincingly that other instances of emitting GHGs are also triggering cases with many chances of triggering harmful outcomes. As Broome observes:

> Greenhouse gas harms people in multifarious ways. Each of them is chancy to some extent. A particular storm will be harmful only if the water rises above the flood defenses. Each increase in the amount of greenhouse gas in the air slightly increases the quantity of rain, but it will be a matter of chance whether the particular quantity of gas you emit this year will be enough to cause a flood on any particular occasion. Your emission increases the likelihood of a flood, but it might not actually cause any particular flood… But during the centuries they are in the air they will have the chance of causing harm on innumerable occasions. It is extraordinarily unlikely that they will do no harm at all.[20]

Broome is discussing our lifetime emissions rather than, say, the emissions from a particular drive. But even if the emissions from a particular drive are likely to do no harm at all, they do, as Morgan-Knapp and Goodman argue, have a small chance of causing a huge amount of damage through dramatic 'butterfly effects' that cascade into harmful events like storms, floods, droughts, and heat-waves. Moreover, because climate science dictates that acts which emit GHGs are more likely to have these butterfly-effect-caused harms and no more likely to have butterfly-effect-caused benefits than their omission, these small chances of great harm are not counterbalanced by equally sized butterfly-effect-caused benefits and do not 'drop out' of the decision theoretic evaluation.[21]

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change: What if the key actors in climate change are… cows, pigs and chickens?', *WorldWatch*, November/December 2009, https://awellfedworld.org/wp-content/uploads/Livestock-Climate-Change-Anhang-Goodland.pdf; and Timothy Searchinger et al., 'Assessing the Efficiency of Changes in Land Use for Mitigating Climate Change', *Nature* 564 (2018), 249–253, https://doi.org/10.1038/s41586-018-0757-z.

20 Broome (2012), p. 76.

21 Unlike the completely random and non-directional risks of butterfly-effect-caused harms from any act, which are counterbalanced by equal chances of butterfly-effect-caused benefits and can thus be ignored—at least so long as there are no constraints on harming (see Howard Nye, 'Chaos and Constraints', in Dimensions of Moral Agency, ed. by David Boersema (Newcastle: Cambridge Scholars Publishing 2014), https://www.cambridgescholars.com/resources/pdfs/978-1-4438-6692-7-sample.pdf; Morgan-Knapp and Goodman (2015), pp. 183–286).

As Hiller observes, because an emission's chance of crossing thresholds and triggering harmful effects is proportional to its size, and we know of nothing else that makes any given emission more or less likely to do this, we can determine an emission's expected harm by multiplying the total expected harm of our collective emissions by the ratio of the emission's size to that of the collective amount.[22] John Nolt employs this method to estimate the expected harm of the 1,840 tonnes of CO2 equivalent emitted by an average US citizen over the course of her life to be the death and/or severe suffering of 1–2 humans.[23] Using the more conservative estimate of one life lost per 1,840 tonnes CO2 equivalent, Hiller estimates the expected harm of a 40 km Sunday joyride in a car, which emits 14.1kg of CO2 equivalent, as that of ruining someone's afternoon (or depriving her of 5.37 hours of life). While weighty enough to decisively outweigh the benefits of joyrides, and to strongly favour walking, cycling, and taking public transit over commuting by car, these expected harms can plausibly be outweighed by such sufficiently serious considerations as the need to rush someone to the hospital.

A fuller account of the expected harms of our GHG emissions would take into account their effects on non-human animals. Brian Tomasik argues that, on a conservative estimate, there are at least about 14 wild land vertebrates and 1,400 wild marine vertebrates for every human.[24] These individuals are clearly sentient,[25] and likely to be at least as vulnerable to the harms of climate change as humans. So a fuller but still conservative estimate of the expected harms of the emissions from a Sunday joyride might also include a proportionally great harm to 14 land vertebrates and 1,400 marine vertebrates. The figure of depriving the human of 5.37 hours of life is based on a full human life expectancy

22 Hiller (2011), 357–358.

23 Nolt (2011).

24 Brian Tomasik, 'How many wild animals are there?', 2018, http://reducing-suffering.org/how-many-wild-animals-are-there/.

25 See e.g. David Edelman and Anil Seth, 'Animal consciousness: A synthetic approach', *Trends in Neurosciences*, 32 (2009), 476–484, https://doi.org/10.1016/j.tins.2009.05.008; Jaak Panksepp, *Affective Neuroscience: The Foundations of Human and Animal Emotions* (Oxford: Oxford University Press, 1998), Jonathan Balcombe, *Pleasurable Kingdom: Animals and the Nature of Feeling Good* (London: Macmillan, 2006); and Victoria Braithwaite, *Do Fish Feel Pain?* (Oxford: Oxford University Press, 2010), https://doi.org/10.1086/656881.

of 80 years. So if, for instance, each of the wild animals had a life expectancy absent climate harm of three years, a proportional expected harm to each of them from the emission of 14.1 kg of CO2 equivalent might be the deprivation of 3/80×5.37×60 = 12.08 minutes of life.

Hiller's method can also be used to estimate the moral importance of reducing our air travel, for instance by substituting online video econferences, e-colloquia, and e-symposia for traditional academic gatherings that require flying. It has been estimated that up to 1/3 of the GHG emissions of an institution like the University of California, Santa Barbara are due to air travel, and that a single round-trip continental flight can emit a full tonne of CO2 equivalent, consuming one's entire carbon budget needed to limit global temperature rise to 1.5 degrees C.[26] The University of Alberta's Kule Institute for Advanced Study estimates that, for each year that it has held its Around the World econference in the place of a comparable traditional conference, it has eliminated the need for 200 flights and prevented the emissions of 300 tonnes of CO2 equivalent.[27] The expected benefit of doing this is 300/1,840 of the benefit of saving the full lives of a human, 14 land vertebrates, and 1,400 marine vertebrates, or omitting to end the lives of an elderly human with a life expectancy of about 13 years and 14 land together with 1,400 marine vertebrates with life expectancies of about 6 months. According to the expected consequences approach, the moral reasons to transition to an econference are thus comparable in strength to those in favor of omitting to end the lives of a 69-year-old Canadian, the 14 elderly dogs for whom he cares at his animal sanctuary, and the 1,400 elderly fish living in the lake next to the sanctuary. Since it would be morally imperative not to kill these individuals just to enable us to have a conference, it is at least as clearly imperative for us to bear the much lesser cost—which may actually be a net benefit when we account for the savings of money and time, and the greater accessibility to scholars of lesser means around the world—of substituting an econference like Around the World for a comparable in-person conference.

26 Ken Hiltner, 'A nearly carbon-neutral conference model', https://hiltner.english.ucsb.edu/index.php/ncnc-guide/.

27 Trevor Chow-Fraser, Chelsea Miya and Oliver Rossier, *Moving Ideas without Moving People: How to Econference at the University of Alberta* (2018), p. 7, https://aroundtheworld.ualberta.ca/wp-content/uploads/2018/05/E-Conferencing-Toolkit.pdf.

3. Gesang's and Nefsky's Challenges: Problems of Indeterminacy

Although he is sympathetic to a similar account of the moral case for reducing our emissions, Gesang has recently argued that the expected consequences approach's account as described above does not straightforwardly succeed. His main contention is that there is a reasonably likely climate scenario in which it is not only unlikely but genuinely impossible for small emissions to cause morally significant effects.[28] To make this plausible, Gesang draws an analogy to the sorites paradox for vague properties like that of being a heap, which is that two very plausible views about the property lead to the very implausible conclusion that nothing has the property:

- *Some non-heaps*: a collection of 1 grain of sand is not a heap.
- *Tolerance thesis*: for any number n of grains of sand, if a collection of n grains is not a heap, then a collection of n+1 grains is not a heap.
- Therefore, *No heaps*: all collections of grains of sand, no matter how many, fail to be heaps.

28 Gesang (2017), pp. 14–19. Gesang sketches another scenario in which the expected consequences approach would not (at least in the straightforward way suggested by Hiller, Morgan-Knapp, and Goodman) support reducing our emissions, namely one in which there is exactly one triggering threshold and we know with certainty (or at least sufficient probability that the expected harm of our emissions is less than the expected harm of the large amount of emissions crossing the threshold times the ratio of our emissions to the large amount of emissions) that the threshold has been crossed and the continued existence of mammals will be impossible, regardless of whether or not we emit any given quantity of GHGs (pp. 8–9). While Gesang thinks this scenario is very unlikely and does not rest much weight on his discussion of it, it is worth noting that (i) even if we knew with certainty that a threshold had been crossed that would soon make life for mammals impossible, it does not follow that our emissions can have no further morally relevant effects (e.g. for the mammals and others before life becomes impossible, and for the sentient non-mammals after life becomes impossible for the mammals), and (ii) even if we thought it was extremely likely that the threshold would be crossed regardless of whether we emit, the tiniest probability of our emissions influencing this catastrophic event could easily, in virtue of the enormous size of the harm, be enough to make our emissions' expected harms outweigh their expected benefits. Compare this to the case of voting for president in Wyoming discussed above.

As Gesang notes, most theorists view vagueness and the consequent Sorites paradox as resulting from the semantic or mental feature that there is no precise fact of the matter about what falls under the concepts signified by vague predicates like 'is a heap' and 'is bald'. His problem is thus to explain how there could be a metaphysical sorites paradox in the case of GHG emissions, in which it seems plausible that small additional GHG emissions can never make the difference between the absence or presence of a morally important effect like a flood taking place—even though small amounts of GHGs add up to large amounts, and large amounts do make such differences.

To make plausible the metaphysical tolerance thesis about emissions and causation, Gesang invokes Nefsky's discussion of a voltmeter with a 1 kv margin of error. If after a series of single nanovolt increases the voltmeter registers '1 kv', Nefsky claims that we cannot say that the last nanovolt increase made the difference between its doing so and not doing so because its registering '1 kV' when it does is 'likely due to mechanical or environmental factors and not to the addition of some single nanovolt'.[29]

However, without saying anything more about the mechanics of the device, this case appears to do nothing to support the claim that it is *impossible* for a single nanovolt to make a difference to whether the voltmeter registers '1 kv'. The most natural way for it to be likely that the last nanovolt failed to make the difference is for it to be likely that the voltmeter would have registered '1 kv' even if one had not added this nanovolt, since the other factors would have made it register '1 kv' anyway. But this certainly does not rule out there being some chance—perhaps quite small—that the single nanovolt increase did make the difference because the other factors would not have made the voltmeter register '1 kv' if one had not added the nanovolt.[30] The analogy to the climate case is thus simply what proponents of the expected consequences approach have been saying all along: for any climate harm, it is most likely that it will happen (or not) absent one's emission, but there is a small chance that one's emission will make the crucial difference and thus cause enormous harm.

29 Nefsky (2012), p. 391.

30 Nefsky actually acknowledges exactly this point on pp. 392–394 (ibid.).

But there could be a more interesting reason why we could not truly say that the last nanovolt made the difference to the voltmeter's registering '1 kv'. Suppose that the voltmeter operates in an objectively chancy or metaphysically indeterministic way, so that, given the entire history of the world at time *t*, the laws of nature fail to dictate that the voltmeter must be in some single state at *t*+1. Given this complete history, it is both possible for it to register '1 kv' and possible for it not to do so. As such, there will be no determinate fact of the matter about what would happen if one were to add or omit to add any given nanovolt. In some of the closest possible worlds in which one omits to add the nanovolt the voltmeter does not register '1 kv', but in others of these closest worlds the voltmeter does register '1 kv'. So for any single nanovolt increase followed by the voltmeter's registering '1 kv', it is not determinately true that this would not have happened had one not added the nanovolt—it might not have happened but it might still have happened.

Gesang's mention of quantum theory, the Copenhagen interpretation, and objective chances also support his being most charitably understood as proposing that the climate system may exhibit the foregoing sort of metaphysical indeterminacy.[31] On this view, for small amounts of GHGs, there is simply no determinate fact of the matter about what would

31 Gesang (2017), p. 18. It is admittedly confusing that Gesang additionally mentions 'emergence theory', the content and relevance of which is unclear, and 'chaos theory', which Morgan-Knapp and Goodman convincingly argue is a plausible way to understand how small GHG emissions can determinately cause morally important effects—since it involves the climate system exhibiting sensitive dependence on initial conditions which gives rise to the above discussed butterfly effects by which events like small emissions can cascade into dramatic effects like floods and serious harms. It is also confusing that Gesang describes the voltmeter and climate scenarios as ones where the nanovolts and small GHG emissions determinately do not make any difference, as opposed to their simply being such that they do not determinately make a difference, because it is indeterminate whether they make a difference. But it seems to me that (i) there is no way to interpret Gesang as getting at a distinct convincing argument by invoking 'emergence' or 'chaos theory', and (ii) my interpretation of Gesang as getting at the above described kind of indeterminacy is the only way to interpret his remarks about the voltmeter and climate system in a way that (a) has him avoid simply being confused about the possibility of overdetermination not precluding the possibility of determinate difference making and the case being precisely the sort that Morgan-Knapp and Goodman were discussing, and (b) makes sense of his invocation of quantum theory and objective chances, which make perfect sense on an indeterministic interpretation of his remarks.

happen if we emit them. In some of the closest possible worlds in which we emit them, climate harms that otherwise might not occur do occur, while in others they do not occur. Our inability to be certain about what would happen stems not only from our ignorance of the exact details of the extremely complex climate system, but also from some of these details being undetermined by the laws of nature.

Gesang's objection to the expected consequences approach's account of the moral case for reducing our emissions is thus most charitably understood as turning upon the possibility of its being metaphysically indeterminate whether our acts will have certain outcomes. Nefsky offers a more general objection to the adequacy of the expected consequences approach that I think also turns upon a kind of indeterminacy, but indeterminacy in the value of the outcomes of our acts rather than whether our acts will cause them. Nefsky's criticism focuses on cases in which none of the possible outcomes of our acts seem to make a morally relevant difference. A classic example is Parfit's case of

> *The Harmless Torturers*. Each of 1,000 torturers presses a button that increases by a tiny amount the electric current being fed to 1,000 victims. When none of the buttons are pressed the victims feel fine, but after each torturer has pressed her button each victim is being shocked by a massive current that causes her excruciating pain. Yet none of the victims seem to notice the additional electrical current from any one torturer's pressing her button.[32]

Here, unlike in the cases discussed earlier, there do not seem to be any sharp thresholds that an additional button-pressing can cross to trigger a morally important outcome of pain or determinately worse pain to any victim. It thus seems that each torturer can be absolutely certain that because her pressing her button will not be noticed by any of the victims, it has no chance of making a morally relevant difference.

Kagan, Morgan-Knapp, and Goodman suggest that some cases of doing collective harm by polluting and causing climate change are *apparently imperceptible difference cases* of this kind.[33] But even if the most important environmental collective action problems are clear triggering

32 Parfit (1984), p. 80.
33 Kagan (2011), p. 129; Morgan-Knapp and Goodman (2015), p. 187.

cases, apparently imperceptible difference cases are still indirectly relevant to the expected consequences approach to explaining our moral reasons to reduce our ecological footprints. These cases challenge the general adequacy of the expected consequences approach, and it would seem problematic to accept this approach to our moral reasons in clear triggering cases but then to endorse a different explanation of our reasons in apparently imperceptible difference cases. Such a hybrid approach would among other things risk either (1) over-generating reasons in the clear triggering cases due to the reasons given by expected consequences combining with the other reasons operative in the apparently imperceptible difference cases, or (2) being implausibly ad hoc due to the lack of principled explanation as to why the non-expected-consequence-based reasons are present in the apparently imperceptible difference cases but not the clear triggering cases.

Kagan and several other proponents of the expected consequences approach have offered versions of the following 'reports-based argument' that apparently imperceptible difference cases are only apparent, and must actually involve sharp thresholds the crossing of which trigger determinately morally relevant differences. Suppose that the torturers press their buttons one after the other, and you ask a victim if she feels worse after each button-pressing. Because at the beginning she feels fine and at the end she feels awful, there must be some button-pressings after which she reports feeling worse. These button-pressings must have made a determinate difference to the badness of her pain.[34]

But as Nefsky observes, if S_0,...,$S_{1,000}$ are the experiential states of a victim caused by 0 through 1,000 units of current affecting her, it seems entirely possible that she could report feeling worse in, say, S_{21} without S_{21} feeling determinately worse than S_{20}. Perhaps there was no clear point at which she noticed her states feeling determinately worse than S_0, but this was somewhere around S_{15}-S_{25}, and it was somewhat random at which of these states she reported feeling worse to catch up to the fact that she seems to feel worse than she did in S_0. Kagan actually concedes

34 Frank Arntzenius and David McCarthy, 'Self-torture and group beneficence', *Erkenntnis*, 47 (1997), 129–144 (pp. 132–135) https://doi.org/10.1023/a:1005376607563; Alastair Norcross, 'Comparing harms: Headaches and human lives', *Philosophy and Public Affairs*, 26 (1997), 135–167 (pp. 141–144), https://doi.org/10.1111/j.1088-4963.1997.tb00079.x; Kagan (2011), pp. 131–134; and Morgan-Knapp and Goodman (2015), pp. 186–190.

that our beliefs and reports about whether two very similar experiences were exactly the same are fallible indicators of whether they were.

Moreover, as Nefsky argues, proponents of the reports-based argument are too quick to dismiss the possibility of vague boundaries between which states in the series feel worse.[35] It might well be that for each pair of adjacent states S_i and S_{i+1}, there is no determinate fact of the matter about whether S_{i+1} feels worse to the victim than S_i. As Parfit has argued in another context, it does not seem that the degrees of badness of different painful experiences are precisely comparable. Consider a comparison between an intense pain that lasts for an hour and a much less intense pain that lasts longer. For sufficiently short durations like an hour and a minute, the less intense pain will be determinately less bad than the intense pain, and for sufficiently long durations like three years the less intense pain will be determinately worse. But it seems very implausible that there is some magic number of seconds or milliseconds of the less intense pain that makes it precisely as bad as the intense pain, such that one second or millisecond less would make it determinately less bad than the intense pain, and one second or millisecond more would make it determinately worse than the intense pain.[36]

4. Indeterminacy and Supervaluationist Decision Principles

I have thus argued that Gesang's and Nefsky's challenges to the expected consequences approach hinge upon indeterminacy. Gesang has shown at most that there may be no determinate fact of the matter about whether our emissions will cause certain outcomes, while Nefsky has shown that there may be no determinate fact of the matter about whether certain of the outcomes caused by our acts are worse than their alternatives. But the expected consequences approach has been extended to these kinds of cases of indeterminacy. In this section I show how these extensions can be used to defend the approach against Gesang's and Nefsky's challenges.

35 Nefsky (2012), pp. 380–387; Kagan (2011), p. 136.

36 Derek Parfit, *On What Matters*, vol. 1 (New York: Oxford University Press, 2011), p. 132, https://doi.org/10.1093/acprof:osobl/9780199572809.001.0001.

If Gesang is correct that there is no fact of the matter about what would happen if we were to emit small amounts of GHGs (and we know this), then proponents of the expected consequences approach like Morgan-Knapp and Goodman are mistaken in claiming that there is a small *epistemic probability*—or degree of expectation we should have given our evidence—that such emissions will determinately trigger significant climate harms. But other proponents of the expected consequences approach have discussed how to apply it to cases in which it is indeterminate what the consequences of our acts will be. As Bykvist observes, if indeterministic processes yield precise objective chances of the outcomes that might obtain if we act in various ways,[37] we should follow

> **The Indeterministic Consequences Extension**: apply the expected consequences approach using the objective chances as the probabilities of the outcomes to determine the (fact-relative) moral case for and against the different acts.[38]

The rationale here seems exactly the same as that in favour of applying the expected consequences approach to cases where one's acts will have determinate but epistemically uncertain effects using the epistemic probabilities of those effects. When one cannot know with certainty

37 Where the objective chance of an outcome obtaining if an act is performed is something like the propensity of the act to lead to the outcome, or the proportion of the closest possible worlds in which the act is performed in which the outcome obtains. Such precise objective chances seem to be involved in the laws of nature according for instance to the Copenhagen interpretation of quantum mechanics—on which they determine such things as that a given electron has a 1/2 chance of being spin-up and a 1/2 chance of being spin-down.

38 Bykvist (2003), p. 30, n. 7; see also Douglas Portmore, *Commonsense Consequentialism: Wherein Morality Meets Rationality* (Oxford: Oxford University Press, 2011), p. 56, n. 1, https://doi.org/10.1017/s0953820812000490. The fact-relative moral case for and against one's alternative acts is the extent to which the facts of one's circumstances count in favour of and against performing them, regardless of one's evidence about these facts (cf. Parfit (2011), pp. 150–162). The evidence-relative moral case is the moral case given one's evidence, which is typically at issue in discussions of the expected consequences approach. In a deterministic world the fact-relative moral case for and against an act is constituted by the benefits and harms it will actually bring about, regardless of one's evidence about this. But in an indeterministic world there are no determinate facts of the matter about what it will bring about: hence in such a world Bykvist suggests that we should use the expected consequences approach to determine what is the fact- and not simply the evidence-relative moral case for and against the act.

what would happen if one were to perform an act, in order to give appropriate weight to the ethical relevance of both

i. the harms and benefits that might obtain if one were to perform it, and

ii. the probabilities that these harms and benefits would obtain if one were to perform it,

one should weigh against and in favour of the act i in proportion to ii. It does not matter to the plausibility of this idea whether the lack of certainty and probabilities are due to one's ignorance of facts or the indeterministic structure of the world.

Even if we assume that our emissions do have precise objective chances of causing various climate harms, we presumably do not know exactly what these chances are. Given our evidence, all we seem to know is that an emission's objective chances of causing harms are proportional to its size, and we know of nothing else that increases or decreases these objective chances. As such, it seems that we should still follow Hiller and determine a given emission's epistemically expected harm by multiplying the total expected harms of our collective emissions by the ratio of the given emission to the collective amount. All Gesang's point about metaphysical indeterminacy does is entail that the epistemic probabilities of harm are generated not only by our ignorance of facts but also by the chancy nature of the world.

What, however, if Gesang's scenario of a metaphysically indeterministic climate system is one in which there are no precise objective chances of various outcomes occurring if various acts are performed? In such a scenario, while it may be determinate that the objective chance of a climate harm given some complete world history is greater than 0.5 and less than 0.9, there may simply be no fact of the matter about whether it is, say, 0.6531, 0.6527, or many other values between 0.5 and 0.9. While this cannot be handled by the indeterministic consequences extension alone, it can be handled by a natural and conservative extension of the expected consequences approach to cases of imprecise probabilities.

As Rinard has argued, there is a compelling way to motivate such an extension to cases in which the epistemic probabilities of various outcomes are imprecise. According to the general *supervaluationist*

approach to vagueness, for a claim with a vague predicate (such as 'Singer is bald') to be determinately true is for it to be true under every *admissible precisification*—or way of making the vague predicate precise (e.g. 'someone with less than exactly 50% of typical hair-distribution is bald') consistent with what is otherwise determinately true and false about the predicate (e.g. 'someone with literally no hair is bald' and 'it is not the case that someone with a full typical hair-distribution is bald').[39] If probabilities are imprecise, then claims about the probabilities of certain harms and benefits occurring if one performed certain acts seem to be clear instances of claims involving vague predicates. Thus, Rinard observes, the supervaluationist approach to vagueness supports

> **The Supervaluationist Principle for Probabilities**: if probabilities are imprecise, but the expected harms of an act outweigh its expected benefits on every admissible precisification of the probabilities, then one determinately should not perform the act.

Suppose that, for every way of making precise the probabilities of the harms and benefits that might obtain if one were to perform an act, which is consistent with what one knows, the expected harms outweigh the expected benefits. Then the ethical significance of the act's possible harms and their range of admissible likelihoods of occurring seems to unequivocally outweigh that of its possible benefits and their range of admissible likelihoods of occurring.[40] Note, moreover, that it does not matter to the plausibility of this rationale whether the imprecision of

39 Brian Weatherson, 'The problem of the many', in *The Stanford Encyclopedia of Philosophy*, ed. by Edward Zalta (2014), §7.3, https://plato.stanford.edu/archives/win2016/entries/problem-of-many/.

40 Rinard (2015), pp. 2–5. See also James Joyce, 'A defense of imprecise credences in inference and decision making', *Philosophical Perspectives*, 24 (2010), 281–323 (p. 311), https://doi.org/10.1111/j.1520-8583.2010.00194.x. As Joyce observes, what I am calling the supervaluationist principle for probabilities is a point of agreement among all proposed decision principles for the context of imprecise probabilities. This point of agreement is all I am relying upon in my argument. Rinard is distinctive in arguing that the general supervaluationist rationale supports not only the supervaluationist principle for probabilities but the further conclusion that, if expected consequences are different under different admissible precisifications of probabilities, then there is no determinate fact of the matter about what one should do. While I am sympathetic to this stronger view, my argument in no way depends upon it.

the probabilities is due simply to one's ignorance of facts that would justify having precise expectations, or to the world having an imprecise objectively chancy structure.

It seems, then, that if even if Gesang were right that a plausible climate scenario involves our emissions having objectively chancy effects without precise chances, we can use the supervaluationist principle for probabilities to apply the expected consequences approach. If we knew all there was to know about an act's objective chances of causing climate harms, we could apply the principle straightforwardly. For instance, if we knew that a given joyride had a propensity between one in one million and one in ten million of causing a flood that will inflict expected harm equal to the loss of 100 lives of 80 years, because the benefit to us is trivial in comparison to someone's losing anything between 70 and 7 days of life, the moral case against the joyride is determinately decisive.

Of course, if we assume any remotely realistic such scenario, we do not know all there is to know about our acts' imprecise objective chances of causing various climate harms. Given our evidence, all we seem to know is that an emission's admissible ranges of chances of causing harms are proportional to its size, and we know of nothing else that increases or decreases these ranges of objective chances. So it seems that, once again, we should use Hiller's method of determining an emission's epistemically expected harm by multiplying the total expected harms of our collective emissions by the ratio of the emission's size to that of the collective amount. The epistemic probabilities are generated not only by our ignorance of facts but by imprecise objective chances. But the epistemic probabilities of harm are exactly what they would be if they were, as Hiller, Morgan-Knapp, and Goodman suggest, due entirely to ignorance of facts.

Thus, even if Gesang is correct that our emissions may have imprecise objective chances of causing harm, modest extensions of the expected consequences approach entail that it is just as important to reduce our emissions as it would be if their effects were fully deterministic.

Rinard develops the supervaluationist approach to decision making in the context of indeterminate probabilities that certain outcomes will occur if we perform certain acts. But exactly parallel reasoning supports a similar approach to decision making in cases where the value of the outcomes of our acts is indeterminate. As Nefsky suggests, apparently

imperceptible difference cases such as that of Parfit's Harmless Torturers seem to be cases of this kind. Pressing a button that marginally increases the amount of current flowing to the 1,000 victims will, for at least some ways the other torturers might act, neither determinately worsen the pain of any victims nor determinately leave them no worse off than they otherwise would have been.

Just as the supervaluationist approach to vagueness supports the supervaluationist principle for probabilities, it also supports

> **The Supervaluationist Principle for Values**: if the degrees of harm or benefit of some possible outcomes of our acts are imprecise, but the expected harms of an act outweigh its expected benefits on every admissible precisification of these degrees of harm or benefit, then one determinately should not perform the act.

Much as above, suppose that, for every way of making precise the degrees of harm or benefit of the possible outcomes of an act that are consistent with what we know, its expected harms outweigh its expected benefits. Then the ethical significance of the range of the act's admissible degrees of harm and their probabilities of occurring seems to unequivocally outweigh that of the range of the act's admissible degrees of benefit and their probabilities of occurring.

To apply this to the Harmless Torturers case, again let $S_0,\ldots,S_{1,000}$ be the experiential states of a victim caused by 0 through 1,000 units of current. For at least some x, it is not determinate whether S_{x+1} is worse than S_x, but $S_{1,000}$ is determinately much worse than S_0. What we must do is consider the set of all admissible precisifications or ways of assigning harm or disvalue to S_1 through $S_{1,000}$ consistent with $S_{1,000}$ being much worse than S_0. Each such precisification distributes the difference in harm between $S_{1,000}$ and S_0, $H(S_{1,000}) - H(S_0)$, among the various states. So on each admissible precisification there will be n ($\leq$ 1,000) states with amounts of additional harm $h_1,\ldots,h_n$ of $H(S_{1,000}) - H(S_0)$, such that $h_1 + \ldots + h_n = H(S_{1,000}) - H(S_0)$. By pressing one's button one has an equal chance of causing any of S_1 through $S_{1,000}$, and the amount of additional harm of any state not assigned an amount of additional harm by an admissible precisification is zero. So on each admissible precisification, one's expected harm from pressing one's button will

be $(1/1{,}000)\times h_1 + \ldots + (1/1{,}000)\times h_n = (h_1 + \ldots + h_n)/1000 = (H(S_{1,000}) - H(S_0))$ / 1,000, which is equivalent to that of a 1/1,000 chance of causing the full difference in harm between $S_{1,000}$ and S_0. Since one is doing this to 1,000 victims, the expected harm one is causing to all of them is equal to that of taking a single victim from S_0 to $S_{1,000}$ with certainty.

But this is the exact same expected harm from pushing the button that we would get if we followed the advocates of the reports-based argument who insist that it cannot be vague whether certain states feel worse than others in apparently imperceptible difference cases. These authors simply insist that, for each victim there is some single actual distribution of the difference in harm between $S_{1,000}$ and S_0 among the states S_1 through $S_{1,000,}$ $\hat{h}_1, \ldots, \hat{h}_n$, such that $\hat{h}_1 + \ldots + \hat{h}_n = H(S_{1,000}) - H(S_0)$ (which they think corresponds in some way to what she would report if she were asked).

Thus, even if (as I suspect) Nefsky is correct that there are vague boundaries among the harms caused to the victims in states S_1 through $S_{1,000}$, on every admissible precisification of the harms, the expected harms to the victims will be identical to what they would be if there were no such vague boundaries. So, given the supervaluationist principle for values, this means that the moral case against pressing the button will be decisive when the differences in harm are vague just in case it would also be decisive if these differences were not vague. So once again, even if there is indeterminacy where advocates of the expected consequences approach have thought that there is determinacy, our modest extension of the expected consequences approach enables it to yield the exact same results that it would if there was actually determinacy.

5. Conclusion

The expected consequences approach provides a clear explanation of why we should take both political and personal action to reduce our ecological footprints. In environmental collective action problems like that of anthropogenic climate change, the collective result of our acts like emitting GHGs is extremely harmful. As Hiller, Broome, Morgan-Knapp, and Goodman have argued, emissions far less than the sum-total of all anthropogenic GHGs have small chances of crossing thresholds and causing the more likely butterfly effects of the chaotic climate system that result in great harm. Because an emission's chance of having

these effects is proportional to its size, and we know of nothing else that makes any given emission more or less likely to have them, we can determine an emission's expected harms by multiplying the total expected harm of our collective emissions by the ratio of the emission's size to that of the collective amount.

Following Nolt, we can use this method to estimate the expected benefit of various political and private acts of reducing our destructive impacts on the environment. Doing so, we can see that policies like a Green New Deal in the US could reduce the emissions of CO2 equivalent by hundreds of billions of tonnes, which can be expected to save hundreds of millions of lives. As such, we must vote and campaign for policies like the Green New Deal because, although our votes and those of others we may convince are very likely to make no difference to the enactment of such policies, they have a small chance of winning the election and making all the difference. This makes the expected benefit of an average vote in such an election equivalent to that of saving between 5 and 10 full human lives, and that of even a vote in an extremely uncompetitive state equivalent to extending someone's life by almost a year, which decisively outweighs the costs to us of voting and canvassing.

This applies just as much to actions within our personal as our political lives. A single choice of purchasing plant-based alternatives rather than a chicken's corpse has a small chance of omitting to cause an enormous number of additional chickens to be tortured and killed in a way that would involve much greater ecological destruction than the production of plant-based alternatives. This makes the expected benefit of a single choice of purchasing plant-based alternatives rather than a chicken corpse equivalent to that of omitting to torture and kill one chicken and omitting the ecological damage of torturing and killing her, which decisively outweighs the relatively trivial cost of forgoing familiar taste e-pleasures from eating her corpse. By going vegan one can be expected each year to directly prevent the torture and killing of somewhere between at least 232 and 443 vertebrate animals, together with the benefits to wild animals and other humans of using up to 2.83 fewer acres or only 1/18 as much land, and emitting at least 1.5 fewer tonnes of CO2 equivalent.[41] We can also prevent a great deal of

41 Oppenlander (2013); Harish Sethu, 'How many animals does a vegetarian save?', *Counting Animals* (February 6, 2012), http://www.countinganimals.com/how-many-animals-does-a-vegetarian-save/.

expected harm by reducing our flying and using video technology to hold our academic meetings online without the need to travel. A single econference like Around the World can be expected to save 300 tonnes of CO2 equivalent, which prevents an expected harm comparable to that of killing a 69-year-old Canadian, his 14 elderly dogs and the 1,400 elderly fish in a nearby pond.

The adequacy of this account has been challenged by Gesang's contention that it may be not only unlikely but genuinely impossible for sufficiently small emissions to make a morally relevant difference, and Nefsky's concern that the expected consequences approach cannot explain why we should avoid contributing to collective harm in cases like the Harmless Torturers where the possible outcomes of our acts do not seem determinately worse for anyone.

In response I have argued that Gesang has shown at most that, if the laws of nature are not deterministic, there may be no determinate fact of the matter about what would happen if we emit some quantity of GHGs. But, as I have explained, the expected consequences approach has already been extended to such cases of indeterminism. If indeterministic outcomes occur with precise objective chances, the general idea of the expected consequences approach supports using those objective chances—or our best estimates of them—in our calculations of expected consequences. If the objective chances are not precise, then we should follow the supervaluationist approach that has already been developed for imprecise epistemic probabilities, and conclude that, if on every admissible precisification of the probabilities the expected harm of emitting outweighs its expected benefits, then we should not emit. From our evidential perspective we do not actually know the precise or imprecise objective chances of any given emission making any given difference—all we seem to know is that the chance or range of chances of the emission causing harms is proportional to its size. So we should still determine an emission's epistemically expected harm by multiplying the expected harm of our collective emissions by the ratio of the emission's size to that of the collective amount. This means that even if Gesang is correct that our emissions may have imprecise objective chances of causing harm, the expected consequences approach entails that it is just as important to reduce them as it would be if their effects were fully deterministic.

Exactly similar reasoning can be used to respond to Nefsky's concern that the outcomes of our acts in cases like the Harmless Torturers may not be determinately worse for the victims. The supervaluationist approach here supports the conclusion that, if it is vague which mental states of the victims are worse for them than others, then we should not perform the act if its expected harms outweigh its expected benefits on every admissible precisification of the harms to the victims. But every admissible precisification must distribute the full difference between no one contributing to the victims' harm and everyone contributing to it among the various amounts of positive contribution, each of which our contribution has an equal chance of causing. So on every admissible precisification, the expected harm is equal to the total difference in harm divided by the number of states of positive contribution. But this is exactly what the expected harm would be if there were one actual precise distribution of the harm among the states of positive contribution. So, if there is indeterminacy in the value of the outcomes of our acts—just as if there is indeterminacy in the probabilities of certain outcomes of our acts occurring—the expected consequences approach entails that it is just as important to omit contributing to the victims' harm as it would be if there was no such indeterminacy.

I therefore conclude that the expected consequences approach can surmount the challenges of indeterminacy posed by Gesang and Nefsky, and that it provides a fully adequate account of our powerful moral reasons to take both political and personal action to reduce our ecological footprints.

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2. Sustainability in the Anthropocene

From Forests to the Globe

Petra Dolata

Various meanings of sustainability emerged at specific historical times shaped by different prevailing energy systems. Even though sustainability in the Anthropocene always included views that saw nature as resource and hence linked sustainable practices to profit-making (yield), there are qualitative differences in the very meaning of sustainability and the ways it related to eighteenth-century forestry practices, nineteenth- and twentieth-century conservation efforts and twentieth-century environmental activism and global development goals. Some of these meanings may have been building on each other, others developed in opposition to previous understandings of sustainability. There is no straightforward, linear evolution of the term and it may be misleading to relate past meanings teleologically to today's definitions as this may overshadow different meanings that were prominent at different times in history. A comparison over time and throughout the Anthropocene shows that the concept needs to be understood within its specific historical context.

The Anthropocene[1] has become an accepted term to denote the multiple ways that humans have impacted the earth system on a scale that justifies

1 Paul J. Crutzen and Eugene F. Stoermer, 'The Anthropocene', *IGBP Global Change Newsletter*, 41 (2000), 17–18; Paul J. Crutzen, 'Geology of mankind', *Nature*,

 https://doi.org/10.11647/OBP.0213.02

introducing a new geological epoch reflecting this enormous human geophysical footprint. As climate change poses the most daunting challenge to today's high-energy, polluting and wasteful societies, sustainability is an important 'buzzword'[2] that is discussed within the Anthropocene. Yet, sustainability has pervaded language in ways that rendered the concept almost meaningless. In corporate talk it is used to signal good business practice which somehow respects nature, while marketing strategies include the attribute 'sustainable' to advertise green products. Sustainability has turned into a normative label that indicates consideration of the environment and is used to 'greenwash'[3] corporate approaches and products. Indeed, it has come a long way since its first alleged appearance as a concept to guide forestry practices in the German publication of Hans Carl von Carlowitz in 1713.[4] Situated at the very onset of the Anthropocene in the eighteenth century, this early modern publication addressed the sustainable use of forests in very localized circumstances of silver mining and metallurgical smelting, which relied on firewood. Over the next couple of centuries, these practices were refined and applied as sustainable forestry management plans creating 'engineered forests'.[5] They informed North American debates on conservation in the late nineteenth and early twentieth century and even found their way into regulatory practices in the oil and gas industry in Texas and Oklahoma in the first half of the twentieth century. Increasing pressure on eco and earth systems after 1945 due to accelerated economic growth, fossil fuel use and urbanization,[6] led to a renewed discussion of sustainability in the late 1960s and 1970s, when various publications

415.6867 (2002), 23, https://doi.org/10.1038/415023a; Dipesh Chakrabarty, 'The climate of history: Four theses', *Critical Inquiry*, 35 (2009), 197–222, https://doi.org/10.1086/596640.

2 Jeremy L. Caradonna, *Sustainability: A History* (Oxford: Oxford University Press, 2014), p. 137.

3 Ulrich Grober, *Sustainability: A Cultural History*, trans. by Ray Cunningham (Totnes: Green Books, 2012), p. 18.

4 Hans Carl von Carlowitz, *Sylvicultura Oeconomica, oder Haußwirtschaftliche Nachricht und Naturgemäße Anweisung zur Wilden Baum-Zucht* (Leipzig: Braun, 1713).

5 Paul Warde, *The Invention of Sustainability: Nature and Destiny, C. 1500–1870* (Cambridge: Cambridge University Press, 2018), p. 314, https://doi.org/10.1017/9781316584767.

6 J. R. McNeill and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge: The Belknap Press of Harvard University Press, 2014), https://doi.org/10.4159/9780674970731.

warned of the limits of global growth, overexploitation of resources and population increases.[7] Following these decades, in which sustainability was used to address global ecological challenges and describe practices beyond forestry management, the 1980s saw the introduction of 'sustainable development', popularized through the 1987 Report of the World Commission on Environment and Development, better known as the Brundtland Report.[8] Originally pioneered as a scientific concept to deal with a visible crisis (wood shortages in Europe in the seventeenth and eighteenth centuries), sustainability was now a term used to address the combined global challenges of environmental degradation, mainly resulting from exponential fossil fuel use, and poverty caused by lack of development in parts of the world. Sustainability bridges the early phase of the Anthropocene, in which fuels of the organic regime[9]—wood—were foundational to life,[10] with the current phase of accelerated use of fuels of the mineral regime—petroleum—which is equally foundational to today's societies, fittingly described by some observers as petrocultures.[11]

The meanings of sustainability emerged at specific historical times shaped by different prevailing energy systems. As will be argued below, even though sustainability in the Anthropocene always included views that saw nature as resource and hence linked sustainable practices to

7 Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962); Paul Ehrlich, *The Population Bomb* (New York: Ballantine Books, 1968); Garrett Hardin, 'The tragedy of the commons', *Science*, 162 (1968): 1243–1248, https://doi.org/10.1126/science.162.3859.1243; Dennis Meadows et al., *The Limits to Growth* (New York: Universe Books, 1972), https://doi.org/10.1349/ddlp.1; E. F. Schumacher, *Small Is Beautiful: A Study of Economics As If People Mattered* (London: Blond & Briggs, 1973).

8 United Nations, *Our Common Future: Report of the World Commission on Environment and Development* (New York: United Nations, 1987), https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

9 For the concept of organic and mineral energy regimes see E. A. Wrigley, *Energy and the English Industrial Revolution* (Cambridge: Cambridge University Press, 2010), https://doi.org/10.1017/cbo9780511779619.

10 Ulrich Grober, 'Eternal forest, sustainable use: The making of the term 'Nachhaltig' in seventeenth- and eighteenth-century german forestry', in *Routledge Handbook of the History of Sustainability*, ed. by Jeremy L. Caradonna (London: Routledge, 2017), pp. 96–105, https://doi.org/10.4324/9781315543017-7.

11 Petrocultures Research Group, *After Oil* (Edmonton: University of Alberta, Department of English and Film Studies, 2016); Sheena Wilson, Adam Carlson and Imre Szeman, eds., *Petrocultures: Oil, Politics, Culture* (Montreal: McGill-Queen's University Press, 2017); Imre Szeman, *On Petrocultures: Globalization, Culture, and Energy* (Morgantown: West Virginia University Press, 2019).

profit-making (yield), there are qualitative differences in the very meaning of sustainability and the ways it related to eighteenth-century forestry practices, nineteenth- and twentieth-century conservation efforts and twentieth-century environmental activism and global development goals. Some of these meanings may have been building on each other, others developed in opposition to previous understandings of sustainability. There is no straightforward, linear evolution of the term and it may be misleading to relate past meanings teleologically to today's definitions as this may overshadow different meanings that were prominent at different times in history. In addition to the diverse historical time periods in which they were coined, the various incarnations of sustainability (sustained yield, conservation, environmentalism, sustainable development) differ in the scales of the related economic activities (forests, oil fields, the global environment and economy) and the increasing complexity of the energy systems in which these occurred. Wood and oil are not interchangeable energy resources; the latter is a subterranean fuel not limited by the land space demands of the former.[12] A comparison over time and throughout the Anthropocene shows that the concept needs to be understood within its specific historical context. In light of current discussions on the Anthropocene and the 'Great Acceleration'[13] after 1945, sustainability needs to be historicized even further in order to understand its historically contingent meaning which is closely related to scale and type of energy system.[14] It is equally imperative to acknowledge the chronology of these conceptualizations, since once certain meanings have become accepted and ubiquitous, it is very difficult to go back to earlier, contrasting definitions and consider them on their own terms. Sustainability is an idea, a discourse; it 'was invented, not discovered'.[15] It tells us a lot more about how societies thought about the relationship between nature and humankind. At the same time, all these specific historical meanings of sustainability in the Anthropocene, which are situated within stories of industrialization and increasing exploitation of resources, share a connection to a political economy that is characterized by treating nature as resource

12 Vaclav Smil, *Energy Transitions: History, Requirements, Prospects* (Santa Barbara: Praeger, 2010).
13 McNeill and Engelke (2014).
14 For general histories of the term see Caradonna (2014); Grober (2012).
15 Warde (2018), p. 334, see also pp. 356–357.

and proposing monetary exploitation. Throughout the duration of the Anthropocene, sustainability is often linked to ideas of growth, progress and profit reinforcing a market-driven capitalist economy. And even those conceptualizations that call for more ecological and anti-consumerist attitudes and propose alternative political economies do so to contest the dominant embedding of sustainability into capitalist systems and to resist prevailing growth paradigms and economic understandings of natural resources.

Sustained Use/Yield

In an attempt to establish a clear lineage to earlier concepts of sustainability, scholars point to the seventeenth and eighteenth centuries and in particular to Hans Carl von Carlowitz, who is considered the father of the idea of sustainability.[16] In his 1713 publication *Sylvicultura Oeconomica, oder Haußwirtschaftliche Nachricht und Naturgemäße Anweisung zur Wilden Baum-Zucht* (*Sylvicultura oeconomica or Economic Report and Instruction on the Cultivation of Wild Trees according to Nature*), von Carlowitz, a mining administrator and cameralist in Freiberg, Electorate of Saxony, addressed the unsustainable use of forest resources. He warned the Saxon ruler of a severe economic crisis in the region if deforestation were to continue. Originally proposed to ensure the supply of timber for silver mining and smelting purposes, his concept of sustainability relied on the idea to limit cutting timber in forests to a rate that allowed for the equal regrowth of this renewable resource. His proposal to manage the use of forests in order to sustain the commercial viability of silver mines in Saxony is seen as an early version of sustainable development as spelled out by the 1987 Brundtland Commission. Already in the seventeenth century, thinkers like Jean-Baptiste Colbert in France, John Evelyn in England and Baruch Spinoza in the Netherlands philosophized about the relationship between nature and economic activity to address overexploitation of forests.[17]

16 Grober acknowledges the instrumental role of von Carlowitz but also dates the idea of sustainability back much earlier and calls it 'our primordial cultural heritage' (2012, p. 15).

17 Ibid.; Roman Sandgruber, 'Korreferat zu Matthias Asche', in *Wirtschaft und Umwelt vom Spätmittelalter bis zur Gegenwart Auf dem Weg zu Nachhaltigkeit?*, ed. by Günther Schulz and Reinhold Reith (Stuttgart: Franz Steiner, 2015), pp. 77–87.

Like von Carlowitz they developed new ways to manage resources creating what has later become known as sustained yield forestry. The early discussions of unsustainable practices were in response to fear of severe regional wood supply shortages due to mining activities in Europe. Trees were foundational to life in early modern Europe, in fact they were as significant as today's fossil fuels are for industrialized societies and any crises in the provision of wood impacted the economic well-being of entire societies.[18] When von Carlowitz criticized the use of the 'insatiable lumber ax' (unersättliche Holtz-Axt) and warned of deforestation due to human behaviour, he was describing a local crisis that was visible to everyone.[19] The lack of infrastructure to transport timber long ways and the high local demand for this organic renewable energy resource in (silver) mining areas led to overexploitation and a wood crisis seemed imminent. Even though this scarcity affected all of Europe, it only did so on a local or narrow regional scale. Also, awareness often remained local, '"connected" thinking about the environment *avant le mot*' only emerged later.[20] This is far removed from the global scale that its successor concept, sustainable development, claims to cover in the twentieth century.

Von Carlowitz criticized the way that human behaviour was devoted to making quick economic gains through exploiting wood for mining and producing silver. However, as Daniela Gottschlich and Beate Friedrich have convincingly argued, this does not readily translate into an economic understanding of the forest as material resource.[21] While *Sylvicultura Oeconomica* emphasized the profit-making aspect of using the forest as an economic resource, von Carlowitz did not portray nature as an inanimate object that needed to be dominated but as exhibiting agency and beauty as 'mother earth'. Furthermore, his entire oeuvre shows a more complex and nuanced understanding of sustainable forest management practices which not only provided continuous yield but also qualitatively improved forests as animate spaces. Thus, the economization of sustainability did not come with von Carlowitz nor

18 Caradonna (2014); Grober (2017); Warde (2018).
19 Von Carlowitz (1713), p. 74.
20 Warde (2018), p. 325.
21 Daniela Gottschlich and Beate Friedrich, 'Das Erbe der Sylvicultura oeconomica: Eine kritische Reflexion des Nachhaltigkeitsbegriffs', *GAIA*, 23.1 (2014), 23–29, https://doi.org/10.14512/gaia.23.1.8.

is there a clear link between von Carlowitz's use of the German word *nachhaltend* and twentieth-century discussions of sustainability.[22] He did not use the term sustainability (or its German translation *Nachhaltigkeit*) in his publication. Etymology of the German term *Nachhaltigkeit* dates it back to von Carlowitz because he used the adjective 'nachhaltend' (later changed to 'nachhaltig') to talk about natural forest management practices in Freiberg, Saxony.

> But as the earth's underground has through labor and expenses revealed its ores, we are confronted with a scarcity of wood and charcoal, that needs to be remedied, therefore the greatest technical skills, science, diligence and management of this country must address how such a conservation and cultivation of wood can be achieved so as to make possible a continual, steady and *sustainable use*, as this is an indispensable matter, without which the country cannot maintain its Being.[23]

Based on this quotation, Ulrich Grober has made a compelling case for differentiating between von Carlowitz' suggestion of sustainable 'use' versus later conceptualizations of sustainable monetary 'yield.'[24]

Industrialization overcame the spatial limitations of an energy system based on wood that needed land as it tapped instead into subterranean fuels such as coal and later oil and gas. This increased use of fossil fuels created unsustainability, but Enlightenment also facilitated its criticism and conceptualization of sustainability in the first place. However, as fossil fuels replaced wood as the fuel of economies, thinking of sustainability detached itself from the visible connection to land and soil and these early discussions of sustainability only survived within forestry over the next century.[25]

Conservation/Sustainable Yield

In the North American context, the idea of sustainability survived beyond forestry through discussions of conservation. European conceptualizations of sustained yield were adapted to the American spatial and social experience. In the late nineteenth and early twentieth

22 Ibid., pp. 25–27.
23 Quoted in Grober (2017), p. 102.
24 Grober (2012), p. 142.
25 Ibid., p. 140; Warde (2018), pp. 265–266.

centuries, conservation took on various meanings. There were those, chief among them naturalist John Muir, who wanted to preserve wilderness and the pristine state of nature, especially forests. To that effect, three national parks were already created in the United States before 1900, Yellowstone (1872), Yosemite and Sequoia (1890). Another four were established in Canada (Banff 1885, Glacier 1886, Yoho 1886, Waterton Lakes 1895). At the same time, a more utilitarian practice gained a foothold in North America, sustained yield forestry, which combined 'constant maximized yield from the forest and [...] rational forest management'.[26] Influenced by forestry methods in continental Europe, especially in France, Switzerland and Germany, this kind of forest management would allow exploitation of nature or monetize the pristine beauty of nature through, for example, tourism.[27] Gifford Pinchot, an American forestry administrator, who travelled to continental Europe in 1890 to study various approaches to forest management, advocated for 'wise use' or sustained yield in American public forestry upon his return. He had studied both the German and Swiss versions of sustained yield forestry and preferred the latter as it was less rigid. In contrast, German forestry methods would regulate every little detail.[28] While wise use echoed the German concept of sustainability (*Nachhaltigkeit*), Pinchot emphasized the generational component of the concept long before the 1987 Brundtland Report inserted such an intergenerational time aspect. According to Grober, he defined wise use as 'the use of natural resources for the greatest good of the greatest number for the longest time'.[29] Wise use became an integral part of the conservation movement in the United States, pitting it against Muir's preservationist philosophy. This created a 'utilitarian/spiritual divide in the wilderness/renewable resource literature'[30] and explains why the protection of wilderness was often considered preservation and not conservation. Conservationists saw forests as a renewable resource that should be utilized economically.

26 Grober (2012), p. 149.
27 Roderick Nash, *Wilderness and the American Mind,* 5th ed. (New Haven: Yale University Press, 2014).
28 Grober (2012), p. 140.
29 Quoted in ibid., p. 150.
30 John Robinson, 'Squaring the circle? Some thoughts on the idea of sustainable development', *Ecological Economics*, 48 (2004), 368–384 (p. 371), https://doi.org/10.1016/j.ecolecon.2003.10.017.

A couple of decades later, conservation was redefined in various new ways. Both the economic and social crisis of the 1930s as well as oversupply of oil and gas in Texas and Oklahoma generated conservation discourses, that were very specific to the United States. According to Grober, during the New Deal era, President Franklin D. Roosevelt launched policies to address the nationwide crisis, which included ecological considerations. For example, the Civilian Conservation Corps was involved in reforestation programs. Furthermore, American interest in German sustainability led Roosevelt to send a forestry delegation overseas. One of the experts was Aldo Leopold, who had criticized the way that Americans had exploited soil 'as a food factory'.[31] Like Pinchot before him, he was not impressed with the highly regulated German forestry management. Instead, he proposed a more integrated approach to understanding land use and thus became 'one of the very first thinkers and writers worldwide who combined the traditional terminology of sustained yield forestry with the vocabulary of scientific ecology'.[32] His writings, especially with regards to what he called land ethics,[33] influenced environmental thinking in the 1970s.

In the case of the oil and gas industry, conservation was a regulatory response to the oversupply of oil. Already in the first two decades of the twentieth century, conservation laws were passed in Texas that addressed the problem of rule of capture.[34] Since 1919, the Texas Railroad Commission (TRC) regulated oil and gas production. Rule of capture was a law derived from English Common Law which established that anyone who could access subterranean deposits of oil and gas could drill for it as long as they did so on their own land. Thus, whenever oil was found, adjacent land was quickly purchased to tap into the same oil deposit. In order to capture as much oil as possible, drilling would commence quickly to prevent others from draining the oil reservoir by accessing it from their property. This led to plummeting commodity prices as the market was flooded with oil, but it also depleted the

31 Grober (2012), p. 151.
32 Ibid, p. 152.
33 Aldo Leopold, 'The land ethic', in *A Sand County Almanac* (New York: Oxford University Press, 1949), 201–226.
34 Howard R. Williams, 'Conservation of oil and gas', *Harvard Law Review*, 65.7 (1952), 1155–1183, https://doi.org/10.2307/1337050; C. A. Warner, 'Texas and the oil industry', *The Southwestern Historical Quarterly*, 50.1 (1946), 1–24.

reservoir more quickly because the over drilling diminished the underground pressure and left more oil uncaptured. Conservation in this context meant two things; first, ensuring that all recoverable oil could be drilled and secondly, that oil prices could be stabilized in order to ensure a profit. In Texas, the Texas Railroad Commission introduced prorationing to conserve and stabilize the industry. During the Texas oil boom of the early 1930s, conservation legislation was an important instrument to stabilize prices and the industry. In the long run, instituting an exploitation rate that guaranteed profitable yield was to ensure the survival of the industry.[35]

This kind of conservation differed significantly from forestry as it was not aimed at allowing a renewable energy resource to regrow but sought to prolong the time a non-renewable energy resource could be exploited, in part to ensure the highest yield or profit possible. Another conservation approach was driven by national security consideration and included the creation of petroleum reserves for the navy to ensure that non-production of petroleum would guarantee access and availability of this strategic fuel in times of crises and during a war. Recognizing the strategic significance of petroleum, the idea of conserving by not producing was even scaled up beyond the nation and used to justify United States foreign oil policy in the 1940s and 1950s. When Secretary of the Interior Harold L. Ickes championed foreign oil production by American multinational oil companies, he argued that this was the best strategy to conserve domestic oil production and thus provide oil security.[36]

Conservation in North America in the first half of the twentieth century and its underlying assumptions about sustainability exhibited a clear link to the economic exploitation of (energy) resources. With the exception of Muir's preservationist philosophy and Leopold's land ethic

35 Erich W. Zimmermann, *Conservation in the Production of Petroleum* (New Haven: Yale University Press, 1957); William R. Childs, 'The transformation of the railroad commission of Texas, 1917–1940: Business-government relations and the importance of personality', *The Business History Review*, 65.2 (1991), 285–344, https://doi.org/10.2307/3117405.

36 Richard H. K. Vietor, *Energy Policy in America since 1945: A Study of Business-Government Relations* (Cambridge: Cambridge University Press, 1984), pp. 29–31, https://doi.org/10.1017/cbo9780511528057. Stephen J. Randall, 'Harold Ickes and United States foreign petroleum policy planning, 1939–1945', *The Business History Review*, 57.3 (1983), 367–387, https://doi.org/10.2307/3114049.

approach, none of these discussions included ecological considerations. These were to become more prominent in the 1960s and 1970s.

Conservation/Environmentalism

The 1960s and 1970s saw the emergence of a new kind of environmental movement. Increasing pollution of air and water, hazardous waste as well as energy crises and nuclear energy risks redirected the conservationist focus away from the protection of wilderness and wildlife. Combined with the rise of civic engagement and activism in the 1960s, new environmental organizations were founded and old ones like the Sierra Club focused on these new threats to nature and human health while proposing a more holistic, ecological understanding of the interconnection between humans and nature. These connections were reinforced by new visual tropes. On Christmas Eve 1968, U.S. astronaut William Anders took a photograph of the Earth from Apollo 8, the first manned spaceflight mission to leave the Earth's orbit and circle the Moon. His famous shot, known as *Earthrise*, was the first color photograph of the Earth from space. Arguably, this extra-planetary view conveyed a sense of a closed but fragile planet. People began using Spaceship Earth as a popular metaphor to denote this new ecological thinking.[37] Rachel Carson's *Silent Spring* (1962), which drew attention to the detrimental effects of pesticides on the environment and human health, Paul Ehrlich's *Population Bomb* (1968) and Garrett Hardin's 'The Tragedy of the Commons' (1968) were all widely read testimonies of the environmental challenges of post-World War II modern and affluent life. Economic thinking of the time was questioning the sustainability of existing growth-fixated economic approaches. Apart from E. F. Schumacher's *Small is Beautiful* (1973) and Amory Lovins' *Soft Energy Paths* (1977) the most famous of these 'ecological economics'[38] publications was *Limits to Growth*, published in 1972 by the Club of Rome, a think tank founded in 1968 by an Italian industrialist. The authors

37 Erik W. Johnson and Pierce Greenberg, 'The US environmental movement of the 1960s and 1970s: Building frameworks of sustainability', in *Routledge Handbook of the History of Sustainability*, ed. by Jeremy L. Caradonna (London: Routledge, 2017), pp. 137–150, https://doi.org/10.4324/9781315543017-10.

38 Caradonna (2014), pp. 112–135.

were using computer modelling and systems theory to determine a 'state of global equilibrium'. The study was based on the understanding of a world system which should satisfy the basic needs of its population but also be 'sustainable without sudden and uncontrolled collapse'. It warned that projected growth rates in 'population, food production, industrialization, pollution, and consumption of non-renewable resources' were unsustainable.[39]

Paul Warde reminds us that 'sustainability' is a fairly recent coinage, at least in the English language, going back to environmental discussions in the early 1970s. Rather than highlighting the idea of yield and profit it addressed the limits of human action and unsustainable ways of life: '"Sustainability" is the idea that to endure, a society must not undermine the ecological underpinnings on which it is dependent. It must not degrade, to use a more archaic term, 'the Earth"'. Warde further argues that '[t]he desire for a balanced economy and a sustained yield did not necessarily lead to a concern for the possible degradation of the Earth'. It was only through the life sciences and their discussions of life itself that these connections were made. Up until the nineteenth century, the realization that resources were wasted and 'society [was] undermining its environmental foundation' did not lead to the questioning of civilizational progress. Instead, rational and scientific solutions such as sustained yield forestry were propagated. However, these interpretations did not enter the mainstream at the time. Only when the concept of 'environment' was introduced, could all natural processes be seen together and connections been made.[40] Other scholars insist on differentiating between environmentalism and sustainability arguing that the two movements are intertwined but that sustainability would 'not have come into existence' without the 'new' environmental movement of the 1970s.[41] In the United States, sustainability could equally reach back to early twentieth-century conservationism and to 1970s environmentalism. The latter focused on pollution applying an ecological systems approach. Of course, the ecologically refined concept of sustainability did not just emerge out of nowhere in the 1970s. It was

39 Dennis Meadows et al., *The Limits to Growth* (New York: Universe Books, 1972), pp. 2, 35, 158.
40 Warde (2018), pp. 5, 9–10, 328, 333–334.
41 Johnson and Greenberg (2017), p. 138.

based on previous ecological thinking by people like Aldo Leopold and decades of conceptualizing the environment as something that is all-encompassing and universal. However, it is easy to forget how new and radical some of the arguments and solutions were that were proposed during the 1970s.

Recycling was at the heart of some of the behavioural changes proposed by environmental groups. The famous 3Rs of 'reduce, reuse, recycle' was first introduced by Pollution Probe, a Toronto-based environmental NGO, which was founded by university students in 1969. As Ryan O'Connor has shown, it originally intended to ask people to '**reject**, re-use, recycle'. However, 'reject' was considered to be too extreme a term and quickly dropped. Pollution Probe was rather unique at the time as it worked with business and government in its early years and was thus worried about language that might have been too radical.[42] It points to the existence of more wide-sweeping proposals to change existing growth paradigms. These proposals questioned whether supply-side solutions were enough to address the environmental challenges of overextending the Earth's resources. Not only were existing liberal market economies questioned but lifestyles were studied to find ways to change people's behaviours creating sustainable societies. It was suggested that people could change their behaviours and decrease their high-energy demands and waste production. This new focus on curbing demand for resources was highlighting conservation as one way of overcoming the insatiable thirst for energy and incontrovertible belief in growth. For example, in Canada the Science Council was instrumental in proposing a shift towards a 'conserver society'. Already in its 1973 report *Natural Resource Policy Issues in Canada*, this governmental advisory board cautioned 'Canadians as individuals, and their governments, institutions and industries should begin the transition from a consumer society preoccupied with resource exploitation to a conserver society engaged in more constructive endeavours'.[43] Combining respect for the biosphere with economy of design and concern for the future, the concept of the

42 Ryan O'Connor, *The First Green Wave: Pollution Probe and the Origins of Environmental Activism in Ontario* (Vancouver: UBC Press, 2015), p. 112.

43 Science Council of Canada, *Natural Resource Policy Issues in Canada* (Ottawa: Information Canada, 1973), p. 9.

consumer society foreshadowed some of the sustainable development discussion of the 1980s.

As the Canadian case shows, governments were involved in this new environmental thinking. Not only did they have to respond to environmental movements and their criticism of air and water pollution, but they also had to react to the energy crises of 1973/4 and surging energy consumption. Some of these governmental institutions even deliberated policies that included radical critiques of society's lifestyles. For example, a look at the 1974 Canadian Energy Task Force shows how expansive and far-reaching thinking proceeded when it came to tackling the monumental task of conserving energy, especially during times of a global oil price crisis. In response to the detrimental effects of the oil price shock of 1973 which was the combined result of OPEC (Organization of the Petroleum Exporting Countries) price hikes and an OAPEC (Organization of Arab Petroleum Exporting Countries) oil embargo in the wake of the October 1973 Yom Kippur War, the Canadian government established a Task Force on Energy Research and Development on January 15, 1974. Housed in the Office of Energy Research & Development in the Department of Energy, Mines and Resources (EMR), this interdepartmental task force which included scientists and environmentalists like Brian Kelly, who had left Pollution Probe in 1974 to join EMR's Office of Energy Conservation (OEC) had established six research tasks and assigned these to various lead agencies. These tasks, which were envisaged to help plan for a more sustainable energy future, included energy conservation, exploitation of domestic non-renewable energy resources, oil and gas substitution, development of nuclear capability, exploitation of renewables and improvement of energy transportation systems. It encapsulated an entirely new approach to energy policy. The first research task, which was led by the Office of Energy Conservation, was the only task subdivided into two sections. Task 1A was devoted to 'reducing consumption and/or increasing efficiency' while Task 1B was dedicated to 'improved data and management'.[44] One of the nine programs within task 1A was devoted to 'Life Styles'. The need for action was justified as follows:

44 Library and Archives Canada (LAC), RG 99–1 121, 150–3 T7 (2), Task Force on Energy Research and Development, Office of Energy R&D, Energy R&D Program, Revised October 1974. As Henry Trim has shown, Trudeau in general and EMR in

> Contemporary lifestyles are characterized by high levels of energy consumption, environmental damage and social unrest. Modern advertising, education and information systems promote a society based on materialism and competition; few alternatives are offered for rational consumer decisions. Consumption is further reinforced by products of low quality and high obsolescence. Our very living patterns, based as they are on private ownership and material status, result largely in consumptive conformity. Even our emerging recreation patterns are dominated by motorized, energy-consuming activities rather than physical exercise, personal fulfillment or relaxation.[45]

Here, private ownership as well as the production of unnecessary goods were explicitly named as two of the main reasons that Canadian society was consuming too much energy and producing too much waste. Such behaviour was not sustainable and needed to be changed. Canadians were 'locked into the dominant lifestyle' and education and government programs should help Canadians make 'informed consumption decisions'. Apart from educational efforts, OEC authors suggested changes to legislation to emphasize 'product durability, repariability [sic ...], re-use and recycling' and 'discourage planned obsolescence, unnecessary style changes [... and] overpackaging'.[46]

As the OEC included former Pollution Probe activists, it is not surprising to see some of the arguments proposed by the grassroots movement to enter government documents. Years before the 1973 energy crisis necessitated the Canadian government to address the challenges of high energy use and wasteful behaviour, Pollution Probe insisted that demand-side approaches were needed. Already in 1970, they warned that the unquestioned belief in growth and rampant consumption imperiled Canada's society and economy and published a guide on how to live an environmentally friendly life.[47] Two years later, the group

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particular championed rationalization approaches as well as computer modelling, planning and expert advisors to ensure objective policy decisions. Henry Trim, 'Brief periods of sunshine: A history of the Canadian government's attempt to build a solar heating industry, 1974–1983', *Scientia Canadensis*, 34.2 (2011), 29–49, https://doi.org/10.7202/1014346ar; Henry Trim, 'Experts at work: The Canadian state, North American environmentalism, and renewable energy in an era of limits, 1968–1983' (PhD diss., University of British Columbia, October 2014).

45 LAC, RG 99–1 121, 150–3 T7 (2), Task Force on Energy Research and Development, Office of Energy R&D, Energy R&D Program, Revised October 1974.

46 LAC, RG 99–1 121, 150–3 T7 (2), Consolidated Program or Sub-Program Statement, Task I: Reduce Consumption and/or Increase Efficiency, Program 9: Lifestyles.

47 Donald A. Chant, ed., *Pollution Probe* (Toronto: New Press, 1970).

released recommendations that called for more durable products and a ban on advertising that attempted 'to induce an artificial demand for a product'.[48]

Despite these efforts, people were less enthusiastic about changing their consumption behavior. However, the environment had become an important political topic and even entered international politics. Already in 1972, the United Nations held a conference on the Human Environment in Stockholm which for the first time addressed international environmental issues. While many in the Western and industrialized world welcomed an international conference dedicated to the environment, many developing countries feared that this would hinder their quest for industrialization and economic growth. The thawing of the Cold War in the first half of the 1970s and the oil price crisis of 1973/74 redirected global discussions along a North-South axis. Debates on a New International Economic Order were particularly pushed by the developing world who were demanding fairer conditions for international trade of commodities and raw materials. To address these divergent interests, the Stockholm Declaration warned that environmental considerations should not lead to the denial of development and economic growth.[49] In this global context, environmentalism and conservationism had to be reconciled with questions of justice and growth in the Global South.

Sustainable Development

In 1987 the so-called Brundtland Report, named after the Chair of the World Commission on Environment and Development, Norwegian Prime Minister Gro Harlem Brundtland, was published by the United Nations.[50] It defined the concept of sustainable development linking questions of environmental protection to those of economic growth and intergenerational justice. The underlying assumption was that global ecological and social asymmetries were interlinked and hence needed to be addressed together. It thus added a socio-economic aspect to the until

48 Quoted in O'Connor (2015), pp. 107–108.

49 Iris Borowy, 'Sustainable development and the United Nations', in *Routledge Handbook of the History of Sustainability*, ed. by Jeremy L. Caradonna (London: Routledge, 2017), pp. 152–153, https://doi.org/10.4324/9781315543017-11.

50 United Nations (1987).

then conservation-oriented sustainability concept which was mainly based on the 1980 World Conservation Strategy.[51] Subtitled 'Living Resource Conservation for Sustainable Development', this publication (which was co-authored by the United Nations Environmental Program, the World Wildlife Fund and the so-called International Union for the Conservation of Nature made up of interested national states, environmental agencies and NGOs) focused on ecological sustainability.

However, the way that the Brundtland Commission propagated the new concept was essentially helping to make sustainability more palpable. While it was radical in linking poverty with environmental degradation arguing that sustainability could not be achieved without addressing poverty, its recommendations were comfortably placed within existing growth paradigms. Development meant economic growth. The report accepted that 'a five- to tenfold increase in manufacturing output will be needed just to raise developing world consumption of manufactured goods to industrialized world levels'.[52] By combining sustainability and development it took off the radical edges that had also been part of discussing sustainable practices in the preceding decade, the 1970s.[53] It has since been criticized as embodying existing power relationships and reinforcing global capitalism by updating its ecological aspirations.[54] Unfortunately, it has also retrospectively led to the reframing of earlier histories of sustainability that were much more critical of consumer societies and global capitalism. If sustainability is understood as a criticism of industrialization, then the introduction of sustainable development was instrumental in mooting this earlier meaning of the concept and ignored the more fundamental need for social change.

Already in the early 1990s, Donald Worster, eminent environmental historian, disapproved of the term sustainable development. For him, it was an empty 'popular slogan' that gave political elites the 'broad easy path [...] going in the wrong direction'. He criticized the underlying utilitarian and anthropogenic notion that humans know what the

51 Antonietta Di Giulio, *Die Idee der Nachhaltigkeit im Verständnis der Vereinten Nationen: Anspruch, Bedeutung und Schwierigkeiten* (Münster: Lit, 2004).

52 United Nations (1987), p. 31.

53 Robinson (2004), p. 370.

54 Helga Eblinghaus and Armin Stickler, *Nachhaltigkeit und Macht: Zur Kritik von Sustainable Development* (Frankfurt: Iko-Verlag für Interkulturelle Kommunikation, 1996).

limits to nature are and exploit nature up to that limit. Sustainable development was about 'resources and economics' and not about 'ethics or aesthetics'. Worster made an important qualitative distinction between environmentalism of the 1960s and 1970s and sustainable development that emerged in the 1980s.[55] The way that sustainability (what he calls contemporary environmentalism) was addressed in those formative decades was much more radical and included the realization that there were limits to population growth, technological advancement and human 'appetite and greed'.

> Underlying that insight was a growing awareness that the progressive, secular, and materialist philosophy on which modern life rests, indeed on which Western civilization has rested for the past three hundred years, is deeply flawed and ultimately destructive to ourselves and the whole fabric of life on the planet. The only true, certain way to the environmental goal, therefore, was to challenge that philosophy at its foundation and find a new one based on material simplicity and spiritual richness—to find other ends to life than production and consumption.[56]

While the Brundtland Report reversed and distorted conceptualizations of sustainability of the previous decade, its emphasis on development and growth makes it a document of its time. The 1980s were characterized by a conservative backlash and neo-conservative governments in the Western world. Unsurprisingly, the Brundtland Report did not question neoliberal market economics nor suggest a different political economy. It believed a compromise was possible between conservation and economic growth. It is also closely linked to larger questions of global economic and energy governance in the 1970s. The New International Economic Order which the Global South was proposing since 1974 was also a direct response to the 1973/74 energy crises because rising petroleum prices and the worldwide recession particularly affected developing countries that were not oil producers. The rise in energy prices hit those countries particularly hard as they were trying to catch up to growth rates in the Global North.

Gottschlich and Friedrich make a convincing case that in the German discourse von Carlowitz's *Nachhaltigkeit* was linked to the 1987

55 Donald Worster, *The Wealth of Nature: Environmental History and the Ecological Imagination* (New York: Oxford University Press, 1994), pp. 142–155, https://doi.org/10.1093/oso/9780195092646.001.0001.

56 Ibid., p. 143.

Brundtland Report when Germans were looking for an appropriate translation of the English term sustainable development. Rather than inventing a new term, Germans rediscovered *Nachhaltigkeit*, the well-known concept in forestry and agricultural management practices since the early eighteenth century. This means that the two meanings of sustainability in German are not congruent. Equally, the Brundtland Commission never considered these earlier forestry-related texts on sustainability.[57] In the meantime that linkage has become so pervasive that it has also entered English-language historical treatments of sustainability which often relate it back to von Carlowitz and other forestry sources from the eighteenth century. As discussed above, the German term *Nachhaltigkeit* was translated by American forestry officials including Pinchot into sustained yield theory of management. This is why, contrary to Gottschlich and Friedrich, one of the harshest critics of sustainable development, Worster, sees a straight line from early European ideas on forestry to the 1980s coinage of the term:

> 'Sustained development' is therefore not a new concept but has been around for at least two centuries; it is a product of the European Enlightenment, is at once progressive and conservative in its impulses, and reflects uncritically the modern faith in human intelligence's ability to manage nature. All that is new in the Brundtland Report and the other recent documents is that they have extended the idea to the entire globe.[58]

Conclusion

Sustainability as a philosophy has undergone various changes. As Warde has cautioned, it is not something to be discovered but to be invented. However, as the above discussion has shown it may have been invented many times over, at different times, in different localities and for different purposes. Sustainability is an idea that has also been imagined for political reasons. Sustainable development is a very good example of how (international) politics and the necessity to arrive at compromise has shaped the ways that we came to understand sustainability toward the end of the twentieth century. Sustainable development aimed to reconcile environmentalist impulses with international challenges of

57 Gottschlich and Friedrich (2014), p. 24.
58 Worster (1994), p. 146.

a world divided between the Global North and South. It is important to remember that sustainable development was introduced as a compromise between environmental concerns in the Global North and developmental concerns in the Global South.

As the various historical episodes demonstrate, sustainability means different things to different actors. Most of the times the word sustainability is not even used to denote what we may infer to be sustainability. As a source concept, which appears in historical sources of the times, it is not as present as we may expect. One should use caution when assuming a linear genealogy of the term. Oftentimes this says more about our views and priorities today and how we want to understand sustainability than how historically accurate those descriptions are. It also allows us to reimagine sustainability today.

Finally, the history of sustainability is closely embedded into the Anthropocene and specific energy systems. While sustained yield forestry, conservation and preservation mainly focused on energy carriers of the so-called organic regime, environmentalism of the 1970s was clearly influenced by and imagined through conceptualizations of fossil-based energy systems. While both discussions may use a similar language they differ noticeably in scale.

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3. Academia, Abstraction and the Anthropocene

Changing the Story for Right Relationship

Kristine Kowalchuk

The following chapter by Kristine Kowalchuk argues the need for humanities scholars to recognize the ecological crisis as a cultural issue arising from modernity's story of human separation from, and superiority over, nature. The author urges humanities scholars to help lead the way in telling a different story, to enable genuine positive change and healing. As Kowalchuk shows, this story is not a new story, but rather an ancient one, of right relationship between humans and nature, and it has persisted in the margins for over four hundred years.

In 2007, the Writers' Guild of Alberta's annual conference, held in Grande Prairie, was themed 'Writing/Righting the Land', and it focused on the ecological destruction caused by Alberta's oilsands. At this time, there was still little open discussion of this problem, or even acknowledgement that there *was* a problem, and it felt like a relief to talk about it. But at one point, I expressed my frustration at the lack of direct action against the destruction. Rudy Wiebe, who was one of the keynote speakers, replied, 'the role of the writer is not to directly act; it is to write about it'. I have mulled over this reply many times since then. On one hand, of course he had a point: the job of writers is indeed to write, and this is a powerful act. But on the other hand, I can't help but think

 https://doi.org/10.11647/OBP.0213.03

the statement reveals the depth of the problem—and that is modern culture's abstract relationship with nature. 'Writing' is not automatically the same as 'righting'. Rather, 'righting' surely means aiming for a 'right relationship' with nature, to use the Quaker John Woolman's term,[1] and any right relationship involves deep connection, active protection, respect, reciprocity, and care; anything less is dysfunction. We would not simply write about the abuse of a family member, so why would we do this when we witness abuse of the land?

Since that conference in 2007, it is clear that modern relationship with the land has not been righted, even though more has been written about it, including by a host of academics; in Alberta and globally, ecological destruction has only intensified. The planet has now entered the so-called Anthropocene geological epoch, in which the earth's very processes have been altered by humans. The term was first proposed by Paul Crutzen and Eugene Stoermer in 2000,[2] and affirmed by the International Commission on Stratigraphy in the journal *Science* in early 2016.[3] Over the past few years, there has been a flurry of discourse in many academic fields on the Anthropocene: the concept 'has been institutionalized […] in a short period of time: networks have been formed, conferences organized, websites established, research programs […] elaborated and journals […] launched' to discuss it, and the concept has now passed into the general cultural sphere as well, through art, film, and museum exhibitions.[4] However, what the academic discourse has yet to fully grasp—and a misunderstanding now shared by the public—is the extent to which the problem is cultural. For it is obvious that a particular culture has led to the destruction, and this culture is not universal, and it did not exist throughout time. Canadian limnologist Dr. David Schindler has touched on this point, saying that the ecological

1 Quaker Earthcare Witness, *Living in Right Relationship* (n.d.), https://www.quakerearthcare.org/article/living-right-relationship.

2 Paul J. Crutzen and Eugene Stoermer, 'The Anthropocene', *IGBP Global Change Newsletter*, 41 (2000), 17, https://www.igbp.net/download/18.316f18321323470177580001401/1376383088452/NL41.pdf.

3 Colin N. Waters et al., 'The Anthropocene is functionally and stratigraphically distinct from the Holocene', *Science*, 351 (2016), https://doi.org/10.1126/science.aad2622.

4 Ralph Lidskog and Claire Waterton, 'The Anthropocene: A narrative in the making', in *Environment and Society*, ed. by Magnus Boström and Debra J. Davidson (Cham: Palgrave, 2018), pp. 25–46 (p. 26), https://doi.org/10.1007/978-3-319-76415-3.

crisis is no longer a scientific issue; it is now a communications issue.[5] But really, it was *always* a communications issue, in that relationship with the land is culturally shaped, through language, history, and belief systems—and science comes second, as a component of one particular cultural frame and as a way of measuring the consequences of that frame. The abstract way in which modern culture relates to nature—evident even in the language we use to talk about it, in distant terms like 'climate change' and 'global warming' and 'Anthropocene' itself—is both a result of anthropocentric thinking and the reason for the Anthropocene problem in the first place. This relationship, which is far from a 'right' one, reflects a destructive feedback loop in which individuals see themselves as separate from, and superior to, nature and resign themselves to the ruination of nature as inevitable, a necessary by-product of human 'progress,' which ultimately leads to further separation and loss. However, once we recognize the Anthropocene as a *cultural* issue, we understand that natural destruction is not inevitable; we have alternatives. This enables us to imagine and articulate another relationship, a right one in which humans are reconciled with the land—and then we can actually shift toward it. Because it is a cultural issue, it is not just an opportunity but also a responsibility of the humanities to more critically and actively engage with it as such and to help to not just write, but to *right* this story.

Such engagement should perhaps begin with discussion of the word Anthropocene. As both concept and term, Anthropocene carries, as Robert Macfarlane suggests, three main assumptions. First and foremost it is 'arrogantly human-focused', thereby further 'embed[ding] the narcissist delusions that have produced the current crisis',[6] a point echoed by Eileen Crist, who criticizes the term as 'a reflection and reinforcement' of human-centeredness and 'self-adulation'.[7] Secondly, it is universalist,

5 Personal communication, March 23, 2017.

6 Robert Macfarlane, 'Generation Anthropocene: How humans have altered the planet forever', *The Guardian* (April 1, 2016), https://www.theguardian.com/books/2016/apr/01/generation-anthropocene-altered-planet-for-ever.

7 Eileen Crist, 'On the poverty of our nomenclature', in *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism*, ed. by Jason Moore (Oakland: PM Press, 2016), pp. 14–30 (pp. 14, 28). As an example, Crist quotes geologist Jan Zalasiewicz's statement that 'we are so adept at using energy and manipulating the environment that we are now a defining force in the geological process on the surface of the Earth'. She notes that 'factoring in a candid admission of our powerlessness to create

'[glossing] over issues of race, class, gender, and colonialism',[8] suggesting all humans are equally responsible for the destruction, when of course this is not the case. Indigenous and traditional peoples have inhabited places around the world for thousands of years in a sustainable way. As Anishinaabe eco-advocate Winona LaDuke notes, 'not everybody screws [nature] up. Some cultures coexist pretty well, work out a set of relations'.[9] Likewise, Derrick Jensen bluntly states,

> [P]lenty of Indigenous cultures did not destroy their landbases. So I would argue that it is not that humans are stupid, but that this culture makes people stupid, in fact so stupid that they would rather kill the planet that is the source of our lives and the lives of all these other beautiful beings with whom we share this planet, than to acknowledge that they are making stupid social choice after stupid social choice.[10]

Thirdly, it is 'capitalist-technocratic', ignoring 'the role of ideology, empire and political economy' in the past, and blind to our options for the future, merely encouraging technology as 'a quick fix for climate change'; in this way, the Anthropocene is imagined as a 'pragmatic problem to be managed [...] within existing structures of governance'.[11] These assumptions, therefore, specifically reflect a cultural frame of human self-centeredness, colonialism, capitalism, industrialism and the patriarchy, meaning a more accurate name for the era would in fact be the Egocoloniocapitoindustriopatriocene.

But that still would not go deep enough. For underpinning all of these elements is a single belief that goes much further back: that humans are separate from, and superior to, nature. And this, of course, is the defining belief of the particular culture we call modernity. The

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(or even imagine) another way of life [his statement might instead] yield: "we are so impotent to control our numbers, appetites, and plundering technologies, and so indifferent to our swallowing up the more-than-human world, that we are now a colonizing force in the biosphere stripping it of its biological wealth and potential, as well as of its extraordinary beauty and creative art"' (p. 23).

8 Alex Blasdel, '"A reckoning for our species": The philosopher prophet of the Anthropocene', *The Guardian* (June 15, 2017), https://www.theguardian.com/world/2017/jun/15/timothy-morton-anthropocene-philosopher.

9 In Paul Schmelzer, 'Omaa Akiing: Paul Schmelzer interviews Winona LaDuke', in *Land, Art: A Cultural Ecology Handbook*, ed. by Max Andrews (London: RSA, 2006), pp. 62–67 (p. 65).

10 Derrick Jensen, *The Myth of Human Supremacy* (New York: Seven Stories Press, 2016), p. 238.

11 Macfarlane (2016).

problem is, many of us are so accustomed to this culture and its beliefs that we don't even see it as a constructed story; instead, '[w]e think it's the truth. We think it's real, rather than that it's simply an interpretation of the world which we have chosen to believe'.[12]

Here, it is worth recounting the separation-and-superiority story of modernity. Although its seeds are in Christianity (in its belief in a God in human likeness who granted humans dominion over the earth),[13] this story took root in seventeenth-century Europe, in the ideas that led to what we now call the scientific revolution and the Enlightenment. Most significant were René Descartes's idea that the human is separate from nature and the mind is separate from the body, and Francis Bacon's proposal that humans can view the world objectively (Bacon is considered one of the founders of the scientific method). These ideas profoundly changed western Europeans' thinking, placing the 'rational' human mind at the centre of the universe ('I think, therefore I am') and excising 'other ways of knowing—intuition, feeling, and sensing'.[14] This thinking unraveled the implicit traditional understanding of life as a complex web of interconnected relationships, and introduced the idea of human exceptionalism or, as Derrick Jensen states in his book of the same name, 'the myth of human supremacy', which gave this culture license to exploit and consume nature (as well as Indigenous peoples—which Winona LaDuke notes is even wrapped up in the relationship between the words colonization and colon).[15] This thinking also shifted understanding about time and place away from cycles and local specificity toward a linear conception of time and abstract, 'universal' principles separate from place, and turned authority away from folk culture, which involved collectivity and significant women's authority,[16] toward an individual, patriarchal, professional knowledge,

12 Paul Kingsnorth, 'The myth of progress', *Emergence*, https://www.emergencemagazine.org/story/the-myth-of-progress

13 Pope Francis, however, suggests in his encyclical *Laudato Sí: On Care for our Common Home* that the meaning of 'dominion over the earth' has been distorted by some Christians and that God's intention was for humans to live in harmony with nature (https://www.w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html).

14 Martin Lee Mueller, *Being Salmon Being Human: Encountering the Wild in Us and Us in the Wild* (White River Junction: Chelsea Green Publishing, 2017), p. 53.

15 In Schmelzer (2006), p. 65.

16 My own research on seventeenth-century women's recipes suggests that we might see modernity's denunciation of myth, folk knowledge, and connection with nature

and the splintering of this knowledge into what we now call the sciences and the arts/humanities. Finally, it also presumed that humans can predict and control nature as if it were a machine. This story promised, therefore, escape from the human condition: its limits of knowledge, its dependence on nature, its reliance upon community, and its acceptance of mortality, which all folk cultures, like Indigenous cultures, had respected as necessary for rebirth. Even the rise in writing and literacy in this period suggested an overcoming of the limits of time and space, as knowledge no longer relied on oral transmission. Human beings, this narrative suggested, could transcend the natural world, especially with the use of technology, and so Western Europeans began to believe that human history was a forward-pointing trajectory of progress and that the present was superior to the past, which they thus began to dismiss. This narrative was further solidified in the nineteenth century, in the narrow interpretation of Darwin's theory of evolution as based on competition between individuals and between species. As a result, Western culture not only perpetuated the myth that humans were separate from and superior to nature, but suggested we had achieved this position through a kind of evolutionary 'progress' that involved pushing everyone else out of the way.[17] This is the story of modernity, based on human separation and superiority, and it became the foundation of Western thinking as we know it today.

as an overthrowing of traditional women's authority. For a brief reflection on this research, see Kristine Kowalchuk, 'The recipe as feminist text: A reflection on the writing of *Preserving on Paper*', *The Recipes Project* (May 10, 2017), https://www.recipes.hypotheses.org/9978.

17 Lessons from wolves show that this focus on competition is wrong. Wolf pack behavior reveals complex intra-species collaboration rather than simple competition, while the positive impact of the reintroduction of wolves on Yellowstone National Park shows that ecosystems depend upon more complex inter-species relationships than science previously thought. Meanwhile, research by Suzanne Simard has shown how trees also communicate and cooperate as communities, throwing into question hierarchical thinking that places animals above plants. And quantum physics has shown that 'There are no things; there are only relations' (Zhiwa Woodbury in Baker, Carolyn, 'Healing climate trauma: Beyond climate change toward truth and reconciliation with Zhiwa Woodbury', *YouTube*, May 6, 2018, https://www.youtube.com/watch?v=Xnae_Fg8iUI, at 45:50–46:02). These lessons were already contained in Indigenous and traditional understanding of interconnectivity within and between species.

This story of schisms and hierarchies is, of course, also the story that our universities are founded upon,[18] and academics are amongst its staunchest adherents and defenders. For example, one of the co-authors of the *Science* article mentioned above, which argues that the Anthropocene should be recognized as a distinct geological era, seemed determined to maintain the appearance of objectivity in commenting on the study's findings; he stated in an interview, 'We're not saying [the Anthropocene] is good or bad. It's about recording impartially a suite of massive changes on earth'.[19] While reluctance to make a value statement when the 'suite of massive changes' includes the climate crisis, the sixth mass extinction of life on earth, and the loss of half of all wildlife in the past forty years seems incredible, it is the unsurprising result of the story of separation and superiority.[20] And so we can see how the ecological crisis is not a problem that modernity can solve, but one that modernity created. To solve it, we need another story.

The role of the humanities in turning things around, therefore, is clear. First of all, we need to recognize the ecological crisis as the cultural crisis that it is. Then we need to share this understanding across academia and publicly. Right now, this recognition is almost nonexistent. For example, consider the spring 2016 issue of the University of Alberta's alumni magazine, *New Trail*, which focused on the importance of scientific research in predicting climate change and mitigating it for humans. Nowhere did this issue ask why we are in the midst of this crisis in the first place, and lacking altogether were Indigenous and humanities perspectives on how we might do

18 At the Centre for Global Citizenship Education and Research conference held at the University of Alberta in 2017, Papaschase Cree professor Dwayne Donald asked in a keynote speech 'What do universities do to wisdom?' and 'On whose terms do we expect reconciliation to happen?' He then answered his own questions, saying, 'Universities are hard places to enable traditional knowledge' (October 27, 2017).

19 Alexander Wolfe in Sheila Pratt, '"Techno Fossils" Signal New Epoch, University of Alberta Scientist Says', *Edmonton Journal* (January 7, 2016), https://www.edmontonjournal.com/news/local-news/new-geological-era-embargo-2-pm-jan-7

20 The geologist later stated that it is science's job to '[define] the term so that it remains the same thing for all those who use it' and that it is then the job of the social sciences and humanities and arts to do something with it—reflecting the idea that the science comes first (personal communication, January 8, 2016). But that he himself recognized problems with this way of thinking is evident in an earlier statement that the ecological crisis is 'not so much a science issue as a geopolitical and even ethical one' (personal communication, February 22, 2015).

things differently to avoid it. When I talked about the issue with Derek Thunder, the manager of the Aboriginal centre at the Northern Alberta Institute of Technology, where I work, he said he had noticed the same thing, and had already commented to his partner that the cover's headline, above the image of a lone polar bear, reflected the same approach Canada historically took to 'Indians': 'Move, Adapt, or Die'. These are the only options modernity gives. But we are not a biologically flawed species and incompatible with nature, and there is no inevitable naturally depleted, technologically focused future toward which we are moving. Instead, we are experiencing (and most of us are complicit in) a period in which a particular cultural story regarding humans' relationship with nature is destroying the planet and ourselves. The solution is thus neither willful human extinction (as some have suggested), nor adaptation to a depleted planet, nor an attempt to simply mitigate our destruction, nor replacement of nature by technology (as if that were possible), but—to repeat the point above—a different cultural story.

The challenge the humanities face in this role is to actually remain aware of the cultural frame ourselves. For we are in a paradoxical position: while our discipline's overarching aim is to explore humans' place in the world, it is, like science, a product of modernity, and it inherited the same story. Furthermore, we suffer a fundamental disadvantage: because the authority of science was privileged over the authority of the arts and humanities from the moment of the divide, and then because the empirical sciences in particular have been privileged for their utility to industrialization and corporate capitalism, we have ended up in a situation in which science is equated with knowledge ('what does the science say?') and the humanities have been continually devalued. So there is much pressure to mimic the sciences' 'objectivity' and theoretical language, and to self-censor to avoid risking being perceived as 'anti-science' or 'anti-technology'.[21] That we have internalized this

21 Recent politics have resulted in (although I would argue they are also caused by) increased loyalty to 'objectivity' in arts and humanities. For example, one of the speakers in a 2017 University of Alberta alumni podcast called 'Fake news: How did we get here?' (University of Alberta (January 28, 2017) https://www.folio.ca/fake-news-how-did-we-get-here/) blamed the teaching of post-modernism in humanities courses for the erosion of truth; she urged greater reliance on objectivity and resisted the point that just because something has not been proven by science,

devaluing is, I think, evident in the fact that we have not yet recognized, as a discipline, the cultural nature of the ecological crisis, when it is so obvious. We need courage, therefore, to step up and take the lead in Anthropocene discourse (which we might rename); rather than running with the baton handed to us by science, we need to question the game. We need to engage our ability to recognize the constructed nature of epistemologies—that knowledge systems are stories—and that science is just part of one knowledge system, and is one, incomplete, way of knowing the world. In other words, it is critical that we remember that science exists within the realm of culture, not the other way around. What we are all subject to is not science, but natural laws, including the limits of functioning ecosystems. And then we need to discuss the ecological crisis as a crisis of modern culture. A culture must relate to the land in a way that respects natural laws and ensures functioning ecosystems, so that there is continued abundance rather than scarcity. This is what sustainability means. Unsustainability, of course, inevitably leads to collapse.

Once it is clear in our minds that the ecological crisis is a cultural crisis, we will be prepared to avoid what environmental sociologists Magnus Boström and Debra Davidson call 'conceptual traps', which often appear in Anthropocene discourse, and which simply uphold the disastrous status quo and delay our chance to achieve right relationship with nature. Their list includes traps such as reductionism, conflation of issues, dualistic thinking, relativizing human actions, and grand theorizing. These conceptual traps occur in the three assumptions Macfarlane and others point out within the term Anthropocene itself (see above), and in particular within three forms of problematic thinking that are so prevalent in modern culture that I think they deserve closer attention. The first of these is thinking that human activities—the economy, or politics, or social systems—matter most. They do not. Functioning ecosystems matter most; they have to be our starting point. The diagram below (see Fig. 1) points out the nested relationship of priorities in a sustainable system:

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that does not mean it cannot be true. She did not seem to recognize that the problem is perhaps less 'post-truth' than 'post-critical thinking', or even 'post-wisdom', which involves an ability to *evaluate* so-called truth and fact, and the need for deepened discussion of subjectivity and objectivity, and the possibilities and limits of each.

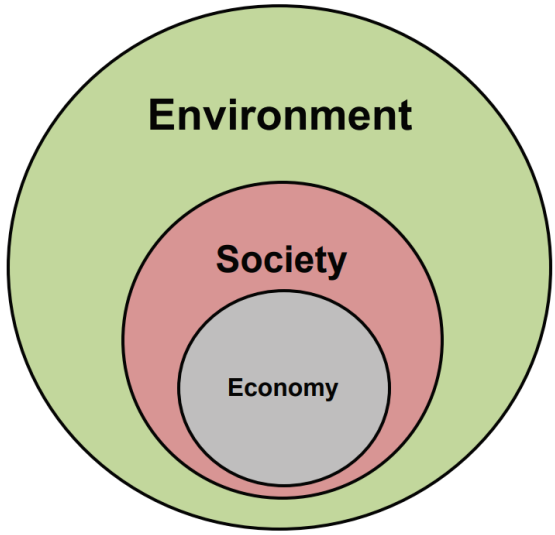

Fig. 1 Hierarchy of priorities in a sustainable system. Diagram from City of Edmonton, *The Way We Green: The City of Edmonton's Environmental Strategic Plan* (2011), p. 17, https://www.edmonton.ca/city_government/documents/PDF/TheWayWeGreen-approved.pdf

Nor can we assume that an inversion of the current prioritization of the economy over the environment is impossible; such pessimism that things cannot be different than the status quo reflects overly 'rigid views of society',[22] when in fact values change all the time. For example, slavery was abolished in the United States even against the argument this abolition was 'uneconomic', and women won the right to vote.

The second example of problematic thinking is techno-optimism: that the ecological crisis can be fixed by technology. Techno-optimism contains multiple conceptual traps. Firstly, it is reductionist, failing to comprehend the complexity of natural systems[23] and their irreplaceability

22 Magnus Boström and Debra J. Davidson, 'Introduction: Conceptualizing environment-society relations' in *Environment and Society*, ed. by Magnus Boström and Debra J. Davidson (Cham: Palgrave, 2018), pp. 1–24 (p. 13), https://doi.org/10.1007/978-3-319-76415-3.

23 These systems are interrelated and often surprising. As one example: in diving to the bottom of the ocean, whales stir up plankton, which, at the surface, absorb huge amounts of carbon dioxide. 'When the numbers of great whales were at their historical peaks, they might have removed several tens of millions of tons of carbon from the atmosphere each year' (Mueller (2017) p. 73).

by human ones; tied up in this thinking is cultural arrogance and ignorance that goes right back to the separation-and-superiority story. This thinking glosses over the loss of nature in favour of human 'opportunities'. Techno-optimism also usually falls for the idea that human beings are fundamentally selfish or competitive or materialistic and that a focus on technology is more positive and realistic than a reliance on social change (which it views as negative and extreme). These points are simply untrue. We have language and families and communities and societies precisely because we are predominantly a collaborative rather than a competitive species. And history makes clear the modern industrial world is not unique in possessing 'advanced' technology—many Indigenous and traditional cultures, including those in the past, have had the technology to overdraw their resources, and so self-restraint became part of their belief system and was integrated into ceremonies to maintain sustainability; restraint is a cultural issue, not a biological one.[24] Finally, techno-optimism fails to recognize the connection between technological solutions and power and politics; that is, that these so-called solutions serve to uphold existing power dynamics and undercut the deep change that is actually needed. For example, it fails to recognize that the authority of science these solutions invoke is frequently reductionist science that feeds corporate profit but is 'not true, in a wider, ecological sense',[25] and it fails to recognize that these solutions usually reflect capitalist values and represent what Luigi Pellizzoni might call a neoliberal 'enclosure' of the natural commons, in which '[n]ature itself is entrepreneurialized'.[26] Unfortunately, we see techno-optimistic solutions everywhere. Now, as Crist states,

> Wherever we turn we find diverse expressions of this single strategy: whether it is the pitch for genetically modified crops to 'feed the world'; the call for desalinization projects to solve freshwater shortages; the

24 As one example, the Klallam people of the Pacific Northwest invented fishing weirs effective enough to fish out salmon stocks in a few seasons; the flourishing of both people and salmon for over seven millennia thus 'suggests that there were intact social structures in place that not only fostered knowledge of technology's propensity for overshoot, but that effectively translated such knowledge into a functional ethics' (Mueller (2017), pp. 200–202). Their rituals of interconnectedness provided a check on the power of their technology.

25 Ibid., p. 272.

26 Dorothee Schreiber, 'Hope and expectation on Turtle Island', *Niche* (June 6, 2017), https://www.niche-canada.org/2017/06/06/hope-and-expectation-on-turtle-island/

> increase of aquaculture operations (fish factories) to generate "protein" for people; the manipulation of atmospheric composition to rectify climate disruption; the expansion and diversification of biofuel production to gas up the growing global car fleet; or the pressure to surrender remaining wilderness areas for people's economic advancement.[27] Unifying these superficially dissimilar projects is the human imperial mission to continue manipulating, invading, and unlocking the bounty of nature as the means to tackle humanity's current and coming tribulations.[28]

For all its talk of 'disruption', techno-optimistic thinking leaves untouched the cultural underpinnings of the ecological crisis—meaning it keeps us on the path to collapse, and is anything but disruptive, or realistic. We already know that techno-optimistic approaches are insufficient at resolving the ecological crisis. As environmental sociologist Ingolfur Blühdorn notes,

> Even in the richest and technologically most advanced countries, the strategies of ecological modernisation and environmental management have been unable to halt, let alone reverse, the trajectory of environmental consumption and destruction. Technological progress has not brought about sufficiently intelligent solutions.[29]

The opposite of techno-optimism is not 'anti-technology' (which would be its own conceptual trap) but techno-skepticism, which we might also simply call critical thinking, in which we carefully consider and evaluate whether or not the technology fundamentally serves us, rather than blind acceptance of it and reliance upon it, without much thinking at all.

The third example of problematic thinking is the perversion of the human-nature relationship that arises out of postenvironmental theory.[30] This theory perhaps superficially sounds promising, as it urges

27 To this list could also be added the push for autonomous cars (rather than intelligent public transit and responsible urban design) and support for nuclear energy (rather than decentralized energy production and decreased consumption).

28 Eileen Crist, 'I walk in the world to love it', in *Protecting the Wild: Parks and Wilderness, The Foundation for Conservation*, ed. By G. Wuerthner, E. Crist and T. Butler (Washington: Island Press, 2015), pp. 2–10 (p. 8), https://doi.org/10.5822/978-1-61091-551-9.

29 Ingolfur Blühdorn, 'Sustaining the unsustainable: Symbolic politics and the politics of simulation', *Environmental Politics*, 16.2 (2007), 251–275 (p. 252), https://doi.org/10.1080/09644010701211759.

30 This theory first rose to prominence with the 2004 publication of Michael Shellenberger and Ted Nordhaus's manifesto, *The Death of Environmentalism: Global Warming Politics in a Post-Environmental World*, https://s3.us-east-2.amazonaws.

that humans are not separate from nature—except that it then suggests that the nature part does not exist at all. This problematic thinking, to which academics seem particularly susceptible, involves 'grand theorizing'[31] that justifies continued human-centeredness, entitlement and colonialism. Promoted by Timothy Morton, Emma Marris and others, it represents dangerous, *false* reconciliation; it 'is resolved not in the direction of conceiving of human-nonhuman relationship as a gathering on equal footing, as many non-western cultures do [...] but of a complete loss of autonomy and distinction of the natural'.[32] This thinking often promotes universal principles rather than place-based knowing, it ignores the past and subscribes to the narrative of progress, and because it relativizes human actions (suggesting everything we do is 'natural') it allows no room for critique of technology (which I myself witnessed recently, when I noted on social media that cellphones create huge amounts of environmental waste and a colleague sent me a 'friendly reminder' warning against the 'pathologization of technology'); it thus also upholds techno-optimism. We can see this thinking right here in Edmonton, with the decision to run an LRT through the North Saskatchewan River Valley, destroying an old-growth forest and an important link in the wildlife corridor, in order to expand 'modern' public transit, and we see it again in the proposal to rezone ninety-nine acres of river valley habitat for a solar power plant. And unfortunately, rather than recognizing the human-centeredness and neoliberal enclosure of the natural commons inherent in this thinking and then speaking against it as public intellectuals, some academics have defended it. For example, one colleague stated we need solar power and suggested that concerns with the river valley power plant reflected 'the human-created fantasy of an untouchable nature'. This statement perfectly represents grand theorizing. And, as Crist notes, it is 'bogus reasoning' to suggest that 'those who defend the natural world from human assimilation' believe in a 'human-nature dichotomy', and the accusation

com/uploads.thebreakthrough.org/legacy/images/Death_of_Environmentalism.pdf

31 Boström and Davidson (2018), p. 15, https://doi.org/10.1007/978-3-319-76415-3.

32 Luigi Pellizzoni, 'Connecting people with things: The commons and environmental sociology', in *Environment and Society*, ed. by Magnus Boström and Debra J. Davidson (Cham: Palgrave, 2018), pp. 281–304 (p. 294). https://doi.org/10.1007/978-3-319-76415-3.

> has worked only to discourage deeper thinking about our relationship with the biosphere. For it requires virtually no thought to say, 'Humans and nature are not separate, therefore no wonder everything looks the way it does'. But it requires critical reflection to discern that the millennia-old stance of human entitlement, with its proliferated conceptions of 'the Human Difference' and its amoral instrumentalism, has all but utterly divorced humans from nature—therefore no wonder everything looks the way it does.[33]

In other words, the point is not that humans are part of nature and so everything we do is fine, it is that humans are part of nature, and so we have to be careful to act respectfully and avoid harm. Of course we need public transit, but that which uses existing transportation corridors and replaces cars rather than parks and forests. Of course we need solar power, but on rooftops and brownfields, not in riparian habitat. What about the deer and coyotes and blue herons and barred owls who live on this land? Where is there any reflection of right relationship, of respect, reciprocity, and care in this thinking? As Pellizzoni notes, this kind of ambivalent takeover of nature for human use is 'perhaps the most dramatic enclosure of all' because it seems to extend to 'humans' own mindset and imagination'.[34]

Humanities scholars, in taking on our role to help resolve the ecological crisis, will not only have to avoid these conceptual traps ourselves, but also push back against them on all fronts—because they are already ubiquitous in academia and wider society. Corporations and political leaders have seized upon the above ideas, particularly eager to take advantage of the 'opportunities' that techno-optimism represents. Today, this thinking is well financed, as evidenced by support for 'ecomodern' research centres such as Future Earth and the Breakthrough Institute. Future Earth seems to actually celebrate (however incoherently) the Anthropocene as an achievement; as one of the speakers in its promotional video for its magazine, *Anthropocene: Innovation in the Human Age* states, 'what an amazing juncture in which to be alive; humanity was mostly a dribble, for most of its existence, and then there's been "zoom". And now within the lives of most everyone who's alive right now, something different is coming'.[35] Meanwhile,

33 Crist (2015), p. 6.
34 Pellizzoni (2018), p. 294.
35 Future Earth, 'Future Earth products', *Future Earth*, 50–1:06, https://www.anthropocenemagazine.org/about-us/.

the Breakthrough Institute defines itself as 'a global research center that identifies and promotes technological solutions to environmental and human development challenges'[36] and it has attracted dozens of 'progressive' researchers from across academic disciplines, including the humanities and social sciences, who have embraced a 'managerial mindset' toward nature.[37] In the real world, this translates into continued rationalizing of human-centered land use and adoption of technology without considering, or actively disregarding, the impact on other species and ecosystems. This thinking also perpetuates colonialism and ignores Indigenous rights.

These conceptual traps are also pervasive in policy-making and are backed by what Blühdorn calls 'symbolic politics' and 'politics of simulation', which aim to reassure the public that leaders are acting on the ecological crisis yet uphold 'the core principles of democratic consumer capitalism' that in fact undermine authentic ecological solutions, ultimately helping to 'sustain what is known to be unsustainable'.[38] Blühdorn presents these politics as both an intentional 'performance' to defend the status quo, as well as—and this ties to the central point of this paper—the result of a cultural inability to seriously question the status quo.[39] We are so thoroughly socialized that genuine challenges to the established system have virtually disappeared; we have instead normalized the ecological crisis and allow it to serve existing power structures through focus on 'narratives of technological efficiency, [...] corporate responsibility, ethical consumption, fair trade, ethical investment, green consumerism, etc.'.[40] These superficial 'solutions', along with all of the above examples of problematic thinking, represent an immature attempt to avoid the cultural reckoning of modernity that the ecological crisis is insisting we must undertake. They do not create a right relationship with the land; they prolong disconnection and continue to cause harm.

The damage caused by attempting to avoid a reckoning of the cultural story of modernity is not only evident in the ecological crisis, but also in ourselves, in a deepening cognitive dissonance. This is evident in

36 Breakthrough Institute, 'About us', *Breakthrough Institute*, https://www.thebreakthrough.org/about.
37 Crist (2016), p. 15.
38 Blühdorn (2007), abstract.
39 Ibid., p. 253.
40 Ibid., p. 263.

how modern culture deals with the ecological crisis not only in science, but also in literature and art. Consider, for example, the tendency for literary conference panels to position Anthropocene discourse alongside dystopian fiction, seemingly regarding the collapse of the natural world as just another 'scarcity narrative'.[41] In this way, the ecological crisis is reconfigured as a creative landscape to be imaginatively explored, perhaps even as a viable or inevitable future. In some cases, such a future is even seen as preferable: Donna Haraway's suggestion that a 'cyborg' world, blurring boundaries between humans and machines, would be good for feminism regards the artificial as not only a sufficient replacement for nature, but superior to it.[42] As Indian writer Amitav Ghosh noted in 2016, most modern literature seems unable to effectively deal with the ecological crisis: 'the literary mainstream, even as it has become more engagé on many fronts, remains just as unaware of the crisis on our doorstep as the population at large',[43] and at the heart of this crisis is a 'broader imaginative and cultural failure'.[44] Ghosh suggests that this failure relates to modern literature's—particularly the novel's—reliance on 'concealment' of large events in favour of everyday life, so that it reflects 'a world of few surprises, fewer adventures, and no miracles at all';[45] he notes how hard it is, for example, for a novel to realistically invoke even a cataclysmic weather event. What Ghosh is ultimately pointing to is the effect of modernity's separation-and-superiority story. The novel arose as a genre in the seventeenth century and centers on the individual protagonist disconnected from nature; the story thus leaves no room for engagement with natural phenomena or anything related to the spiritual or an enchanted nature.[46] The disconnection upheld by this worldview explains why literary works dealing with environmental collapse are 'banished' to 'fantasy, horror, and science fiction',[47] as if imminent ecological collapse was not actually real.

41 Macfarlane (2016).

42 Donna Haraway, *Manifestly Haraway* (Minneapolis: University of Minnesota Press, 2016). https://doi.org/10.5749/minnesota/9780816650477.001.0001 .

43 Amitav Ghosh, 'Where is the fiction about climate change?', *The Guardian* (October 28, 2016), https://www.theguardian.com/books/2016/oct/28/amitav-ghosh-where-is-the-fiction-about-climate-change-.

44 Ibid.

45 Ibid.

46 The eternal irony, or perhaps prescience, is that the first novel, Miguel de Cervantes's *Don Quixote*, is all about the delusion of humans perceiving themselves as heroic.

47 Ghosh (2016).

This same deepened disconnection is likewise evident in what is perhaps the best-known public art project of the Anthropocene so far, the photographs of Edward Burtynsky. The photos, which show the ruin of the planet as aesthetically pleasing patterns from above, suggest a god-like gaze, so that even while drawing attention to the destruction modern industrial culture has wrought on a grand scale, the photos uphold assumptions of human power. Usually missing, meanwhile, are the other-than-human victims of the destruction; it is as if they never existed. Burtynsky has gained fame for his works: in September 2018 he had six exhibits in three countries, and 2018 also saw his Anthropocene Project turned into a documentary of the same name.[48] The perspective in his photos depends upon separation, and indeed privilege. There is no ground-level acknowledgement of the suffering, no connection, no intervention, no alternative presented; the photos exacerbate abstraction rather than encourage action, and almost everyone I know who has seen the film said they felt numb afterward. We need less numbing, not more; we need waking up to the fact that the damage is *real* and then collective action to change course.

The problem with delayed reckoning of the modern cultural story is that the inevitable response *is* numbness; since the damage is so overwhelming, the only possible reaction to stave off despair while remaining within this story is deep denial. And we see evidence of this denial everywhere. See, for example, news stories from August 2018 that compared the smoke in Edmonton from forest fires in British Columbia to a 'zombie apocalypse' without a single mention of climate change or global warming.[49] Or Maori Elder and whale expert Hori Parata's statement regarding tourists' response to the surge in mass whale strandings on New Zealand beaches: '"These days it is like a zoo. People just want to come and gawk at us, without even trying to understand what is happening with the animals and the environment"'.[50] Or the death of a baby dolphin in 2016 after hordes of people on a beach in

48 Edward Burtynsky, https://www.edwardburtynsky.com/events

49 Karen Bartko, '"Lovely morning in the apocalypse": Edmonton wakes up to orange, smoky sky', *Global News* (August 15, 2018), https://www.globalnews.ca/news/4388625/edmonton-apocalypse-sky-wildfire-smoke/.

50 In Eleanor Ainge Roy, 'What is the sea telling us?', *The Guardian* (January 3, 2019), https://www.theguardian.com/environment/2019/jan/03/what-is-the-sea-telling-us-maori-tribes-fearful-over-whale-strandings.

Argentina took it from the water to take selfies with it.[51] It is as if the fires were a TV show, the animals simply memes on social media. While we may gape and gawk, the objectification of nature prevents us from feeling any deep pain; as ecopsychologist Zhiwa Woodbury notes, it is a strategy for cognitively keeping the ecological crisis at arm's length.[52] Woodbury notes this disconnection has deepened to the level of extreme collective dissociation.[53] He is right; look at how the Intergovernmental Panel on Climate Change talks about the climate crisis in its 2018 *Global Warming of 1.5° Celsius: Summary for Policymakers*—keeping in mind the purpose of this document is essentially to state what the world needs to do to prevent global ecological collapse:

> B3.1. Of 105,000 species studied, 6% of insects, 8% of plants and 4% of vertebrates are projected to lose over half of their climatically determined geographic range for global warming of 1.5°C, compared with 18% of insects, 16% of plants and 8% of vertebrates for global warming of 2°C (medium confidence). Impacts associated with other biodiversity-related risks such as forest fires, and the spread of invasive species, are lower at 1.5°C compared to 2°C of global warming (high confidence). {3.4.3, 3.5.2}[54]

Where is the care in this language? Where is the understanding of right relationship? The modern cultural belief that humans are separate from, and superior to, nature, which caused the problems in the first place, prevents them.

We have labelled this condition of separation as 'nature deficit disorder' and as 'shifting baseline syndrome' (in which each generation assumes a progressively depleted 'normal' state of nature—so that we risk 'sleepwalking through the destruction of the natural world without taking action to remedy the situation'[55]) but without the recognition

51 Lauren O'Neil, 'Dolphin calf dies after tourists use it for selfies', *CBC* (February 19, 2016) https://www.cbc.ca/news/trending/dolphin-calf-dies-after-tourists-use-it-for-selfies-1.3456188.

52 In Baker (2018), 15:10–15:50.

53 Zhiwa Woodbury, 'The talking cure for the climate crisis', *Truthout* (April 14, 2016), https://www.truthout.org/articles/the-talking-cure-for-the-climate-crisis/.

54 IPCC, *Global Warming at 1.5° Celsius: Summary for Policy Makers* (Geneva: IPCC, 2018), p. 11, https://www.report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

55 Milner-Gulland in Jeremy Hance, 'Proving the "shifting baselines" theory: How humans consistently misperceive nature', *Mongabay* (June 24, 2009), https://www.news.mongabay.com/2009/06/proving-the-shifting-baselines-theory-how-humans-consistently-misperceive-nature/.

that the disconnection from nature and widespread amnesia are not unexpected consequences or isolated phenomena, but are instead built right in to modern culture.[56] They are simply the result of the modern cultural story of human separation and superiority and its belief in 'progress'—that is, a culture founded on objectifying nature and dismissing or mocking the past.[57] And because of the built-in taboos to even critique the modern cultural story—through, for example, name-calling accusations of anthropomorphism, or bias, or romanticizing the past, or reverting to old-fashioned or 'medieval' thinking—we continue to cause harm to both nature and ourselves. Because we are caught in a feedback loop of destruction, the disconnection only deepens: we further objectify nature, so we rationalize more harm, including through language that both silences other voices and downplays the harm, and in so doing we numb our own consciences, and then we forget even the memory of other ways of being and seeing and knowing. As Crist states,

> How true the cliché that history is written by the victors, and how much truer for the history of the planet's conquest against which no nonhuman can direct a flood of grievances that might strike a humbling note into the human soul [...] Anthropocene discourse veers away from environmentalism's dark idiom of destruction, depredation, rape, loss, devastation, deterioration, and so forth of the natural world into the tame vocabulary that humans are changing, shaping, transforming, or altering the biosphere, and, in the process, creating novel ecosystems and anthropogenic biomes [...] [Non-human beings] have been de facto silenced because if they once spoke to us in other registers—primitive,

56 As Mary Annette Pember notes, 'In the tradition of a Western-based worldview, people, especially academics, construct pathologies and syndromes to objectify and compartmentalize our humanness'; when the result of isolating ourselves from nature is depression and a longing for connection, it is hard for Indigenous people to not do 'a collective eye roll while voicing an exasperated, "Duh, ya think?"'. Mary Annette Pember, 'How native and white communities make alliances to protect the Earth', *EcoWatch* (December 21, 2018), https://www.ecowatch.com/community-alliances-protect-the-earth-2624052967.html

57 'Shifting baseline syndrome' fails to recognize that Indigenous and other traditional cultures, which ritually remember the past, have avoided the problems of ecological degradation in the first place. Thus, consider the irony: 'The proof of the shifting baselines theory requires that human experience of nature must be backed up by empirical evidence in order to be understood as accurate. Clearly, human perception of nature is subject to all sorts of failings, due to short life spans, poor communication (generational amnesia), and unreliable memory (personal amnesia)' (Hance, 2009).

> symbolic, sacred, totemic, sensual, or poetic—they have receded so much they no longer convey such numinous turns of speech, and are certainly unable by now to rival the digital sirens of Main Street.[58] The centuries-old global downshifting of the ecological baseline of the historically sponsored, cumulative loss of Life is a graveyard of more than extinct life forms and the effervescence of the wild. But such gossamer intimations lie almost utterly forgotten, with even the memory of their memory swiftly disappearing. So also the Earth's forgetting projects itself into humanity's future, where the forgetting itself will be forgotten for as long as the Earth can be disciplined into remaining a workable and safe human stage. Or so apparently it is hoped, regarding both the forgetting and the disciplining.[59]

It is urgent that those of us in the humanities recognize the ecological crisis as a cultural crisis—as the inevitable endpoint of modern culture's separation-and-superiority story. While this story, the 'tall tale of progress',[60] pulled off the illusion of working for awhile (for those who are part of that culture, and not the humans and other creatures colonized or repressed or decimated by it), that was only because of the earth's natural abundance, especially in places that had been stewarded by Indigenous people for millennia. As that abundance has now been eroded, the problem with the narrative—which one could also see as a problem with accounting, because one cannot simply take without giving back forever—is now glaringly obvious. A forward line of 'progress', rather than a circle enabling regeneration, will always end in exhaustion. We are at a reckoning point, and it could not be more clear that the separation-and-superiority story is a dysfunctional story. We might even say it is a lie. The proof, the feedback, is the ecological crisis itself—the climate crisis, mass extinction, the loss of half the world's wildlife—as well as human cultural and psychological losses. This same story is never going to offer a way out; it can't. So we need to be the voices of all those who have been harmed and destroyed by this story,

58 As Kingsnorth (n.d.) notes, many of us have forgotten how to even hear old stories of an enchanted nature; 'we tend to want to rationally analyze and imagine that we can intellectually grasp and understand every aspect of something that we hear in order for it to make sense, but that's not necessarily the case'. He suggests the way to relearn is to '[shut] our mouths for a while and [be] a bit humble and [go] outside and [listen]'.

59 Crist (2016), pp. 17–19.

60 Rita Wong and Fred Wah, *Beholden: A Poem as Long as the River* (Vancouver: Talon Books, 2018), p. 96.

and call it out loud and clear. This might be, to paraphrase Thomas Berry, the humanities' great work. And then, as Thomas King notes and as is emphasized above, we need to tell a different story. We've created the 'environmental ethics', 'business ethics', 'political ethics', and all the 'other codes of conduct suggested by our actions [...] We've created the stories that allow them to exist and flourish. They didn't come out of nowhere. They didn't arrive from another planet. Want a different ethic? Tell a different story'.[61]

While, as Paul Kingsnorth says, a new cultural narrative cannot simply be consciously constructed as a grand project (he knows, because he tried it with the Dark Mountain Project), awareness and articulation of an alternative can create a movement, and then even deep cultural change can happen when 'lots and lots of small stories come together to form something bigger',[62] for 'stories mobilize us to live toward the possibilities they contain'.[63] The alternative narrative we need to make way for now is not new. Rather, it is an ancient story that has worked for cultures around the world for millennia and has persisted in the margins all along, persecuted by modernity. Essentially, the story is: *of course nature exists, and we are simply part of it*. This is the ecocentric story, containing 'profound deference for the living world'[64] within which we see ourselves as merely embedded, and it enables right relationship. This story seeks to know the world holistically, as Potawatomi writer and botanist Robin Wall Kimmerer notes, through 'mind, body, emotion, and spirit' rather than just intellectually.[65] This story remembers the past and connects deeply with place, and because it recognizes the triumph of rebirth in nature rather than fearing death, it is a circle rather than an arrow. This story sees the land as caring for us, and reciprocates care back for the land. It recognizes the truth that destruction of nature and erasure of connection with it is an ongoing act of colonialism. It faces the pain of the harm we have caused, and mourns the losses, for feeling ecological grief is 'a legitimate response to ecological loss' and it

61 Thomas King, *The Truth About Stories: A Native Narrative* (Toronto: House of Anansi Press, 2003), p. 164.
62 Kingsnorth (n.d.).
63 Peter Denton, *Technology and Sustainability* (Toronto: Rocky Mountain Books, 2014), p. 19.
64 Crist (2016), p. 28.
65 Robin Wall Kimmerer, 'Corn tastes better on the honor system', *Emergence*, https://www.emergencemagazine.org/story/corn-tastes-better/.

> reminds us that climate change is not just some abstract scientific concept or a distant environmental problem. Rather, it draws our attention to the personally experienced emotional and psychological losses suffered when there are changes or deaths in the natural world. In doing so, ecological grief also illuminates the ways in which more-than-humans are integral to our mental wellness, our communities, our cultures, and for our ability to thrive.[66]

But this story does not remain in despair. The story itself, because it is based on deep connection rather than intellectual abstraction, guides us to act. Action takes many forms: paying careful attention to the land in everything we do; working together to clean up the mess we have caused and restoring the ecological health of the landscape; and standing up as humble human beings, physically putting our bodies on the line to defend the land and its creatures, not because they are our garden to tend, as Emma Marris says, but because they are our relations. Action matters, I would now argue to Rudy Wiebe, because it changes the way we know a place—and thus changes our stories, the place, and us.[67] Healing begins.[68] The feedback loop for this story is regenerative and creative: as people forge deep cultural connections with nature,

66 Neville Ellis and Ashlee Cunsolo, 'Hope and mourning in the Anthropocene: Understanding ecological grief', *The Conversation* (April 4, 2018), https://www.theconversation.com/hope-and-mourning-in-the-anthropocene-understanding-ecological-grief-88630.

67 See Wong and Wah (2018); the authors said the language they used came from the Columbia River itself. This connection enabled Wong's rising sense of activism—near the end of the poem, she writes that she travelled to Powell's bookstore to find *How to Save a River* and *Dam Removal* (p. 126).

68 Despite Haraway's statement that 'We cannot go back ideologically or materially' (2016, p. 30), there are in fact a number of examples of successful ecological restoration that have already happened, because the places were approached through a changed story: the improved health of Yellowstone's ecosystem with the return of wolves; the swift return of marine species once ocean reserves are created (see George Monbiot, *Feral: Rewilding the Land, the Sea, and Human Life* (London: Penguin Books, 2013), p. 249); and the restoration of the entire Loess Plateau in China. John D. Liu, who filmed this incredible latter project, has since started up Ecosystem Restoration Camps around the world, noting that the restorative potential of collective, active collaboration with nature is 'the knowledge that must be understood by all people on the Earth as quickly as possible' (in Ricardo Tucci, 'John D. Liu interview: "It is possible to rehabilitate large-scale damaged ecosystems"', *Permaculture News* (June 29, 2016), https://www.permaculturenews.org/2016/06/29/john-d-liu-interview-possible-rehabilitate-large-scale-damaged-ecosystems).

including through 'particularizing'[69] and poetic rather than abstract language and art and active care for nature, nature becomes richer and better able to care for the people, and this in turn inspires deeper connection. This story is thus deeply positive. Telling a different story brings a different world to life. And if we make our priority not passively observing the human-centered, deathly geological epoch known as the Anthropocene, but rather actively ushering in a new *cultural* era, one of right relationship that enables the flourishing of life, which we might call the Era of Regeneration, we finally have a chance of turning everything around.

Indigenous storytellers are the first sources to turn to for this story. Besides opening academia up more fully to oral storytelling, we can learn from books by Indigenous authors. Works like Robin Wall Kimmerer's *Braiding Sweetgrass* or Leanne Betasamosake Simpson's *Dancing on our Turtle's Back* show that if we listen, we will hear what other creatures have to say, and realize they are our teachers because they have existed for so much longer than we have.[70] These authors also show how stories that include the agency of other beings are more meaningful and deeply satisfying in all the ways that the story of separation and superiority is empty. Wall Kimmerer, who is both a botanist and a keeper of traditional Potawatomi wisdom, asks, 'what good is knowing, unless it is coupled with caring? Science can give us knowing, but caring comes from someplace else'.[71] Holistic knowing allows us to better understand what to value and how to act, and reveals that a lot of things we think we can't live without are actually burdens rather than gifts, and that real gifts take a very different form.

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69 Wendell Berry in Robert Macfarlane, 'The word-hoard: Robert Macfarlane on rewilding our language of landscape', *The Guardian* (February 27, 2015), https://www.theguardian.com/books/2015/feb/27/robert-macfarlane-word-hoard-rewilding-landscape.

70 Mueller makes a similar point, noting humans appeared in the Americas around twelve thousand years ago—'that is between four and five hundred generations […] The oldest known ancestor of all modern salmon, *Easalmo drifwoodensis*, lived in the lakes of Western Canada between forty and fifty million years ago […] Because salmon have very different life spans […] you can figure that anywhere between six and twenty-five million generations were born from these rivers and returned to them at the close of their lives' (2015, pp. 57–58). Plants, of course, go back much further (see Robin Wall Kimmerer, *Braiding Sweetgrass* (Minneapolis: Milkweed, 2014), pp. 9–10, 346–347).

71 Wall Kimmerer (2014), p. 345.

Traditional European literature also offers stories of connection and agency of nature, 'that old animal, emotional, spiritual connection to the natural world' that is 'the heart of things'.[72] One writer who tapped into English folklore interconnecting culture and nature is Roger Deakin, and his writings about his daily life present a model of right relationship. In his book *Waterlog*, for example, the humbleness with which he regarded his place on earth is evident in his desire to allow wild animals to share his farmhouse with him; when he catches himself feeling impatient for the swallows that nest in his chimney to migrate in fall so that he might make a fire, he says, 'However, whenever such selfish sentiments creep up, I remind myself that I'm a mere newcomer to this ancient dynasty of nomads, who settled here centuries before I ever appeared on the scene and will, I sincerely hope, long outlast me here'.[73] Because Deakin embodied right relationship, he was also necessarily an activist; he said, 'A writer needs a strong passion to change things, not just to reflect or report them as they are'.[74] He co-founded an eco-arts group called Common Ground to resist 'the footloose excesses of development' and foster 'local distinctiveness', through preservation of those aspects of the land and of our culture that suggest an 'age-old intertwining of human life and the natural world'.[75]

There are also settler writers who have long been ignored or considered 'unrealistic' and 'irrelevant'[76] in academia precisely because they connected ethics and nature. Aldo Leopold, in his 1949 *A Sand County Almanac*, described the 'shallow-minded modern who has lost his rootage in the land'[77] versus the intellectually humble scholar who recognizes humans' role as mere participants in a community that includes the 'soils, waters, plants, and animals, or collectively: the land';[78] he also recognized that right relationship is not just an intellectual pursuit, but also an embodied, emotional and spiritual

72 Kingsnorth (n.d.).
73 Roger Deakin, *Waterlog* (London: Vintage Books, 2000), p. 262.
74 Roger Deakin, *Notes from Walnut Tree Farm* (London: Penguin, 2009), p. 120.
75 Common Ground, *Common Ground*, www.commonground.org.uk/what-we-do/
76 The terms biologist Ludwig Carbyn said another scientist used when Carbyn referenced Aldo Leopold (personal communication, December 11, 2018).
77 Aldo Leopold, *A Sand County Almanac* (New York: Ballantine, 1970), p. 279.
78 Ibid., p. 239.

one: 'We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in'.[79] And he articulated a crystal-clear land ethic: 'A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise'.[80] Likewise, Rachel Carson, in her 1962 *Silent Spring*, noted that pesticide spraying raises 'a question that is not only scientific but moral. The question is whether any civilization can wage relentless war on life without destroying itself, and without losing the right to be called civilized'.[81] She also stated,

> In some quarters nowadays it is fashionable to dismiss the balance of nature as a state of affairs that prevailed in an earlier, simpler world, a state that has now been so thoroughly upset that we might as well forget it. Some find this a convenient assumption, but as a chart for a course of action it is highly dangerous. The balance of nature is not the same today as in Pleistocene times, but it is still there: a complex, precise, and highly integrated system of relationships between living things which cannot be ignored any more than the law of gravity can be defied with impunity by a man perched on the edge of a cliff.[82]

She noted the arrogance inherent in the phrase 'control of nature'[83] and emphasized that 'We need a more high-minded orientation and a deeper insight, which I miss in many researchers. Life is a miracle beyond our comprehension, and we should reverence it even where we have to struggle against it […] Humbleness is in order; there is no excuse for scientific conceit here'.[84]

The stories that we need to make way for are already there, waiting for us to learn from them and be inspired from them in our own story-making. I myself have been inspired and changed by the stories above; I can no longer just write, I now need to try to actively right. So when Edmonton's city council decided to run its LRT through the North Saskatchewan River Valley, knocking down an old-growth forest and the popular Cloverdale footbridge—a place that in many ways symbolized right relationship, by connecting people with nature right in the heart

79 Ibid., p. 251.
80 Ibid., p. 262.
81 Rachel Carson, *Silent Spring* (New York: Fawcett, 1962), p. 95.
82 Ibid., p. 218.
83 Ibid., p. 261.
84 Ibid., p. 243.

of the city—I wrote about it,[85] but I also founded a group called Save the Footbridge. We started a petition and social media campaign, we created buttons and stickers, we organized summer concerts and other events on the footbridge, we spoke to the media and at public hearings, and we protested the ground-breaking.[86] And since the footbridge was carved with hearts and initials dating back forty years, I called northern Alberta artist Peter von Tiesenhausen, who in 1996 copyrighted his land to protect it from oil and gas companies, to explore the possibility of copyrighting the footbridge as a collaborative public art piece. Von Tiesenhausen is in some ways the antithesis of Edward Burtynsky: rather than looking down on places around the world, he creates art from his farm, with which he has an intimate and reciprocal relationship; in a phone interview in 2016, he said he 'borrows from the land', which he considers 'sacred', and that he 'gives back to it'. The land he is on 'is the place that has nurtured me since I was a baby, and has given me everything I've ever needed'. He was encouraging, and said, 'we have to fight for these things [...] Everything is impossible until it's not'.

We did not succeed in stopping the destruction of the footbridge, or the old growth forest, and I will forevermore be haunted by the sight of robins and chickadees that fluttered around the destruction that perfect spring morning when the chainsaws arrived and the trees came down. But we did manage, I think, to shift the collective story about our relationship to the river valley and the need to think more carefully about the type of public transit we develop. Thousands of people signed our petition. Two of my former students joined our group; one later began researching illicit writing in the river valley,

85 For example, see Kristine Kowalchuk, 'Cloverdale Bridge', *Edmonton City as Museum Project* (May 26, 2015), https://citymuseumedmonton.ca/2015/05/26/cloverdale-bridge/.

86 TransEd, the multinational consortium undertaking the work, includes Bombardier, EllisDon, and Bechtel. In 2002, Bechtel tried to privatize the water in Cochabamba, Bolivia (including 'even the rain' as the Spanish film by this name says) leading to massive protests and the death of a seventeen-year-old boy; they then tried to sue Bolivia for backing out of the contract. Meanwhile, EllisDon has created a public contest soliciting ideas for developing the river valley. As a 2002 *New Yorker* article stated, 'The world is running out of fresh water, and the fight to control it has begun' (see William Finnegan, 'Leasing the rain', *The New Yorker* (April 8, 2002), https://www.newyorker.com/magazine/2002/04/08/leasing-the-rain. TransEd's contract includes not just the construction but also operation of the line for the next thirty years. TransEd, *TransEd LRT Valley Line*, https://www.transedlrt.ca/.

including the graffiti on the footbridge railings; the other organized a storytelling event on the footbridge and has since published a fictional book, *The Melting Queen*, in which the bridge appears. At one of our concerts on the footbridge, members of the Edmonton Symphony Orchestra showed up to play. Another group played the bridge itself, using their drumsticks on the metal beams and wooden slats and the bicycles passing by. They said the bridge made a beautiful sound; the hollowness of the beams meant it reverberated in a special way. And what became increasingly clear was that people loved the place, and that the more time we spent together on the footbridge and in the vicinity of the woods and river, the more we all cared about saving it. The story of separation got in the way—while Blackfoot activist Duane Good Striker, who performed a ceremony on the footbridge, urged us to stand up for the land, most of our group's supporters drew the line at risking arrest, so only two of us actually defended it the day the trees came down (and were arrested). If there had been 100 of us, I am certain we would have won. Since then, I have taken solace in Erica Violet Lee's words that 'there is nothing and no one beyond healing'.[87] Our group has now formed the Edmonton River Valley Conservation Coalition, which is part of the Alberta Environmental Network, and Edmontonians for Responsible Urban Public Transit, and in 2017 my colleague Sarah Krotz and I began organizing free public talks about the river valley at the University of Alberta (we've done ten so far; an early version of this paper was the first one presented). And I now talk about ecocentrism and the footbridge and civil disobedience in the courses I teach. So that next time, 100 people, then 1000 people, will be there. Because action, not abstraction, is part of the right story.

I did not ask von Tiesenhausen how he thought we might collectively turn toward a right relationship with nature. But at one point in the interview, he said: we need to 'look at the biggest picture we can think of, and start there'. This struck me as precisely how an artist would describe holistic thinking. The 'biggest picture' includes seeing all of nature as our relations, as a complex system of which we are just a part, and as the beautiful home in which we belong. And this is the right story—the one we need to relearn, for it is not the land, but *we* who must

87 In Schreiber (2017).

change. And when we begin with the biggest picture, the right story is the one we will find ourselves in.

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4. Kitting the Digital Humanities for the Anthropocene

Digital Metabolism and Ecocritical DH

Amanda Starling Gould

As our landscapes of digital stuff continue to expand and connect, it is imperative we devise a toolkit for thinking (and doing) that tends to the environmental pulses of our digital condition. It is time now, if it isn't already too late, to enact a spongier digital-material form of knowledge-production, tailored to the concerns of our emerging Anthropocenic humanities, that absorbs the full force of our interconnections. A deliberate environmental intervention is not only an obvious response but also an opening: it plants our field securely within the earth, opens us to seeing our tools as environmental artifacts, and urges us to use our talents for doing earth work.

Introduction: Activating Digital Environmental Metabolism

In her keynote for the Digital Humanities conference in 2014, Bethany Nowviskie invited listeners to think about how their scholarship might change if it grappled truly with the grand ecological challenges of the Anthropocene: a planetary epoch that—to paraphrase atmospheric chemist Paul Crutzen—coincides with human-driven forces fundamentally changing the composition of the planet. Nowviskie,

 https://doi.org/10.11647/OBP.0213.04

thinking with the coming extinction of numerous species and the loss of ecological habitats, called for a digital humanities, in all of its broad forms, that changes its global sense of scale to embrace larger temporalities, to teach its practitioners to memorialize and live differently, and to pursue an active—and I'll add activist—engaged praxis that connects technology, the environment, and the 'ethical conditions of our vital here-and-now'.[1]

This is my inspiration.

That we are living in worlds profoundly altered by human influence is no longer a speculative issue. The facts and figures of anthropogenic environmental change daily rehearsed in news outlets and on social media illustrate, among other things, climate changes, sea level rises, severe weather events, polluted living conditions, growing mountains of toxic waste and extinction-level losses of biodiversity. The implications of environmental change are now, borrowing the words of Ian Baucom 'deeply connected to what it means to be human on earth in the twenty-first century'.[2]

In the so-called age of the Anthropocene, the planet's wealthiest and most educated humans have, through our daily acts of wasteful modern technological living, accelerated climate change more than 170 times its natural pace. Despite claims that technology will save us (from ourselves), our technosphere is in fact partly, if not largely, to blame for our current Anthropocene habitat. The misguided notion that our digital networks are composed of 'immaterial' 'clouds' of digital data that one 'goes to' when one 'gets online' is at best untenable and, at worse, blindingly destructive. Indeed, this type of (un)thinking sentences us to lives lived with the afterlives of our technologies and the implication of their geophysical wastes.

As our landscapes of digital stuff continue to expand and connect, it is imperative we devise a toolkit for thinking (and doing) that tends to the environmental pulses of our digital condition. It is time now, if it isn't already too late, to enact a spongier digital-material form of knowledge-production, tailored to the concerns of our emerging Anthropocenic

1 Bethany Nowviskie, keynote address. Also published as 'Digital humanities in the Anthropocene', *Digital Scholarship in the Humanities*, 30.Sup1 (2015), i4-i15 (p. i5), https://doi.org/10.1093/llc/fqv015.

2 Ian Baucom and Matthew Omelski, 'Knowledge in the age of climate change', *South Atlantic Quarterly*, 116.1 (2017), 1–18 (p. 1), https://doi.org/10.1215/00382876-3749271.

humanities, that absorbs the full force of our interconnections. A deliberate environmental intervention is not only an obvious response but also an opening: it plants our field securely within the earth, opens us to seeing our tools as environmental artifacts, and urges us to use our talents for doing earth work.

About a year before Nowviskie's call, I started thinking about metabolism as a model for better understanding our inherent and inescapable physical connections with our technologies and the planet. If humans cannot be human without our nonhuman metabolic partners—and we know we cannot—new ecosystemic patterns materialize if we trace our contemporary digital vitalities with a metabolism in mind. If we take as a premise that, in our present Anthropocenic age defined by humans acting as a geophysical force, human bodies, cultural technologies and the earth are intersecting material practices, we edge toward this living relation. I argue this human-earth-technology intersectionality is neither cyborgian nor posthuman, as some digital media scholars insist, but is something far more natural: it is a metabolic relationship wherein each system is inherently implicated in the perpetuation of the others. Thinking ecosystemically—not about ecologies of machines working in tandem like Matthew Fuller does in *Media Ecologies*[3] but about the interconnections between humans, our digital technologies, and the environment—reveals a metabolic relation. In turn, metabolic thinking ties our technologies to their rare earth mineral beginnings and also to their earth-infecting wastes.[4]

Digital metabolism is not meant to be a metaphor but an operational, and observable, definition of the digital's functionings and interconnections with the earth's human, biotic and geological ecologies. What digital metabolism makes thinkable is a world in which digital and environmental systems are not separate but inherently linked, in our modern ways of living, as kin. At its core, digital metabolism is a concept of co-living, of overlapping and co-constituting systems. Digital metabolic thinking gives us a rather radically ecosystemic way

3 I do not here mean to critique his project but to set mine apart.

4 See more on this concept of digital metabolism, and more about digital minerals and wastes, in my 2017 dissertation 'Digital environmental metabolisms: An ecocritical project of the digital environmental humanities' (PhD diss., Duke University, 2017), https://dukespace.lib.duke.edu/dspace/handle/10161/14457.

of looking at our bodies, our technologies and our contingent ecological connections.

Ecocritical digital humanities gives us a way to play out these digital metabolic relations. It gives us a kit for enacting deeper engagements with our entanglements as well as solutions for developing more sustainable digital practice. I see promise in ecocritical digital humanities as an ethical and active practical skill set that might unhinge dominant forms of *doing* in digital humanities scholarship to provide a richer and more engaged framework for Anthropocenic digital humanities practice. Indeed, digital scholarship is uniquely positioned to address the ecological concerns of climate change. Ecocritical digital scholarship can intervene to produce what Nowviskie calls a 'capacious' thinking capable of responding to Anthropocene-age challenges by operating simultaneously across scales, disciplines and institutions.

Ecocritical Digital Engagement

Ecocritical digital work like that we'll see here has the advantage of being public, global, accessible work. As such, it can reach a wide audience to engage public, global issues such as environmental justice, climate change, eco-awareness, environmental health, and daily living in Anthropocene futures. It can translate human-environmental issues into digital interventions that can meaningfully disturb the system through outreach, participation, education and organization. It can help us actively remake our ideas about nature and the relationship between humans and the environment.

Ecocritical digital work comes in the form of digital archives, digital activism, digital data, and digitally-based research projects. It is self-reflexive while performing its work: it is aware of its ecological footprint and acknowledges its role in environmental anthropogenic/technogenic destruction. Ecocritical digital work pivots from traditional ecocriticism by refocusing from reading representations of environment in text to more active and activist projects that instead focus on the material effects of our digital tools/texts and on documenting/sharing 'real' environmental issues. It is a platform for exploring and publicizing the (in)human(e) aspects of our increasingly severe environmental issues.

I'll ground us here in the work by detailing a few examples. The critical data-saving post-Obama North American #Datarefuge project had humanists rallying to archive critical climate and environmental data from United States government websites.[5] Projects like 100 Views of Climate Change, *FutureCoast* and Climate Stories NC capture climate stories from people across the globe.[6] Carl Sack's #NoDAPL Map plots Indigenous cultural areas alongside governmental geographic areas and oil pipeline sites. Researchers at the University of British Colombia and Yale, among others, have developed augmented reality projects that educate and compel users to initiate more sustainable behaviours. The new project Solar Protocol, by Tega Brain, Alex Nathanson and Benedetta Piantella, at http://solarprotocol.net/, 'explores the sun's interaction with Earth as a form of logic that shapes daily behaviors, seasonal activites and the decision making of almost all life forms. Other ecocritical digital projects digitize and archive historical environmental media, map the overlaps between poverty and pollution, provide public updates on air and water quality, illustrate the relationship between environmental and human health, and elicit public participation in local pro-environmental activities.[7]

Mark Sample's tweeting sharks project is an example of an open and accessible ecocritical digital mediation that works to reconfigure, or re-narrate, the relationship between humans, technology, literature, sharks and the earth. In this project, Sample hacks into OCEARCH's website to turn a pair of location-pinging sharks, Mary Lee and Katharine, into literary swimmers.[8]

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5 For more, see https://www.datarefuge.org/.

6 For more, see 100 Views of Climate Change at http://changingclimates.colostate.edu/, *FutureCoast* at https://ccnmtl.github.io/polarhub/core_projects/futurecoast.html, and Climate Stories NC at https://climatestoriesnc.web.unc.edu/.

7 See, for instance: U Penn's Da/um project, lexiconofsustainability.com, Digital Detroit, The Asthma Files, Environhealthsense.org, EnviroAtlas. For more on digital environmental art works, see my essay 'Dirtying the Digital,' in the *Digital Trash* Exhibition Catalog, Rutgers (2018) and my 2017 dissertation 'Digital environmental metabolisms: An ecocritical project of the digital environmental humanities' (PhD diss., Duke University, 2017), https://dukespace.lib.duke.edu/dspace/handle/10161/14457..

8 Mark Sample, 'Your mistake was a vital connection: Oblique strategies for the digital humanities', Keynote Address, Institute for Liberal Arts Digital Scholarship (2015).

OCEARCH's open-source Global Shark Tracker monitors the surfacing activity of great white and tiger sharks.[9] When any of their tagged sharks surface for longer than ninety seconds, their tags send location data to the OCEARCH's website and app. OCEARCH's researchers then share that information via social media. This is similar to Australia's Surf Life Saving Western Australia project which has since 2014 had more than 300 sharks tweeting their locations in alert as soon as they swim within half a mile of a beach.[10] These sharks have been co-opted by marine scientists into providing a social service act of tweeting their locations to potential ocean-swimmers.

What Sample's project does is hijack this scientific project, turning it into a more ecohumanist enterprise. Sample discovered an undocumented application programming interface (API) in OCEARCH's shark tracking database that allowed him to pull OCEARCH's location data on the two great white sharks Mary Lee and Katharine from its site so he could feed it into his Twitter bot @Shark_Girls. He then partnered Mary Lee and Katharine's location information with a coded Python program that randomly-generates sentences from Virginia Woolf's novel *Night and Day*, whose main characters are Katharine and Mary. The result is a Twitter bot—an automated Twitter account—that tweets an image of Mary Lee and Katharine's mapped location data along with a line from Woolf's novel. Reading through the Twitter feed, we watch Mary Lee and Katharine appear in different oceanic locations, reporting one day to be near Florida, another to be near South Carolina, and another to be in the Pelagic Sargassum Habitat Restricted Area. As we track their travels, we 'hear' them speak lines of literature. Their tweets are like postcards we receive from vacationing friends.

What Sample's project urges us to do is reconsider the relationship between oceanic wildlife (sharks), humans (those who are engaging the tweets) and our technospheric surround. If carefully considered, it brings to light our interconnections. It amplifies the live-ness of the sharks by allowing tweeting technohumans a glimpse at their pelagic

9 Since 1962, the US National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program (CSTP) has tagged more than 300,000 sharks.

10 See: Surf Life Saving Western Australia (SLSWA), http://surflifesavingwa.com.au//; and Alan Yu, 'More than 300 sharks in Australia are now on Twitter', *NPR* (January 1, 2014), https://www.npr.org/sections/alltechconsidered/2013/12/31/258670211/more-than-300-sharks-in-australia-are-now-on-twitter.

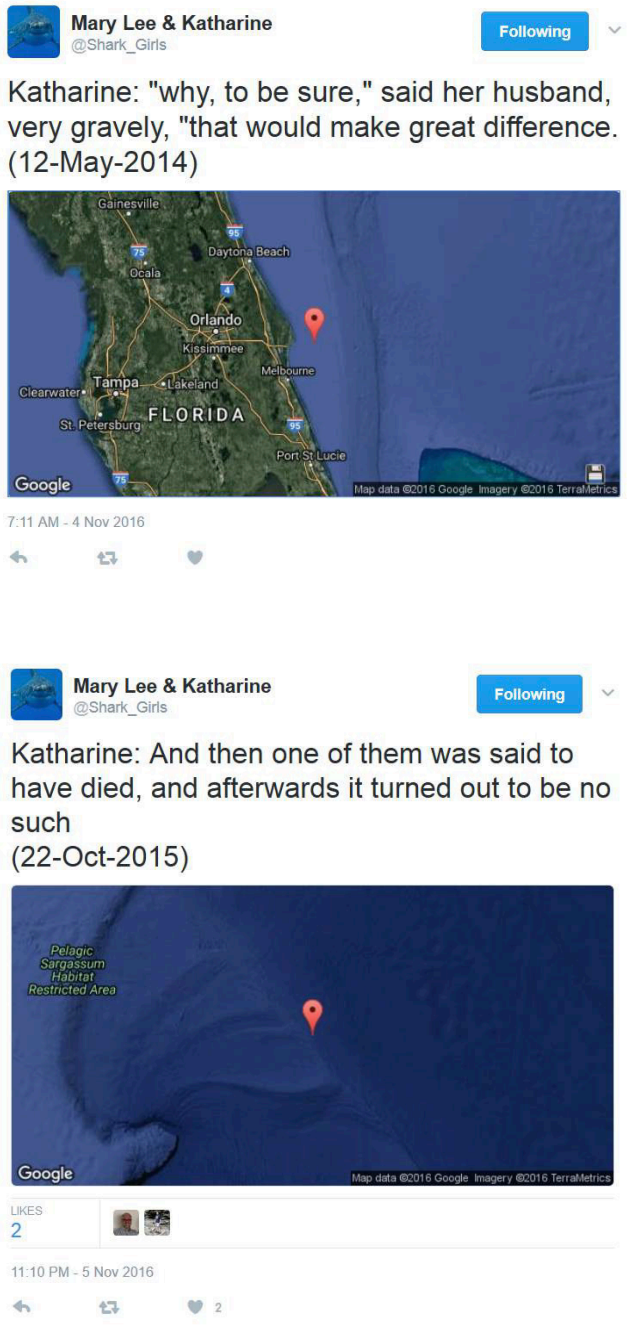

Fig. 1 Screenshots from Mark Sample's @Shark_Girls (November 4, 2016; November 5, 2016).

daily lives. We see them move, driven by predators, prey, reproduction, death and weather. We meet them here, online on Twitter, as kin, as creatures similar to ourselves.

When placed alongside images of sharks interacting with (and sometimes even biting) undersea Internet cables, we are introduced to a second layer of anthropogenic shark behaviour: not only are we making them tweet, we are also disturbing their habitat with our transpacific hyperspeed telecommunications cables. Perhaps rightfully so, they are disturbing us back with their bites. In 2014, Google began wrapping its transpacific fiber cables in Kevlar to protect from shark bites.[11] The hope of a project like Sample's, from an ecocritical digital perspective, is that we'll recognize the sharks, both those who tweet and those who eat upon our Internet cables, as "oddkin" implicated in our digital system.[12]

In *Staying with the Trouble*, Donna Haraway offers a similar project—the Pigeon Blog, a project by UC Irvine's Beatriz da Costa in 2006 that used pigeons to monitor and report air pollution—to illustrate how our interconnectedness *matters*. Miniature pollution-stations were put into tiny backpacks that were worn by professional racing pigeons—with the collaboration of the pigeon's owners—who flew throughout Los Angeles recording and reporting pollution data. Their data was transmitted in real-time to the project's researchers and shared on the Pigeon Blog.[13] Projects like Pigeon Blog can activate the human part of the earth-human-digital connection to behave more generously toward the other two. In the context of the Pigeon Blog, Haraway reports the youth who were involved in the project 'move from seeing pigeons as "rats with wings" to sociable birds with lives and deaths. [They] transmute from bird hecklers and sometimes physical abusers to astute observers and advocates of beings whom they had not known how to see or respect'.[14] The youth, she says, 'became response-able'.[15] To those still

11 Amit Chowdhry, 'How Google stops sharks from eating undersea cables', *Forbes* (August 15, 2014), https://www.forbes.com/sites/amitchowdhry/2014/08/15/how-google-stops-sharks-from-eating-undersea-cables/#15904d931f2b.

12 The term 'oddkin' is from Donna Haraway's *Staying with the Trouble*. She defines there 'oddkin' as 'the colloquial term for other-than-conventional biogenetic relatives.' Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), p. 221, https://doi.org/10.1515/9780822373780.

13 Dr. Da Costa unfortunately passed in 2012 and the blog is no longer active.

14 Haraway (2016), pp. 24–25.

15 Ibid., p. 25.

dubious, she offers: 'I know this account is a story, an invitation as much as an accomplishment, but the space for recuperation across despised cross-species categories of city dwellers deserves to be widened, not shut down [...] To re-member, to com-memorate, is actively to reprise, revive, retake, recuperate'.[16]

The human-animal, human-nature divide—what Valerie Plumwood calls hyperseparation—holds us apart and 'contributes to our inability to be *affected* by the incredible loss of this period of extinctions'.[17] These projects, the Pigeon Blog and Sample's literary sharks close the distance between the human, technology and the natural nonhuman world. They open, as Thom van Dooren might say, new sensitivities to the living practices of nonhuman creatures.

In his work, van Dooren asks us to imagine life forms as forms-of-life entangled with other forms-of-life in inescapable webs of co-dependence. He asks us to 'pay attention to species as evolving "ways of life" that are shared, produced, and nurtured in the world through the work of successive generations of living beings'.[18] These ecocritical digital projects provide us an avenue to do just this. '[B]eing attentive to the stories of penguins and others', which here for us are pigeons and sharks, can 'help to challenge the closure of human-centric narratives', van Dooren says. We open new stories and, in turn, open new possibilities for care relations when we recognize nonhuman others as partners in the 'ethical, collaborative, communicative and mutualistic' project that is Anthropocenic living.[19]

When we are unable or unwilling to recognize or properly acknowledge the stories and relationships other creatures have, we destroy (and de-story) their ways of living—and ultimately, our own. 'Knowing more matters' van Dooren says, 'not least because it can and does enable us to see differently, and so to be drawn into new kinds of relationships, new ethical obligations'.[20]

16 Ibid.
17 Thom van Dooren, *Flight Ways: Life and Loss at the Edge of Extinction* (New York: Columbia University Press, 2014), p. 18, https://doi.org/10.7312/columbia/9780231166188.001.0001.
18 Ibid., p. 22.
19 Ibid., p. 79.
20 Ibid., p. 83.

Environmentally-related citizen science work, most particularly that of Jennifer Gabrys, co-opts neither sharks nor pigeons but instead human bodies, to promote data-based human-nature interactions. In Gabrys's Citizen Sense work humans become digital sensors and the living loci bridging the digital, the environmental and the human.

Unlike an ecologically-minded Augmented Reality project which uses carbon-devouring large-screen AR technology to 'immerse' a user in certain 'natural' environments, Gabrys's citizen science immerses users in 'real' natural habitats—their own and those surrounding them—asking them to experience anew the relationships and lifecycles, the metabolic systems, if I may, in which they are always already implicated.

Citizen Sense's pollution sensing projects display pollution data and develop platforms to make that data more accessible. The projects 'attempt to make more immediate and actionable the details of environmental pollution' through direct engagement, collaborative citizen-powered fieldwork and thoughtfully composed human data stories.[21] In a project like Dustbox (October 2016-April 2017), Citizen Sense lent, from the Deptford Lounge Library, air monitoring kits called 'Dustbox sensors' to south Londoners so they might monitor and report local rates of particulate matter and pollution. Nearly 9,500 Londoners die each year due to exposure to NO_2 and particulate matter and Dustbox puts "the itinerant qualities of individual exposure to air pollution" to work as a site for citizen engagement and empowerment with and against this fact.[22] A similar project conducted by Citizen Sense in 2013–2015 in Pennsylvania worked with residents living near oil fracking facilities to develop air monitoring kits that would allow them to measure and report local conditions. For both projects, the Citizen Sense team created a user-friendly, human-friendly digital tool that translated their captured data into human-readable stories that organize, visualize, and otherwise transform abstract numbers into usable narratives that suggest actionable responses. Earth health (care) and people health (care) are shown to be intimately interrelated.

21 See Citizen Sense, *Pollution Sensing*, http://citizensense.net/projects/pollution-sensing/.

22 Ibid.

As citizen scientists use their smart phones and small DIY electronics to *sense*, record, access and engage environmental data, they gain access to a sixth sense—one digitally mediated by technological devices—that moves environmental data from an abstract, and often unseen, concept to a concrete experience of embodiment. The body of the citizen sensor becomes not one set in opposition to nature but one that is, as Spinoza long ago recognized, 'radically open to its surrounds and can be composed, recomposed and decomposed by other bodies'.[23] The citizen sensor's body is always caught up in the material systems and beings that compose their immediate environments and these projects make that connection visible. '[W]ith every breath you take', Mitchell Thomashow says, 'you participate in a dynamic exchange of global metabolism'.[24] When that breath is filled with pollutants and particulate matter, our dynamic exchange becomes one of metabolic disease. I believe one of the fundamental roles of ecocritical digital work is to highlight exactly this and facilitate methods for citizen response.

The hope here, from an ecocritical angle, of Citizen Sense's work and similar, is that the average daily consumer will become aware of her behaviours, will subsequently reduce her contribution to pollution, and will also become an amplifier of the message that humans and nature and consumption and pollution are all deeply intertangled and are, in some senses (for the relatively well-off and careless consumer) one and the same.

Gabrys's work exemplifies embodied digital work in so far as it enables material interactions between person-machine-environment. Participants enact ways of knowing through doing with their bodies. Here, pollution data is (as it should be) human data, and is of human concern. She recruits human bodies to be active in data projects that affect human bodies.

Her projects help us understand how human bodies and communities are bound and implicated in the metabolic processes of extinction, re/production, disturbance and how those feed back into human bodies

23 Moira Gatens, *Imaginary Bodies: Ethics, Power, and Corporeality* (London: Routledge, 1996), p. 110, https://doi.org/10.4324/9780203418659, paraphrasing Spinoza, quoted in Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Indiana University Press, 2010), p. 28.

24 Mitchell Thomashow, *Bringing the Biosphere Home* (Cambridge: MIT Press, 2002), p. 2, https://doi.org/10.7551/mitpress/1673.001.0001.

and communities. The Citizen Sense projects, and many others akin to them (see, for instance, the Center for Research in Environmental Epidemiology in Barcelona, Spain, where researchers are using wearables to track and map pollution[25] and the collaborative work of the CITISENSE consortium of 29 institutions from 14 countries), alongside consumer buyable or DIY makeable products (like UC Berkeley's Clarity sensor, Dustduino, Air Quality Egg, Smart Citizen Kit, Tzoa, Airbeam and Speck), translate earth data (which is also human data) into its embodied, embedded contexts.[26] Where Gabrys's work stands out is it then further translates that data into seeds for doing important earth work:

> [D]ata are seen to enable modes of action that are meant to offer effective ways to respond to those problems. With more data, potentially more accurate data, and more extensively distributed data, environmental problems such as air pollution are intended to be more readily and effectively addressed. Data are intertwined with practices, responses to perceived problems, modes of materializing and evidencing problems, and anticipations of political engagement.[27]

By measuring environmental data of human concern, with the help of the humans who are affected by it, and then creating human-legible data stories, Citizen Sense makes visible the unseen, the ignored, and

25 For more, see Brian Handwerk, 'With wearable devices that monitor air quality, scientists can crowdsource pollution maps', *Smithsonian Magazine* (March 12, 2015), http://www.smithsonianmag.com/innovation/with-wearable-devices-that-monitor-air-quality-scientists-can-crowdsource-pollution-maps-180954556/#5zKIohrRUEkmuLlr.99.

26 See also Davey Alba, 'This wearable detects pollution to build air quality maps in real time', *Wired* (November 19, 2014), https://www.wired.com/2014/11/clarity-wearable/; Megan Treacy, '10 environmental sensors that go along with you', *Treehugger* (March 5, 2013), http://www.treehugger.com/clean-technology/environmental-sensors.html; 'Small, portable sensors allow users to monitor exposure to pollution on their smart phones' (n.a.), *Jacobs School News, UC San Diego* (December 18, 2012), http://jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1295; and visit Instructables to find instructions to make your own DIY sensor: FabLabCuneo, 'Environmental pollution', *Instructables* http://www.instructables.com/id/Environmental-Pollution/. As of early 2017, the United States EPA website even has an 'Air Sensor Toolbox' for citizen scientists: United States Environmental Protection Agency, *Air Sensor Toolbox for Citizen Scientists, Researchers and Developers*, https://www.epa.gov/air-sensor-toolbox.

27 Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (Minneapolis: University of Minnesota Press, 2016), p. 159, https://doi.org/10.5749/minnesota/9780816693122.001.0001.

the overlooked. If, as Gabrys asks 'environmental problems need to be visible in order to be actionable', these projects are revealing untold stories and facilitating participation—both bodily and narratively—between humans, pollution and the environment.[28]

The ecocritical digital projects mentioned here allow us to read air, birds, marine animals and environmental health as environmental texts through digitally-mediated collaboration. These are perhaps precarious, imperfect readings but they are, in a way, entry points, or 'ecotones', if we might borrow a term from ecology and permaculture, that blur the boundaries between human and nonhuman and environment. If we respond by making moves to clean, restore and protect those who—and that which—speak to us through data, these ecocritical digital projects are indeed planting seeds. They open, as Gabrys says, 'new ways of approaching digital technology as material, processual, and more-than-human arrangements of experience and participation' while all the while also opening new ways of approaching our environments as material, processual and more-than-human arrangements of agencies.[29] In bringing an ecocritical humanities lens to environmental issues, these projects complicate the complex relationship between humans and animals and illustrate the fragility of the claim for human-nature separation and the damage done by what Plumwood calls hyperseparation.

Projects like *Soil Selfies* and *FutureCoast* combine the mediated digitality of Sample's sharks with the human-involvement of Gabrys's Citizen Sense projects to create wholly new experiences. The goal of the 2015 *Soil Selfies* project, developed by Australian environmental educator Jeanie Clark, was to coerce people to develop a new, and more caring and familiar, relationship with the soils upon which they walk and from which their food feeds.[30] Participants were invited to take and post photos of themselves with their soils and to thus take a moment to consider how intimately associated their lives are with our soils. Soil provides food, plants (which clean the air), natural environmental protection like water barriers, human and nonhuman

28 Ibid., p. 138.
29 Ibid., p. 21.
30 See the *Soil Selfies* project here: enviroed4all, *Soil Selfies* (July 12, 2015), http://soils.enviroed4all.com.au/soil-selfies/.

habitat, minerals, raw materials, water filtration and even carbon storage. Soils are our friends, with whom we can take selfies, and *Soil Selfies* celebrates this.

FutureCoast is a more robust project devised by *World Without Oil* designer Ken Eklund and a team at Columbia University. Funded by a National Science Foundation grant, *FutureCoast* is a storytelling project that asks participants to record voicemail messages from the future. Those voicemails are then organized, published, and promoted on the *FutureCoast* website. Recognizing that science has not yet been able to tell compelling behaviour-altering stories of climate change and Anthropocene futures, *FutureCoast*'s simple intervention adds the missing human dimension. The human voice replaces scientific data and the contemporary medium of voicemail message brings the future into the present. Chilling quick messages left by friends, family members and neighbors report of water shortage, underground markets for fish or fruit, carbon rationing and extreme weather events:[31]

> 'Hi it's me. the city has just turned off the water. If you've got water, bring home as much as you can. Love you, bye'.
>
> 'Hi Mom. I'm calling to see if you or grandpa happen to have any credits left on your Cal Card for the month. I was [robbed] and they got my Cal Card. And we're running low on food here'.
>
> 'Oh hey, Jordan, this is Dave. The house battery isn't charging like it used to. I even hooked it up to the bicycle recharger and it's just not holding a charge anymore. Do you think you can come by and take a look?'

Other messages, from automatic robotic messaging systems, foretell eminent institutional organizations:[32]

> 'Good morning valued citizens, this is your monthly reminder from the Department of Resource Conservation and Rationing. Remember that your water usage is limited. Each family is allowed two gallons a day. Failure to comply will lead to disciplinary action and potential deportation'. (Automated Human voice)

31 All messages taken from *FutureCoast*.
32 *FutureCoast*.

> 'Hello, this is the Federal Department of Rations reminding you to renew your sixth-month order of rations. We thank you for your cooperation. Have an eco-friendly day'. (Robot Voice)

These glimpses from the future remind us of our present. The voices compel us to rethink our relations to water, oil, food and our resource-sharing human and nonhuman kin. They ask us to think about what we would we do if we didn't have water to grow our last cucumber seeds or bathe before work. They introduce us to short tales of woe due to rationing, scarcity, surprise weather events, and property value loss due to climate change. The voicemail messages, with different voices and various qualities of transmission (like real voicemail messages) put us on the phone with the future.

Eklund reports participants in his globally-known *World Without Oil* project—which created a simulated no-oil world, complete with an infrastructure of news updates, mock protests, and live participant feedback to make the situation more realistic and asked participants to live as if the world was experiencing an inescapable oil shortage—actually succeeded in transforming participants' lifestyles. After being immersed in the alternate realty of a world without oil, participants planted gardens, started cycling to work, and adopted other oil-saving practices. The hope, of course, is that *FutureCoast* participants and listeners will do the same. As an ecocritical project, it uses digital technology to reflect on a diminished present and future habitat in part propelled by our excessive overreliance on polluting material-intensive technologies.

Ecocritical digital humanities projects, like these mentioned here and in other contributions in this volume, can reconfigure our perceived contingencies. They re-narrate through digital tools and hands-on practice, reframing, providing 'proof', collaboration, ecodata and digital stories. Ecocritical digital work recognizes our technospheric condition and disturbs it, positively, through education, outreach, participation and cultivation of new flows of behaviours with the system.

The point is not to advocate we rid ourselves of technology—after all, man is both ecological and technological, as Claire Colebrook reminds us—but to add a layer of metabolic awareness to our technology use and

theory and to use our technologies to address the issues they create.[33] We have an opportunity to set an example from within our own digitally-inflected humanities fields of praxis, and we have a ready platform for using our knowledge to help foster lasting changes of practice and relational understanding.

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5. Impact of the Digital Revolution on Worldwide Energy Consumption

Doug Barlage and Gem Shoute

We Tweet, Facebook, Netflix and YouTube in the palm of our hand. We are aware of the amount of energy that it takes from how many times that we need to recharge our devices. However, this is just the tip of the iceberg. For every joule of energy we expend locally, many more joules are spent in the backbone of the Internet. While our appetite for data has largely been insatiable over the last thirty years, the energy required to sustain this has been held in check by Moore's Law's driving creed that density of function in a computer chip increases by two every two years, and energy/function decreases by a similar amount. With that said, this driving relationship between power consumption and computing density is slowing due to a multitude of physical constraints when the density of transistor packing approaches the limits. In the following chapter, the authors examine these relationships and outline some of the challenges that the world is facing as we continue to meet and exceed the expectations of our data-driven world with a finite growth in worldwide power generation capacity.

Introduction

Increases in computational demand has led to rising demands on the power grid for energy efficiency. When we use our cell phone, our

 https://doi.org/10.11647/OBP.0213.05

computer or one of the many things that interact with the larger cloud of data, we forget that we are exercising a certain amount of energy to do so. Unlike a light bulb where the energy spent is all at the point of use, when we watch a viral cat video on our phone, we spend about 10–100 times more energy supporting the data path to get it to you. That energy is spent away from you, but nonetheless it is required so that you can download information and fully enjoy the fruits of the information age. For that matter, the conference on sustainability that inspired the initial presentation documented in this paper depends on the World Wide Web. Streaming information across the planet forces energy to be expended. Whether it is watching Netflix or researching remote documents to write a paper, the computations required are not an amount that can be brushed aside as trivial. While this energy to communicate across the Web is considerably smaller than the amount of energy that it would take to bring everyone physically to the same room at the same time, it is not zero and in our growing, increasingly interconnected world, it can no longer be considered an afterthought of the total energy that we expend in our daily lives. Computational energy has become something that must be considered when planning on future energy demands. Our increasing demand for instantaneous information consumes energy that is definitely not zero and is actually the fastest growing area of energy consumption around the world. In this chapter, we introduce the reader to the basic principles of energy consumption by digital computation and the limitations in reduction of this energy using the current technology available. The realities of Moore's Law reaching a plateau are discussed. We follow this with a calculation of the demand that is occurring on a rapid level as the information revolution continues to unfold before us, and we identify the limiting economic principles that drive this energy consumption phenomena. Lastly, we propose some approaches to finding a solution to this dilemma and look at the role that industry and national governments are playing and should play as this increasingly demanding economic sector continues to require an ever-growing quantity of energy.

Energy Consumption of Computation

Computation machines preceded the discovery of the transistor by John Bardeen and Walter Brattain by several thousand years.[1] The abacus was one of the first computational machines in existence. The abacus served the ancients through the accountants and traders that used it. The energy consumption of these abacuses should be thought of as two distinct entities: the actual energy used to drive the abacus and the energy used to sustain the driver of the abacus. This could be considered the energy consumed by the system. In the days of the ancients, this would be considered the amount of food required to feed the accountants who drove the abacus. We refer to this as E_{System}. Today this energy is the amount of energy that our computational machines require. Furthermore, it is possible to directly analyze the amount of energy required to do the computation. The energy required to do a computation could be determined by the amount of energy required to move the beads. This energy is of the non-recoverable variety and could be easily calculated if the amount of friction was known. In a very general way, the energy could be calculated as follows:

$$E_{Computation} = \int_{X_{state1}}^{X_{state2}} F(x)dx$$

Where the force, $F(x)$, is the force required to move the beads and X_{State1} is the starting position and X_{State1} is the ending position. A first-year physics student is taught to make this calculation. To try and make this a little more tangible, we can look back to the Babbage machines of the 1800s. Modern computational apparatus and architectures are at least an inspirational descendent of these devices. It is possible to see what's going on the inside with your eyes rather than relying on electron microscopes and what really amounts to applied imagination when you look at the working mechanisms of a modern system. Every piston that moved to perform a calculation expended an amount of energy that is easily observed. This energy is of the kind that follows thermodynamic principles of non-recovery and introduces some

1 John Bardeen and Walter Hauser Brattain, 'The transistor, a semi-conductor triode', *Physical Review*, 74.2 (1948), 230–231, https://doi.org/10.1103/physrev.74.230.

entropy. These systems had hundreds of tiny pistons that executed algorithms at several calculations per second. To perform a binary calculation many pistons would have to change positions many times to perform one operation. It might be said that our mechanical computation forerunners had a superior way to do calculations. It was able to accomplish more output with less internal operations. In modern terms, this is referred to as a floating point operation or FLOP. Our modern systems require that many individual beads must change position to perform one calculation.

In principal, the driving notion behind reducing energy in computation from an engineering standpoint remains essentially the same today. But instead of beads we move electrons from one energetic state to another. In a very tangible, though not computationally sufficient way, reductions in energy on the per bit level comes from moving states closer together with lower amounts of energy between those states. Using these ideas, we can calculate the efficiency of the system and put this directly in the context of power and bits per second. While the modern computational system is a little more complicated than an abacus, the principle is the same. A user tells the computational system what it wants and the computational system does what it takes to provide the user what it desires. Every time the computational system moves a bead on the abacus, the computational system takes energy. A modern system such as your cell phone has well over a billion such beads that calculate at well over a billion calculations per second. When the calculation system does its work, it takes energy. Some of the energy is used to move the beads on the abacus, and other energy is required just to maintain the computer. You have to supply both to make the whole system work and keep it healthy and so this has to be included when you consider energy consumption. Just as if we had a million accountants from ancient times to do our bidding, we have to feed those accountants to keep them well and we have to feed them the energy it takes to do our bidding. Likewise, we feed our computers to allow them to do work.

It was not until after World War II that vacuum tubes powered the first electronic computers. The first system, ENIAC, was constructed at the University of Pennsylvania, consumed about 150kW and fit in a fair-sized room. For reference, 150 kW is pretty close to the power that

a modern electric vehicle expends when it is accelerating to cruising speed. This is something that is completely manageable by today's standards, but in 1946, when the only real loads on the grid were light bulbs, heaters and refrigerators, this was a significant amount of energy. The first computer on the campus at the University of Pennsylvania took about as much energy as a 100-person dormitory to operate. While this is not a small amount of energy, when you consider a campus of about 25000 students, the energy consumption due to this room-sized computer is barely noticeable. For an individual operation it took around 100 J on this system. It is hard to make a comparison to what this energy actually means. There are 11 calories in a peanut, 4,184 J in a calorie, therefore a perfectly converted peanut gives you about 460 operations. For every joule of energy spent, ENIAC took 5 J of energy just to stay on. So it might be said that ENIAC may have been ever so slightly more efficient than the people operating it. But ENIAC was faster than the people operating it. It could execute around 300 multiplication operations per second and so it was very useful.

Solid state electronics came into full force with the introduction of a practical integrated circuit process by Robert Noyce in 1958.[2] This led to a realization that was documented by Gordon Moore in 1965. Moore's Law famously states that the complexity of integrated circuits increases by a factor of two every two years. The semiconduction industry was advanced by the invention of the Metal Oxide Semiconductor (MOS) Transistor in 1963[3] and the road to perfection of the initial process for metal oxide transistors was initiated by Andrew Grove in 1964. Since then, the creation of a well-established set of business and engineering rules has continued to push the industry forward.[4] In 1970, Intel, which was founded by Noyce, Moore and Grove, reported a revenue of just over $4.2 million versus expenses of around $5.6 million.[5] The minimum printed transistor dimension was over ten microns (ten one millionths

2 Robert N. Noyce, 'Semiconductor device-and-lead structure', U.S. Patent No. 2,981,877 (April 25, 1961).

3 Kahng Dawon, 'Electric field controlled semiconductor device', U.S. Patent No. 3,102,230 (August 27, 1963).

4 Tim Jackson, *Inside Intel: Andrew Grove and the Rise of the World's Most Powerful Chip Company* (New York: Viking Penguin, 1997).

5 Intel, *1970 Intel Financial Statement* (Arthur Young & Company, 1971), https://www.intel.com/content/dam/www/public/us/en/documents/corporate-information/history-1970-financial-statement.pdf.

of a meter). In 2018, Intel's revenue was approximately $70 billion with a minimum printed dimension approaching ten nanometers (ten one billionths of a meter).[6] In 1974, another set of rules was established for the governing and scaling of the MOS transistor by Robert Dennard.[7] When the complementary process was introduced in production around 1980, the minimum printed dimension of the transistor was reduced by a factor of 40% every two years (area reduction by a factor of 2). This became a well-documented and executable realization of Moore's Law. These governing economic and engineering principals, which allowed for continued functionality enhancements from device scaling held until at least 2015. What was also true during this time was that the energy per computation reduced at the same rate as minimum dimension. This has a direct analogy to the abacus example that was discussed previously. Smaller devices consume less energy. This minimum amount of energy per 'bead' movement can be found simply by recognizing that there are about thirty electrons moving through one volt of electric potential in the modern device. The minimum energy for this single bit change is then around $5*10^{-18}$ joules, or 5 aJ. When the bit changes it must remove thirty electrons in addition to adding thirty holes (electron voids which behave as particles in semiconductors) or vice versa. The total energy under this scenario is 10 aJ. This is a good estimation of the capabilities of CMOS technology for a single bit. The present complementary MOS (CMOS) technology has not improved upon this minimum energy significantly since about 2011. In other words, the leading-edge energy efficiency has not really improved considerably during that time. In truth, by lowering the voltage swing and by reducing the total number of carriers per bit, there is still room to improve and billions of dollars are spent every year by multiple governments and private companies to improve that figure. However, these efforts have not yielded a significant amount of difference in the minimum amount of energy required to create and destroy a single bit that can meet the stringent requirements necessary to begin plans for

6 NASDAQ, *INTC Company Financials* (2019), https://www.nasdaq.com/market-activity/stocks/intc/financials

7 Robert H. Dennard et al., 'Design of ion-implanted MOSFET's with very small physical dimensions', *IEEE Journal of Solid-State Circuits*, 9.5 (1974), 256–268. DOI: 10.1109/JSSC.1974.1050511.

production. When it is discussed that Moore's Law may be coming to an end, it is this fact that dominates the conversation.[8]

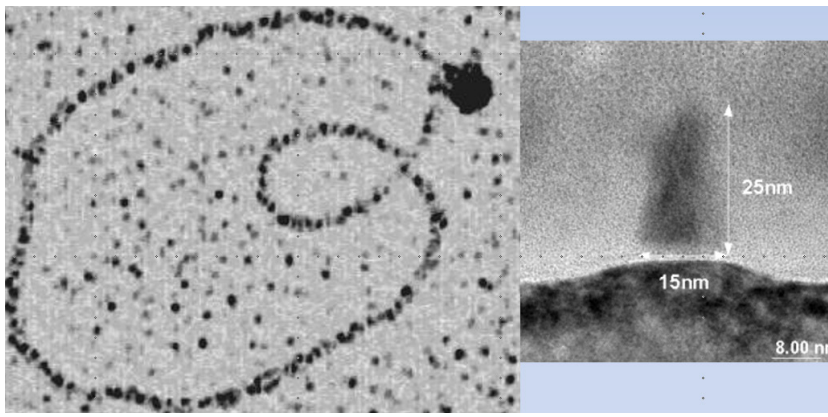

Fig. 1 From the author's (Barlage) notebook, c. 2000. A stock photo of a strand of DNA, adjusted to be at the same scale as a prototypical 15nm gate length MOS transistor produced by his group at Intel in 2000. This prototype transistor from dimensions are actually slightly larger than production transistors in 2019. From an atomistic view point, there is little room for further scaling.

What does the size 10 nm mean? Around the year 2000, prototypes of this size of device were made. To explain what this meant, the prototype device was compared to a strand of DNA. In Figure 1, a transmission electron microscope of a DNA strand is compared to the same scale as a prototype 10 nm CMOS device. The DNA strand is on the same scale. In fact, within the prototype device, there is an oxide film with a critical dimension less than 1 nm in thickness. This is truly approaching the limits that scaling can achieve as 1 nm corresponds to a single molecular thickness of the material silicon dioxide, a key building component in this device. This is informative because typical production devices today are roughly at the same scale. There is simply not much room to become smaller. Our expected increase in efficiency may truly be at an end, or at least within sight of the end.

8 Jonathan Koomey and Samuel Naffziger, 'Moore's Law might be slowing down but not energy efficiency', *IEEE spectrum* 52.4 (2015), p. 35.

While the CMOS technology is physically limited to a minimum amount of energy as described above, a far more fundamental limit—Landauer's Limit—is determined by the second law of thermodynamics as it pertains to information. The minimum energy required to erase a classical bit is given by $k_B T \cdot ln(2) \approx 0.003$aJ at room temperature. There is room to move towards this fundamental limit by at least a factor of one thousand, even more if the system is cooled, if an ideal switch can be found. But at present there is no device that has a lower energy per switch than the CMOS device. An examination of available competing technologies that rely on charge transport shows that at best, the minimum energy of bit flipping could be reduced to 1 aJ (reducing the number of electrons/holes to ten to make bit and reducing the supply voltage to 0.3 V, regardless of how the transistor is made, is about the best that can be achieved) and this too would be limited by the statistical nature of quantum mechanics at room temperature. So, the Landauer Limit remains fairly far away from being functionally realized.

In its most idealized realization of computational efficiency, we see the supercomputer. The supercomputer is actually extremely efficient and makes use of the approximately 10 MW of power that it consumes for computation more efficiently than many other computing devices. An examination of the current champion of supercomputers,[9] Summit, located at the US Department of Energy Oak Ridge Laboratory (ORNL) near Knoxville, Tennessee, finds that it can execute 200 Thousand Tera FLOPs or 0.2 ExaFLOPS every second.[10] A quick calculation that looks at the power consumption and the rate of calculation:

$$\frac{Energy}{Flop} = \frac{Power\left(\frac{Joules}{second}\right)}{Computation\ Rate\left(\frac{FLOPs}{second}\right)} = \frac{10MW}{0.2 \cdot 10^{18}\left(\frac{FLOP}{second}\right)} = \frac{50pJ}{FLOP}$$

indicates that every FLOP consumes 50 pJ or $50*10^{-12}$ J. This is 10,000 times more than the minimum energy per bit required in state art microprocessors and about 10,000,000 times more than the minimum

9 'US Debuts world's fastest supercomputer' (n.a.), *BBC News* (June 11, 2019), https://www.bbc.com/news/technology-44439515.

10 Jonathan Hines, 'Stepping up to summit', *Computing in Science & Engineering*, 20.2 (2018), 78–82. DOI: 10.1109/MCSE.2018.021651341.

energy per bit defined by the Landauer Limit. In truth, each operation requires many individual bit transfers to perform one calculation. A further investigation shows that this disparity can be explained by the weakest link in energy efficiency. This is when the processing unit needs to access memory. This is the cause for hope in terms of engineering. While the reduction in energy and size in producing devices to access information is reaching an end there are simply a lot of inefficiencies to reduce to make the overall system more efficient.

10 MW, the power required to drive the world's more powerful supercomputer, is a lot—nearly enough power to meet the energy demand for 10,000 homes. While large, this amount of power available is not nearly as large as the amount of power required to supply a typical server farm that is currently being operated by companies such as Google or Facebook. Just 200 km or so east of the Summit supercomputer is a Facebook server farm. The power consumption of this operation is not published. The majority of the people that operate this server farm are in locations that are far away from this modest looking Forest City, North Carolina information hub. The physical size of this facility is about ten times the size of the Summit facility. The density of microprocessors inside the facility is about the same. If an extrapolation is made, you could note that the Facebook facility consumes about ten times the amount of power as the Summit supercomputer. That would imply that the energy consumed by this server farm would be equivalent to 100 MW. This is enough power to supply 100,000 homes. Both Google and Facebook, have committed to moving to renewable energy to help manage the high energy bills that they face from their data centers. Putting it into perspective, it takes over 70,000,000,000 kWh per year to run all data centers in the U.S.,[11] and the average household takes about 10,000 kWh per year.[12] It should be noted that the decisions are predominately driven by profit motive and not an altruistic desire to save the earth. Renewable energy has become more cost effective than non-renewable sources and these

11 Arman Shehabi et al., *United States Data Center Energy Usage Report* (Berkeley: Lawrence Berkeley National Laboratory, 2016), https://www.osti.gov/servlets/purl/1372902/.

12 US Energy Information Administration (EIA), *How Much Electricity Does an American Home Use?* (Washington: 2019), https://www.eia.gov/tools/faqs/faq.php?id=97&t=3.

technology companies are taking advantage of this. In April of 2018, Google announced that it had achieved 100% use of renewable energy in its operations.[13]

The Rising Demand of Computation

The total consumption of energy use for computation is on the rise and this rate of increase shows no signs of slowing down. Depending on the source, the percentage of energy consumption dedicated to computation has risen from under 2% in 2000 to over 6% in 2012 and the figure continues to rise.[14] While the exact figure is currently unavailable, recent trends would suggest that today at least 10% of all electrical power produced in the world is dedicated to computation. It is estimated by 2025, this figure could rise to as much as 20% of total worldwide power generation.[15] It should be noted that this figure includes the energy that is used for displays and that in 2000, that made up a large percentage of the resources required for computation. Today, that human interface is a mere fraction of the total energy expenditure required in calculation, most of the energy that is consumed as you are watching the most recent viral cat video is consumed in a server farm far away from you, not from the screen directly in front of you. To put this in perspective, in the year 2000, worldwide energy consumption for computation was still a minor consideration for overall energy consumption in the world. Refrigerators were a bigger concern than computers in 2000.

2000 is a good year to choose as the time when we transitioned from using discrete computers as our primary resource for computation to when we use networked resources to create our primary value. This dramatically pressured the demand for computation. Metcalfe's Law states the more similar devices that are connected on a network, the greater the value of the collective network by a factor of N^2 (it has been recently suggested to modify this expression to N*ln(N) instead of

13 Urs Hozle, '100% renewable is just the beginning', *Google* (5 April, 2018), https://sustainability.google/projects/announcement-100/.

14 United States, US Energy Information Administration (EIA), *2012 Energy Consumption Survey* (Washington: Government Publications, 2017), https://www.eia.gov/consumption/commercial/reports/2012/energyusage/.

15 Shehabi, et al. (2016).

N^2).[16] When this happened value increased dramatically for companies that made use of networked machines to add value. Among the best example to illustrate the increasing value of networked computers is the Amazon market cap stock evaluation. Amazon is the leader in server farms for hire. Since 2005, Amazon, a company that depends dramatically on the number of interconnected machines, has increased its value from $14 billion to nearly a trillion dollars. In that same time period, Intel the primary maker of computation machines rose from a value of $100 billion to $200 billion. More machines, N (Intel's value driver), were attached to the Internet and the value of a server farm was recognized by businesses, universities and governments worldwide and increased as N^2 (Amazon's value driver).

The energy consumption required for computation has increased at a steady but large rate but less than the amount of operations that are being performed. Furthermore—on demand video and social networking became increasingly dominant and the energy consumption of computation started to become a more relevant number. These two applications drove the increasing demand for bits as the energy cost per bit became increasingly lower. In the year 2000, the power supplies driving the server farms were barely 50% efficient and today that number stands closer to 90% and yet the total power consumption continues to grow. Computation, and its supporting infrastructure continued to be more efficient and this increase in efficiency was outpaced by the demand for more bits. An irony of technology development, known as Jevon's Paradox, says that as you make more efficient use of a resource, society as a whole will not use less of that resource, it will actually use more.[17] When things get more efficient more people want those things. We lived in a world where advanced computation was found only in the domains of businesses, governments and the scientists who needed advanced computation. Jevon's Paradox of consumption started to prevail as computation became more efficient. Computation spread to the masses and the energy consumption rose dramatically. The number of operations

16 Carl Shapiro and Hal R. Varian, *Information Rules: A Strategic Guide to the Network Economy* (Boston: Harvard Business Press, 1998).

17 William Stanley Jevons, *The Coal Question* (New York; The Macmillan Company, 1906).

used has been increasing at an extremely high rate while the energy per operation decreases at an almost equally fast rate through 2015. The combination of these factors is what drives the demand side of computation. It was the continued drive of reduced transistor size that kept the energy demand in check for much of this time, however, as discussed previously, the gains that come from transistor scaling are no longer available with CMOS scaling alone. It can be expected that in the near future, the energy expended per bit at the leading technology will be restricted to no less than 10 aJ. Working towards the 1 aJ limit and the Landauer Limit will be an unlikely path toward greater energy efficiency, despite the fact that this was the driver from more than fifty years.

This insatiable demand for bits of information is captured in Figure 2. This approach to the representation of this type of data was originally presented in an advocacy report from the Semiconductor Research Corporation and the Semiconductor Industry Association[18] and is updated here with a further breakdown of the entire world energy supply. Here, we can see the rising demand for information that is literally catching up with the total capacity for world energy production. By estimating the total number of bits that are used and monitoring its rise we can start to grasp the potential problems at hand. In 2010, it was estimated that for every bit of information that was processed it took 10 fJ to process. This is in fact about 2000 times the minimum amount of energy it should take today. This extra amount of energy comes from the fact that when a bit is processed it must also access memory and move this bit from one part of the computer system to another. The number of bits processed in the world increased by a factor of approximately 1000 from the year 2000 to the year 2010. From 2010 to 2015, this trend continued and there is little likelihood that this trend will slow down. Fortunately, as the world's demand for data increased, the efficiency of the way in which data was processed also increased. The minimum energy per bit reduced by a factor of about 100 during that time. Thus, the total energy still increased. The world went from having almost no noticeable energy consumption due to

18 Semiconductor Industry Association, *Rebooting the IT Revolution: A Call to Action* (2015), https://www.semiconductors.org/resources/rebooting-the-it-revolution-a-call-to-action-2.

computation, <2% of all energy produced on the grid being consumed in computation, to nearly 5% in 2010. The only reason that the impact on energy consumption has not been higher has been the steady gains throughout the electronic ecosystem that Moore's Law has given us for over fifty years.

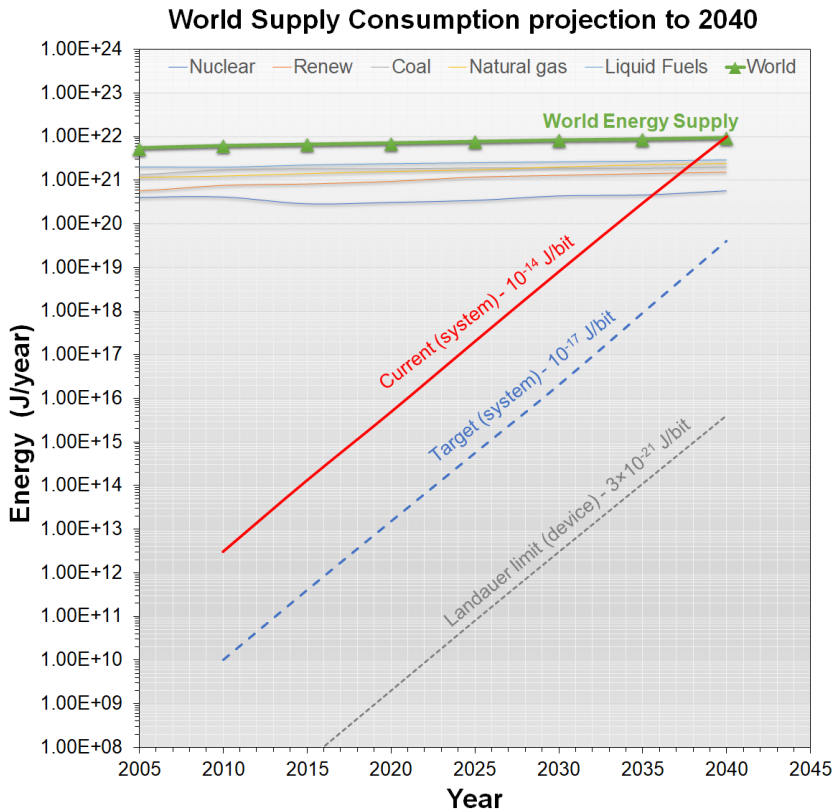

Fig. 2 Computational energy used with respect to total number of bits that are being demanded and the increasing amount of worldwide energy supply. This data is adapted from a joint report from Semiconductor International Association and the Semiconductor Research Corporation (2015).

Table 1 Comparison of fundamental units of energy consumption for computation.

Energy Consumption	Type of Operation	Source
50 pJ	Floating point operation (FLOP) requiring many bits to achieve an operation	Top Super Computers in 2018, Sumitt Statistics[19]
10 fJ	Average energy required to create or destroy one bit when considering memory access	Considerations from 2011 estimate that include memory access[20]
10 aJ	Energy required to create or destroy one bit of information in the microprocessor	Dimensions and operating conditions of reported devices of major semiconducting manufactures (14 nm node of Intel, TSMC and Samsung)[21]
0.003 aJ	Thermodynamic limit of the creation of a single bit of information	Landauer Limit[22]

A comparison of the required energy consumption indicates paths to strategies to reduce the total system energy in Table 1. The differences in the total energy consumed yields pathways that can be followed in meaningful engineering strategies to meet the expected 1000X/decade increase in demand for computation. Reducing the number of bits per operation is the most notable path to meaningful gains in energy

19 Chibuzor Aguwa, 'Top 5 fastest supercomputers in the world 2018', *Blogginfotech* (July 10, 2018), https://blogginfotech.com/top-5-fastest-supercomputers-in-the-world-2018/.

20 Semiconductor Industry Association, *2011 International Technology Roadmap for Semiconductors* (*ITRS*) (2015), https://www.semiconductors.org/resources/2011-international-technology-roadmap-for-semiconductors-itrs/.

21 Jin Cai (organizer), 'Scaling survival guide in the more than Moore Era', International Electron Devices Meeting (IEDM) 2018, San Francisco, 2 December 2018, short course.

22 Rolf Landauer, 'Irreversibility and heat generation in the computing process', *IBM Journal of Research and Development*, 5.3 (1961), 183–191, https://doi.org/10.1147/rd.53.0183.

efficiency. In fact, great strides have been made in this area. The most obvious example of this can be found within the supercomputers built at ORNL. Reducing the complexity of operation, i.e. reducing the number of bits required to perform an operation, allowed the energy per bit to be reduced by a factor of three from Summit, commissioned in 2018 to Titan, which was first turned on in 2012. The more impressive gains have come from the server world, where introductions to approximate computing has led Google to be able to perform searches with 200 times less energy with the same technology than they were able to use just a few years ago. To achieve these ends, Google uses what is commonly referred to as accelerators to perform specific computations and to streamline the computational efficiency per operation. They changed the amount of energy by changing the floating point energy computational energy required. They moved from 50 pJ to 400 fJ (125 times less) without changing the underlying technology. Reducing access to memory is also a means of improving computational efficiency. If the memory does not have to be accessed, each act of bit destruction could be reduced to the technology minimum of 10 aJ. This is a factor of 1000 to be gained by incorporating memory directly into the central processing unit. This gain could be achieved without further altering the core transistor technology. Changing the core technology to an ultimate limit that still uses principles of well-established semiconductor physics, could allow the number of electrons and holes to be reduced by a factor of 10 and the voltage that the system is operated to be reduced by a factor of 2. The maximum possible gain that could be obtained would be a factor of 20. This pales in comparison to the amount that stands to be gained from more efficient architectures and designs. The last is that driving towards the Landauer Limit and the gains that can be found from improving the underlying semiconductor technology in some capacity. Can there be a single electron device that can operate without error and be manufactured and considered reliable? That answer is not certain and will certainly be pursued in the coming years by the organizations that have the most to gain from the increased gain in efficiency.

The architecture gains that were alluded to in the last paragraph form the foundation for the applications that will drive the new sources of demand in the coming ten to twenty years. What was loosely recognized as the smarter way to do computing, and is being

implemented, is the foundation for what could loosely be referred to as neuromorphic computing. This type of computing is, in some sense, the hardware realization of artificial intelligence. We have become familiar with artificial intelligence in our daily lives through many applications that exist just below our awareness. These applications have been almost universally software driven. This next step, incorporating these algorithms directly into the hardware has already begun to yield fruits in efficiency and stands ready to be the next driving force in computer evolution. This is where Jevon's Paradox will again take hold as the next wave of computation will drive artificial applications such as self-driving vehicles. While watching the latest viral cat video took a measurable amount of energy, being driven to work by an algorithm operating on a remote computer connected by the 5G network will take 100–1000 times more energy. Yet that algorithm when run today will be executed in a way that is 1000 times more efficient than if it were to be executed with technology available in the year 2000. Autonomous vehicles are just one of the many artificial intelligence applications that are becoming more prevalent and constitute just one more increase to the energy demands of computation.

Pursuing neuromorphic computing is a realizable approach to computing improvements, just like CMOS scaling was the most realizable approach to gains in efficiency from 1980 through 2015. An important fact that should be noted when considering advanced CMOS processes: in 2000, there were nearly thirty companies in the world that could produce the most advanced silicon devices. Today there are only three. In 2000, the typical minimum dimension in production at the advanced node was 180 nm and today it is 10 nm. The capital investment for every 40% shrink has increased even faster than 40% and slowly eliminated the number of companies able to keep up at the leading edge. In terms of energy consumption per bit, that represents a nearly 400 times improvement from the year 2000 to today. Of these three companies, one is what is referred to as a foundry service (Taiwan Semiconductor Manufacturing Company, TSMC), one offers both internal and external services (Samsung) and the last (Intel) only manufactures products that are issued under its brand. Foundry services enable companies to produce chips with their own designs with the most advanced silicon. Recently former participants in this economic sector, IBM and Global

Foundries have bowed out of the race at the edge as neither could compete due to financial considerations.

Today, Apple and Huawei do not produce silicon microprocessors; but they do build the most advanced cell phone microprocessors in the world in the same multi-billion-dollar facility in Taiwan.[23] The most advanced products and computationally energy efficient devices in the world are built side-by-side, using the exact same technology. What does this mean for experimental research in neuromorphic computing at the leading edge? Both advanced microprocessors and neuromorphic computing require an extraordinary amount of capital; this largely prohibits universities and other smaller facilities from being able to do experimental research in this area. What can be said about computing is that, ultimately, the most energy efficient endeavors have prevailed in the marketplace and slowly eliminated competition. Neuromorphic computing, and its related approaches, shows a high potential for energy gains and for increasing its chances of a successful and significant market penetration. These gains, however, only occur when operating within the smallest node. Only the largest players who have access to the smallest nodes will be able to compete in the field. The best ideas that enable energy savings will largely not make it out of the laboratory without access to opportunities for experimenting within these advanced nodes.

Navigating the Future of Computing

Unlike the last fifty years, where the gains came largely from material, device design and technology implementation, the gains of tomorrow will come from improved architectures. This approach is commonly referred to as accelerators or heterogeneous computing. Accelerators are application specific integrated circuits (ASICs) that offer advantages in speed or energy efficiency for very specific tasks. The number of people that can be trained in these new architectures will be limited by the companies that control the leading edge of technology. In the past, access

23 Malcolm Owen, 'Apple, Huawei both using 7nm TSMC processors, beating out Qualcomm and Samsung', *Apple Insider* (October 2, 2018), https://appleinsider.com/articles/18/10/02/apple-huawei-both-using-7nm-tsmc-processors-beating-out-qualcomm-and-intel.

to advanced device manufacturing could be realized with relatively small investments. Today, at least in the near future, that capability is lost. While companies such as Apple, Amazon or Google can afford to hire either Samsung or TSMC to build speciality chips, the rest of the world cannot. This limits the open expression of ideas that has largely defined the semiconductor and digital applications world for most of its existence, and has driven the innovation cycle. The expense of access to a resource which has largely become a commodity, as necessary to modern life as petroleum, will be held in the hands of fewer and fewer organizations as time progresses. Recognition at the government level is what is required to ensure this openness, and to ensure that this ever-increasing commodity is not unnaturally limited.

National strategies to maintain and create access in this area are being pursued by both China and Saudi Arabia. Both nations have committed an extraordinary amount of resources to enhance the sovereignty of the data that flows through both nations. India has also announced plans to build its own national foundry to rival that of TSMC. These are examples of governments that recognize that computation is fundamental to their growth and survival as a nation. China has committed to invest $150 billion USD through an investment fund (Tsinghua Unigroup) that is matched by another $300 billion in corporate investment to develop competitive manufacturing at the most advanced nodes of semiconductor manufacturing. In Saudi Arabia, there is an investment fund, nearly the size of China's investment fund, to establish semiconductor manufacturing in the region. The United Arab Emirates privately owns Global Foundries, the third largest semiconductor foundry in the world. The United States has more recently recognized the attention that is required by initiating legislative discussion of this with the Semiconductor Foundry Act of 2020.[24]

Our future world of computing will look a lot like the world that we live in today, however the biggest change will be what drives that world behind the scenes. There will be an increasing number of specialty chips

24 Shannon Davis, 'American Foundries Act would provide needed investments in U.S. semiconductor manufacturing, Research', *Semiconductor Digest* (June 26, 2020), https://www.semiconductor-digest.com/2020/06/26/american-foundries-act-would-provide-needed-investments-in-u-s-semiconductor-manufacturing-research/.

to perform specific tasks within the computing environment. We already see the first steps in phones that offer facial recognition, delivered by an additional chip that is designed to specifically address facial recognition algorithm—not general computing. The energy that would be required in a general-purpose chip would be too high to maintain, so an accelerator designed to do nothing but provide facial recognition enables energy efficiency for this task. This is a good example of the many accelerators that are likely to come. The energy efficiency that is gained is obvious. Future tasks will see a master controller central processor with many accelerators providing functions of which we have not yet fully conceived. The nations, companies and individuals that can offer advancements in these areas will lead the semiconductor industry and subsequently the information technology of the future.

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6. Sustainable DNA In Conversation

Mél Hogan and Deb Verhoeven

Big Tech supports social media, the stock market, insurance companies, scientific research, financial transactions, mass surveillance and monitoring, the 'Internet of things', 'smart city' sensors and grids, and mobile communications for Internet users writ large. By most industry accounts, data centres—and the cloud infrastructure that undergirds it—has become the most important sociotechnical system of our time, but also the least sustainable. Interestingly, one of the alternatives to these water- and energy-intensive data storage solutions has emerged from advancements in synthetic DNA technologies, now touted by the industry as a safer, greener and more efficient storage medium. But how did we get here? How might ideas of 'sustainability' and 'efficiency' function in this context? In conversation, Mél Hogan and Deb Verhoeven discuss the idea of 'Sustainable DNA'—in its various instantiations—as an object of critical media studies.

By most industry accounts, data centres and the cloud infrastructure that undergirds them have become the most important sociotechnical system of our time, but also the least sustainable. During these pandemic times, for example, with many on lockdown, self-isolating or under quarantine, we have seen a surge in Internet demands: up by 70% for work, research and entertainment.[1] Scientists worldwide are busy

1 Mark Beech, 'COVID-19 pushes up Internet use 70% and streaming more than 12%, first figures reveal', *Forbes* (March 25, 2020), https://www.forbes.com/sites/markbeech/2020/03/25/covid-19-pushes-up-internet-use-70-streaming-more-than-12-first-figures-reveal/#6d22fd223104.

 https://doi.org/10.11647/OBP.0213.06

sequencing the genome (DNA) of COVID-19 while others sit at home creating and streaming more media content than ever. There's probably been no time like this current pandemic for thinking through the ways in which something like DNA and the Internet coexist (if not collide) as constitutive paradigms. Specifically—and what we discuss here—one of the alternatives to water- and energy-intensive cloud infrastructures has emerged from advancements in synthetic DNA technologies, now hailed by the industry as a safer, greener and more efficient medium for data storage. But how did we get here; from large scale cloud storage to the molecular? How might ideas of 'sustainability' and 'efficiency' function in this context? In conversation, Mél Hogan and Deb Verhoeven discuss the idea of 'Sustainable DNA storage'—in its various instantiations—as an object of media and critical infrastructure studies. The following stems from a talk given by Mél Hogan, delivered at the University of Alberta's 2019 Sustainability Lectures.

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MH: I first came to think of 'sustainable DNA' storage by positioning it as a response to data centres. The current infrastructure for data storage generally includes tape and hard drives in large scale data centres, or what we've come to simply think of as 'the cloud'. As a media object, DNA data storage is a great object for analysis, not only for the way it offers continuity, in an analysis of storage technologies, but also for the way it makes us confront code anew. What makes DNA such a viable storage modality is, in part, how compatible the code of DNA—its four constituent chemicals: cytosine (C), thymine (T), guanine (G), and adenine (A)—is with the binary code—the zeros and ones of digital data. So, to explain it most simply, the process of converting data into DNA is one of translation and conversion into various combinations of the four possible acids: C, T, G, or A. The use of the DNA sequence as a storage medium is expected to take off within the next ten years, with both universities and commercial companies leading the way.

DV: My reflections on sustainable DNA developed out of my experience building digital archive infrastructure and then a serendipitous encounter with a taphonomist. This got me thinking: if DNA is used to store information, what would be the nature of its decay at the

informational level? How sustainable is 'sustainable DNA' in both practical and philosophical terms?[2]

Media Studies encourages us to approach the question of sustainability in terms of discursive histories including complex narratives about origins, provenance, inheritances, temporality, longevity and 'the archive'. In thinking specifically about the industrialisation of DNA (its storage and its use as storage media) these approaches interleave with many issues brought into consideration by Critical Infrastructure Studies.[3] Infrastructure establishes the conditions for the possibility of connection. DNA can be thought of in a sense as a form of infrastructure. And the 'connectivity' it enables is existentially defining. We hear this when people talk about 'the DNA' of an organisation or a system—meaning its constitutive, connective tissue. DNA here is 'foundational' in the sense that it is presented as conceptually irreducible (i.e., as essential) and in the way it cuts through time by producing a kind of 'present-day provenance' in the form of an authoritative ontological explanation (i.e., as essentialist). This is the kind of 'originary thinking' that I've written about previously in my work on sheep as foundational tropes. Originary thinking is a totalising thinking that purports to account for everything by getting to the ground of things.[4] Forget about Dolly the cloned sheep. Even woollen apparel now comes with DNA certification (see Figures 1 and 2).[5]

This understanding of DNA as 'connective' gives rise to specific narratives about how our DNA links us—I'm thinking of the widely quoted statistic that we share 99.9% of our DNA with the person sitting next to us for example. But these claims of a defining human capacity for sharedness also touch aspects of the world that are typically excluded from western human taxonomies and that are now drawn into

2 Deb Verhoeven, Mike Jones and Stephen Loo, 'Replicating the replicants; or, do archivists dream of downloadable sheep?', paper delivered at 'Australian Society of Archivists—Archives in a Blade Runner Age: Identity & Memory, Evidence & Accountability' (Perth, Australia, September 25–28, 2018).

3 On Critical Infrastructure Studies, see https://cistudies.org/, which includes a detailed bibliography outlining this emerging field of interest. See also Jean-Christophe Plantin, Carl Lagoze, Paul N Edwards and Christian Sandvig, 'Infrastructure studies meet platform studies in the age of Google and Facebook', *New Media & Society*, 20.1 (2018), 293–310, https://doi.org/10.1177/1461444816661553.

4 Deb Verhoeven, *Sheep and the Australian Cinema* (MUP: Melbourne, 2006), pp. 15–19.

5 Australian Wool Network, http://woolnetwork.com.au/dna.html.

a connection with us and that therefore redefine human relationality as something that includes the 'more than human'. My favourite is the line about how more than half of our genetic code is the same as a banana. What does this even mean? I guess for me it prompts us to think much more broadly about the co-dependencies or relationality at the heart of

Figs 1 (left) and 2 The use of DNA to ensure the 'naturalness' of garments through provenance tracing. Photographs by Deb Verhoeven (2020).

our 'lifeworld'.[6] It evokes for me what Indigenous theorist Shawn Wilson says in a different context: 'Rather than viewing ourselves as being *in* relationship with other people or things, we *are* the relationships that we hold and are part of',[7] or when Kim TallBear writes about understanding existence as a matter of 'being in good relation' rather than as the assertion of a defined point in hierarchical taxonomies.[8]

To take this to a more prosaic level. We might also want to understand the opaque interconnections in the digital infrastructure that have arisen around the sale of DNA related services—I am thinking here of Ancestry.com and 23andMe, for example. The familial relationships

6 Maggie Walter, 'The voice of Indigenous data beyond the markers of disadvantage', in *Griffith Review 60: First Things First*, ed. by Julianne Schultz and Sandra Phillips (Brisbane: Griffith University, 2018), pp. 256–263.

7 Shawn Wilson, *Research is Ceremony: Indigenous Research Methods* (Halifax, Nova Scotia: Fernwood Publishing, 2008), p. 80.

8 Kim TallBear, 'Caretaking relations, not American dreaming', *Kalfou: A Journal of Comparative and Relational Ethnic Studies*, 6.1 (2019) https://doi-org.login.ezproxy.library.ualberta.ca/10.15367/kf.v6i1.228.

that underpin these companies aren't obvious but are structuring. Anne Wojcicki, co-founder of 23andMe was married to Sergey Brin, co-founder of Google and investor in both 23andMe and Calico, a multibillion-dollar 'seed' funding company whose express mission is to understand and influence the genetic basis of aging, and which is Ancestry.com's main research partner. I'm not even going to debate whether a company like Calico is much more than a vanity project for Silicon Valley millionaires with an extended life wish. But I do want to point out that it isn't just our DNA that we share in so many ways. It's also the DNA data itself that is being shared unexpectedly—between a range of personally interrelated companies. I am tempted to think of them as 'geneo-platforms' or even 'geno-platforms': digital DNA platforms that are themselves linked genealogically.

It is not therefore without untold levels of irony that platforms devoted to the procurement of vast amounts of DNA data participate in a geneo-financial network of digital infrastructure that is fundamentally contributing to the very problem it seeks to solve—human longevity. This is the key point I feel that Mél you've been making in your extended research on DNA infrastructure and its environmental impact.

MH: In the talk I gave at the University of Alberta on the idea of 'Sustainable DNA',[9] I was making a link between Big Tech's investments in genomics and how that gave rise to both the idea and material support of using synthetic DNA to store media. I've since visited the lab at the University of Washington where the first fully automated synthetic DNA data storage machine[10] was invented, funded (mainly, I think) by Microsoft. The idea is that synthetic DNA—which is essentially four chemicals—is a denser and less energy-intensive medium for data storage. And in my talk, I was demonstrating that the mechanics came easily enough, but the legacy of genomics is also imbricated in the logics of these technologies… scientism, religion, settler-colonial science, eugenics etc. We need to talk about these things in order to talk about sustainability when it pertains to DNA data storage, too. And, like you

9 Mél Hogan, 'Genomic media/sustainable DNA', paper delivered at the 'University of Alberta: Sustainability Lectures' (University of Alberta, September 13, 2019).

10 Jennifer Langston, 'With a "hello," Microsoft and UW demonstrate first fully automated DNA data storage', *Microsoft* (March 21, 2019), https://news.microsoft.com/innovation-stories/hello-data-dna-storage/.

say (along with Kim TallBear and Jess Kolopenuk among others), in terms of relations; to other species, to land, to planet, to universe.

The recent turn to the misguided belief that DNA data storage is a 'solution' sees this 'solution' as curtailing the environmental impacts of current storage modalities, such as wasteful products and processes, and demands on rare earth minerals, water and electricity. Considering that the millions of data centres around the world currently account for 2% to 8% of global energy use to manage the 2.5+ quintillion bytes of data created each day, genomics data (i.e., collecting genomes of humans, plants, animals and viruses, etc.) actually intensifies environmental problems in terms of generating huge amounts of data that then needs to be processed and stored... and, in the context of global warming (and now, the pandemic!), this data requires vast infrastructural transformations. When I last visited a data centre in Stockholm, the CEO of Bahnhof told us—as he was showing off the highly energy-efficient server room—that: 'a few Google searches use the same amount of energy as boiling an egg'. I use the image of an egg often in my talks so that it sticks with the audience, but I also make the point that personal or individual consumption isn't the crux of the problem, generally, when it comes to environmental questions.

DV: I love this idea of boiling eggs as a measure of digital infrastructure efficiency. As a metaphor it is a kind of genius, eggs being a DNA repository or storage facility. And of course, we already talk about 'easter eggs' and 'server farms' in the vocabulary of computing. But what if Google searches really were eggs? Maybe then we would be more inclined to ask if they're the product of caged or free-range data farming? We might at different times prefer our results scrambled rather than carefully presented sunny-side up? And maybe when the results rise quickly and threaten to collapse with unfulfilled expectation then we would recognise them as unstable 'souffle searches' rather than the 'hard boiled' option we are told we must swallow?

MH: Metaphors do function to reveal meanings by association but, as we know from the idea of 'cloud computing'—metaphors can also obscure and misrepresent. Sometimes, in fact, this is the objective.

DV: Yes. When you spoke at the University of Alberta, I had the image of a self-entwined helix running through my head the entire time,

especially in terms of the way you interleaved both the style and the substance of your commentary on data centres and DNA (specifically the entanglement between DNA and digital code).

Metaphor itself is a kind of connective tissue, bringing into frame things that seem at one level to be dissimilar but that once compared bear on each other in expressive ways. Derrida says something along the lines that metaphor is never innocent,[11] suggesting that it limits meaning because it reiterates a binary or at best a fixed relation like the triples of a graph: subject, object, predicate.

I guess, for me, if we rethink relationality to be a capacity rather than the description of a connection then we might arrive at a different way of thinking about metaphor, too. How could the process of metaphoric connection support complex, overlapping, co-constituting, non-binary understandings of infrastructure? So, sure, clouds give rise to the idea that computing infrastructure is somehow 'natural' and out of the reach of ordinary human capability; that computing infrastructure is just a way of recuperating floods of data (in the form of vapour). Clouds are an obvious continuation of the diluvian descriptions of data inundation. And the term swiftly sidesteps the terrible way in which data centres, with their profligate use of water resources, mock these metaphors.

But clouds are also unstable and dynamic processes of conversion. They accumulate only to burst, they constantly threaten their own dissipation. They are neither 'infra' (existing below) nor 'structure' in any meaningful sense. Instead they conjure a collapse of infrastructure and perhaps therefore metaphor itself. So, the poverty of cloud imagery as an analogue for computing infrastructure isn't the real problem; the real problem is the fragility of infrastructure (and therefore also metaphor and perhaps representation itself). We might take this opportunity to think about how both metaphor and infrastructure can propose an inclusion that isn't necessarily coercive.

MH: Genomics research has embedded within it a computational rationale that is constitutive of thinking of DNA as *code*, and as *coded*. Genome scientists worldwide estimate acquiring, storing, distributing and analyzing approximately 2 billion human genomes, mapped

11 Jacques Derrida, *Writing and Difference* (Chicago: The University of Chicago Press, 1980).

globally by 2025, amounting to 40 exabytes of data. With genomics—as with many big data projects—the machine is essentially fed the largest amount of data to generate patterns from which findings are then made using artificial intelligence and other algorithms. But the key (unanswered) question is what constitutes 'genomics' exactly? Nobody I've asked seems to fully know because it's an ever-evolving answer. There have, however, been many scholars working to dismantle the conceptual, cultural and material centrality of the gene by addressing in some capacity the role of code and technologies for rendering visual and mappable genetic information.

In brief, here are some important takeaways by the key thinkers:

Lily E. Kay writes: 'The products of science and technology are sociotechnical; they work because they are embedded not only in material practices but also in cultural practices that stabilize and naturalize the technologies for producing knowledge and power. In the case of the genetic code, it is biopower'.[12]

Evelyn Fox Keller explains that in the early stages of the Human Genome Project there was a 'precocious simplicity' to the new wave of molecular genetics that explained what genes 'do' as encoding enzymes. Defects in genes mean defects in the enzymes which correlate to trait abnormalities. This was the simple formula of genetics that inspired the quest to linearly sequence DNA as code. As she explains: 'The answer was stunning in its simplicity; also, it had the elegance of a mathematical equation'.[13] DNA makes RNA and RNA makes proteins and proteins make humans. Keller further argues that this formulation of DNA, as code, pushed scientists to read gene function by way of their structure. She writes: 'It established DNA as the molecule that not only holds the secrets of life but also executes its cryptic instructions—it was, in short, the Master Molecule'.[14] But she casts doubt on the given agency of genes, or the idea that all genes work the same way, and invites us to consider other agents that call genes into action. Rather than act, genes are activated. While some genes encode RNA to proteins, as our simplified idea of genetics imagines, some genes play other roles—as regulators,

12 Lily E. Kay, *The Molecular Vision of Life: Caltech, the Rockefeller Foundation, and the Rise of the New Biology* (Oxford: Oxford University Press, 1999), p. 19.

13 Evelyn Fox Keller, *The Century of the Gene* (Cambridge: Harvard University Press, 2002), p. 54.

14 Ibid.

promotors, terminators, leaders, activators. Keller asks, 'what then should we count as the beginning and end of a gene?'[15]

Kaushik Sunder Rajan explains that the first phase of genomics was very much about 'the generation of databases'.[16] These databases are the output of DNA (genetic) mapping and/or (genomic) sequencing. Science, he explains, functions within 'its own authority by virtue of its ability to generate scientific "fact"'.[17]

Jenny Reardon echoes this statement twelve years later, writing that human genomics companies still face the problem of how 'to create valuable knowledge from genomic data' in the first instance.[18] Genomics do not contain inherent value, value is created from genomics.

As *Alondra Nelson* writes: 'the special status afforded to DNA as the final arbiter of truth of identity is vividly apparent in the language we use to describe it [...] the language of DNA pervades our cultural imaginations''. She writes that 'hyperbolic phrases such as "code of codes," "the holy grail," "the blueprint," the human "instruction book," and "the secret of life" suggest a core assumption about the received omnipotence of genetics'.[19]

Ashley Dawson applies this insight over DNA as a code and suggests that, 'over the second half of the twentieth century, communication was transformed cybernetically into information, and information was subsequently reduced electronically to digital bytes. In tandem with this process, biological life was parsed as a molecular code in the form of DNA's strings of four basic nucleotides: cytosine (C), guanine (G), adenine (A), and thymine (T)'.[20] Similarly to Sunder Rajan (and others), Dawson makes the case that biology (or, bios) can be circulated 'as information, as commodity, and as material artifact'.[21]

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15 Ibid., p. 59.

16 Kaushik Sunder Rajan, *Biocapital: The Constitution of Postgenomic Life* (Durham: Duke University Press, 2006), p. 28.

17 Ibid., p. 19.

18 Jenny Reardon, *The Postgenomic Condition: Ethics, Justice, and Knowledge after the Genome* (Chicago: University of Chicago Press, 2017), p. 123.

19 Alondra Nelson, *The Social Life of DNA: Race, Reparations, and Reconciliation After the Genome* (Boston: Beacon Press, 2016), p. 4.

20 Dawson, Ashley, 'Biocapitalism and culture', paper delivered at 'Spring 2015 Colloquium Series' (UC Davis, March 4, 2015), http://environmentsandsocieties.ucdavis.edu/files/2015/02/Dawson_Biocapitalism-Culture.pdf, p. 6.

21 Ibid.

Catherine Bliss also identifies that the core problem of sociogenomics has to do with our central beliefs about what constitutes 'humanness'—and issues a warning: 'DNA, with its portrayal of the truth of human beings, wins the day. So essentialism can thrive and amplify even as arguments are assailed against it'.[22]

Jessica Kolopenuk,[23] and *Reardon and TallBear*,[24] have put into question the ways in which DNA molecules have been harvested by the settler scientific community as almost always separate from the body. This disconnect has meant a lack of attention paid to issues that pertain to ownership in an embodied sense.

There are others, of course... but together these give us a pretty substantial and ongoing critique of the gene in terms of its perceived and propagated unassailability by the genomics industrial complex!

DV: The trick here is not to let the powerful if elusive conceptualisation of DNA pass without also understanding the impact it has had, not just on the definition of contemporary science, but also on the allocation of research infrastructure. The wholesale optimism generated by just the idea of DNA resulted in significant (financial and political) investment. And yet, so far the outcomes have not lived up to the hype associated with the launch of the Human Genome Project of 1990–2003, for instance.

I think there is an ethical question here around scientific accountability. And one that has really haunted science from the outset. At what cost? Do the means (intellectual efficiency and/or reproducibility, for example) justify the ends? And where human life is now concerned—the endings? Aspirations for efficiency (Occam's Razor as one example) and scientific reproducibility (validation as an agreement of results) drive the shape of digital research infrastructure around the world, although they are a highly linear and specific mode for measuring the extent of knowledge. I believe we need to be asking, how has an institutional disposition devoted to scientific accountability,

22 Catherine Bliss, *Social by Nature: The Promise and Peril of Sociogenomics* (Stanford: Stanford University Press, 2018), p. 113.

23 Jessica Kolopenuk, 'Miskâsowin: Indigenous science, technology, and society', *Genealogy*, 4.1 (2020), https://doi.org/10.3390/genealogy4010021.

24 Jenny Reardon and Kim TallBear, '"Your DNA is our history": Genomics, anthropology, and the construction of whiteness as property', *Current Anthropology*, 53.5 (2012), S233–S245, https://doi.org/10.1086/662629.

understood through acts of 'reproducibility', actually compromised a broader need for social 'reproduction' or sustainability?

MH: Because of this ongoing belief that more data means more knowledge, we are willing to invest in, build, program and maintain at all costs the machines that will, one day, reveal to us great truths…

I think that genomics thrives in this liminal space… a kind of relentless and just around the corner revelation is promised to us. 'We've invested so much, we can't stop now…'

In the meantime, genomic data is mined for all sorts of capitalist ventures, which may be an always temporary ideal state for the industry. It can live off the promise for a few more decades. What is happening in the meantime is that a new logic of code is becoming culturally entrenched. We need code because we imagine it to be the simplest trace of humanity we can leave behind, as our legacy, at the end of the world, because it is the simplest formulation—the most basic unit—of how we now understand ourselves scientifically.

DV: Yes! And here is where it gets super interesting. The very code that we are willing ourselves to believe is the most essential definition of our 'selves', the very code we are squandering untold natural resources to try and understand at great risk to the survivability of the planet—is also being proposed as the best media to 'archive' human accomplishment. We are running out of storage and we are running out of a viable world. Rather than attempt to address these twin problems by adopting more sustainable practices in relation to data production and storage, science just turns to new storage options like synthetic DNA.

Possibly the most hubristic example of this is the ARCH (pronounced Ark—get it?) project—a sort of a high school time capsule writ quite a bit larger. In 2019, the ARCH Mission's Lunar Library crashed onto the surface of the moon. Inside it were tens of millions of pages of documents as well as cells from twenty-five humans and other organisms and seemingly without irony, it included an open letter from the Mayor of Austin extolling the virtues of queso and urging any and all aliens to stop by and try. In a country that proposes to build walls to keep humans at bay, an open invitation to aliens. To eat queso. I can't even begin to express how many levels of misguided and wrong this initiative is. Starting with the extraordinary vanity that assumes this

highly selective but apparently globally representative archive will be in any way comprehensible to future humans—let alone cheese-eating aliens.

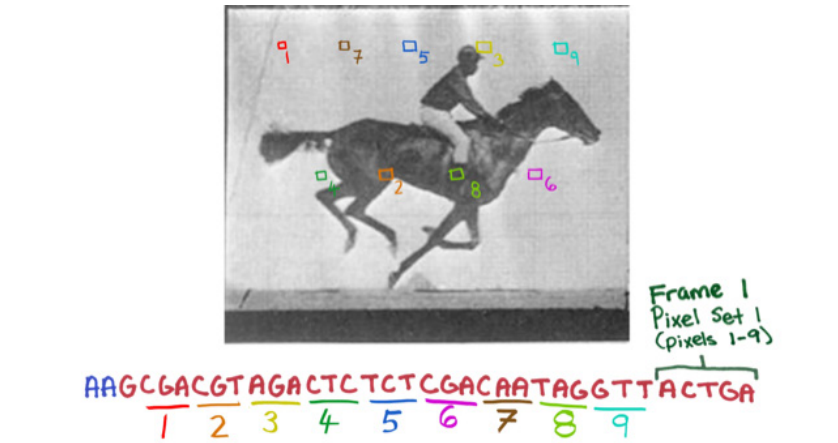
Riding on the exhaust fumes of initiatives like this are startups such as LifeShip, which offers to send personal genetic code embedded in a polymer described as 'synthetic amber', to the moon. The ill-fated Lunar Library was encoded on twenty-five nickel discs but the ARCH Mission has plans to use archives stored in DNA itself on future missions. I like to say it's putting the thumb back into the thumb drive. Actually, the thumb reference might also explain why early experiments in this particular tech focussed on encoding *The Hitchhiker's Guide to the Galaxy* into DNA sequences.

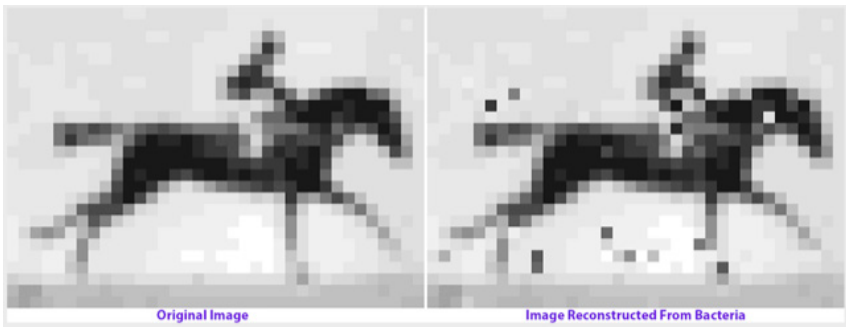
Recently a huge buzz erupted around a team at Harvard that used CRISPR gene-editing technology to store a 'movie' in the form of bacterial DNA. They started with the image of a splayed hand, inspired by parietal art. Always the nod to foundation myths and preservable practices ('synthetic amber' and cave paintings). But the 'movie', even as a more contemporary reference point, is also more complicated than it might first seem, and as it turns out, also bears a type of originary thinking.

The scientists chose to use five frames from what they claim is an 1870s movie of a racehorse, broken down into pixels which were then encoded using DNA (Figures 3 and 4). Their point was not to actually store videos in bacteria but to 'turn cells into historians'. According to one of the researchers: 'We envision a biological memory system that's much smaller and more versatile than today's technologies, which will track many events non-intrusively over time'.[25] So the important thing about the experiment was the ability to sequence bacterial DNA in order to reconstruct the pattern of frames that represent change through time.

As a tricked-up film historian, a large part of me applauds the idea that attention to temporality and change (in any media, including DNA) is a useful thing. Of course, the scientists are not really turning cells into historians. It's more along the lines of creating a new DNA level recording device that will provide retrievable information about the

25 'Scientists replay movie encoded in DNA: "Molecular Recorder" would reveal secrets of brain development' (n.a.), *National Institutes of Health* (July 12, 2017), https://www.nih.gov/news-events/news-releases/scientists-replay-movie-encoded-dna.





Figs 3 and 4 Image Credit: Wyss Institute at Harvard University. Image by Seth Shipman (June 2020).

progression of cellular processes. This makes the other part of my film historian self want to address the critical lack of history in this account of video encoding. And another part of me wants to talk about the operating definition of archiving that all these initiatives seem to rest on.

For the scientists, the images are now a 'movie' (I'm not going to get into the technicalities of why a GIF isn't really a movie), therefore they must have always been a movie. If there is a known problem in film archiving, it is not the fragility of the media that films are recorded on—it is the obsolescence of the technological infrastructure. Whenever formats are upgraded, massive migrations need to occur and swathes of dispensable content falls by the wayside.

Film and video archiving is a dynamic, constant process of evaluation, migration and management. None of this is more evident than in the case of British photographer Eadweard Muybridge, the ethically suspect artist who created the horse images used by the Harvard scientists in this exercise (Figure 5). This 'movie' was actually a selection of highly curated still images of a galloping horse named Annie G. and published in Muybridge's *Human and Animal Locomotion*.[26] It is no surprise to learn that late in his career, Muybridge sought to have himself removed from document archives in order to advance the idea that he was the progenitor of the motion picture industry (a claim which is the basis for many debates in the field of film history).[27] But Muybridge's motivating interest was in dissecting and deciphering movement, not synthesizing it.

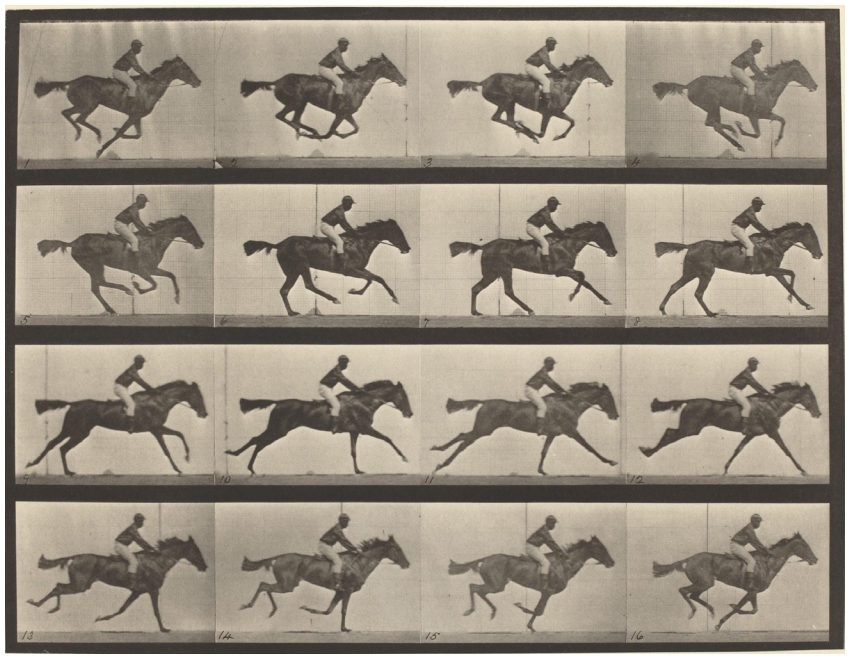


Fig. 5 Eadweard Muybridge, *Animal Locomotion, Plate 626* (Washington, D.C., National Gallery of Art, 1887).

26 Eadweard Muybridge, *Muybridge's Complete Human and Animal Locomotion* [1887] (New York: Dover Publications, 1979).

27 Marta Braun, 'Muybridge's scientific fictions', *Studies in Visual Communication*, 10.3 (1984), 2–22 and Marta Braun, 'Muybridge's Animal Locomotion', *History of Photography*, 24.1 (2000), 52–54, https://doi.org/10.1080/03087298.2000.10443363.

Here then, we have cinema infrastructure itself as obsolescent. For the Harvard scientists, the idea that the infrastructure of moving images itself comes from contingent historical circumstances has been conveniently wiped from memory. This recovered video sequence serves as a metonym for the archive (as I understand it)—*the arbitrary extraction of entities or events from their context, which are teleologically manipulated into a singular progressive structured sequence that produces the illusion of forward momentum and therefore an expectation that there is something 'next'.*

Rather than take this as an opportunity to observe and work within a mangled global entanglement, DNA is used by these scientists as a field for mining or harvesting categories of time and space that optimistically promise human progression, technological posterity, generational sustainability and individual longevity. And yet as we keep saying, such claims rest on processes that are materially responsible for compromising these ambitions.

MH: What we know now and what is revealed to us from every project above as well is that genomics research relies on massive Internet infrastructures and computational power and is imbricated in the extractivist logics that allow and encourage their expansions. Our global communications infrastructure is built on social inequalities that allow for cheap labour, cheap nature, expensive products, proprietary software and hardware, and quick distribution and sales. It is a profit-driven system. Genomics is also powered by profit.

DV: And bad history.

MH: By way of a conclusion I also want to mention three, generative, non-industry examples for seeing this storage idea through by way of both scientific realism and speculative design: Karin Ljubic Fister's 2016 scientific experiments encoding data (like music) into plants;[28] *Grow Your Own Cloud* (2018) by Monika Seyfried and Cyrus Clarke (https://growyourown.cloud/); and *Data Garden* by Kyriaki Goni (https://www.onassis.org/whats-on/data-garden).

When asked by the *New Scientist* (2016) why the DNA of plants were an opportune storage technology, Fister responded:

28 Geoff Manaugh, 'Landscapes of data infection', *BLDGBLOG* (February 8, 2016), http://www.bldgblog.com/2016/02/landscapes-of-data-infection/.

> I was annoyed about the amount of disc space on my computer. I started wondering, what if I could store data in DNA? It's such an immense reservoir of potential storage—1 gram of it could store over 450 x 10^{18} bytes. All of the archives in the world could be stored in one box of seeds.[29]

Similarly, the justification for *Grow Your Own Cloud* was to explore the 'the link between two key topics of our time; data and anthropogenic climate change'.[30] The idea of storing 'memories' in house plants, and of having a community flower shop be the custodian of preservation (as opposed to an inaccessible data centre) meant a new strategy and an enhancement of consciousness of the current systems that do this. Goni's *Data Garden* works from this idea and asks us to think of 'the future of connectivity beyond surveillance, minimizing the consequences of technological infrastructures on the natural environment'.[31] So it seems like artists are at the forefront of exploring not only the environmental impact of DNA's technological infrastructures but also the poetics within the political questions embedded in storage, memory, access and preservation.

DV: I really love that these artistic explorations are also poetic in the sense of 'poetic justice'—in which the answer to an environmental problem (the negative effect of DNA data storage for global sustainability) is in fact, the natural environment itself (the DNA of plants and seeds). And once again you've sown that image of a self-enfolding helix in my mind!

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SECTION 2:
ART AND/IN THE ANTHROPOCENE

7. Design Education in the Anthropocene

Teaching Systems Thinking

Eric Benson and Priscilla Ferronato

The following chapter discusses how teaching design through the process of systems thinking, as derived from the disciplines of both ecology and biology, is the best path forward to prevent the worst-case scenarios of climate change. Systems thinking is a process that can help designers to uncover the root cause of a problem and how it connects to the larger picture: people, profit and planet (and everything in between). The conditions of the Anthropocene mean that designers must be able to identify the social, political and environmental repercussions of their work—and take responsibility for them. This process empowers designers to evaluate and shift the emphasis of their outcomes to consider the demand put on our natural resources: where and how we get materials to produce our projects, who and what is affected by our decisions and what will happen to the project after it is implemented. The systems thinking process explored in this chapter is a four-step model (determine project goals, map out the design problem, brainstorm design outcomes and evaluate each possible design outcome) as set forth in the 2017 book *Design to Renourish: Sustainable Graphic Design in Practice*. The authors, who are based at the University of Illinois at Urbana-Champaign, taught this systems thinking model over two years in three different courses to test its effectiveness and make improvements

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to the process, methods, tools and resources from one academic term to the next.

Introduction

The Anthropocene is the current geological epoch in which human activity has 'negatively' impacted not only individual ecologies but the entire system of our environmental interactions.[1] We have ignorantly pushed Earth out of the Holocene epoch in which agriculture, sedentary communities and, eventually, socially and technologically complex human societies developed.[2] The scope, scale and complexity of the self-imposed ecological issues we face today—like global warming, decreasing biodiversity and species extinction, and air, soil and water pollution—have led environmental scholars to suggest the worst is yet to come for our civilization and planet. In fact, a 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report from the United Nations (UN) details how the Anthropocene will eventually bring humanity to its knees. The UN study found that '75% of land environment and some 66% of the marine environment "have been significantly altered by human actions"' and 'up to 1 million of the estimated 8 million plant and animal species on Earth are at risk of extinction—many of them within decades'.[3]

Designers and design educators are therefore forced to now confront the fact that they should have acted proactively decades ago (as Victor Papanek prophesied in his 1971 book, *Design for the Real World: Human Ecology and Social Change*) to help prevent the worst from our current

1 Roy Scranton, 'Learning how to die in the Anthropocene', *The New York Times* (November 10, 2013), https://opinionator.blogs.nytimes.com/2013/11/10/learning-how-to-die-in-the-anthropocene; Will Scranton, Paul J. Crutzen and John R. McNeill, 'The Anthropocene: Are humans now overwhelming the great forces of nature', *AMBIO: A Journal of the Human Environment*, 36.8 (2007), 614–621.

2 Will Steffen et al., 'The trajectory of the Anthropocene: The great acceleration', *The Anthropocene Review*, 2.1 (2015), 81–98, https://doi.org/10.1177/2053019614564785.

3 The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *IPBES Global Assessment Preview* (April 29, 2019), https://www.ipbes.net/news/ipbes-global-assessment-preview.

potentially dystopian epoch. Additionally, educators must act collectively to realize that furthering the current status quo design instruction will *not* create a viable response to today's eco-crises.[4] The development of ephemera and artifacts using our historically taught linear processes (cradle to grave) ignores the natural systems of our planet entirely. This antiquated approach to design education will only hasten the speed of our current downward spiral through the Anthropocene, from which, once we reach the bottom, we may not be able to recover.

However, instead of creating a beautifully kerned apocalypse, design educators could empower their students to create what we want our future to be. Instead of continuing with the current model that increases environmental and consequent social destruction, design educators could use their skills to provide our students with the creative toolkit to regenerate what we took from our Indigenous brothers and sisters, land and waterways. This concept of imagining and creating the future we want will result in what scholars call the 'Ecocene'. Rachel Armstrong coined the term in 2015, having proclaimed at the Urban Ecologies design conference in Toronto: 'there is no advantage to us to bring the Anthropocene into the future. The mythos of the Anthropocene does not help us. We must reimagine our world and enable the Ecocene'.[5]

We argue that the best way forward to enable the Ecocene is to change our professional practice and teaching to use the process of systems thinking derived from the disciplines of both ecology and biology. Systems thinking is a process that can help designers to uncover the root cause of a problem and how it is connected to the larger picture—people, profit and planet (and everything in between). The conditions of the Anthropocene mean that designers must be able to identify the social, political, and environmental repercussions of their work—and take responsibility for them.[6] This process empowers designers to evaluate and shift the emphasis of their outcomes to consider the demand put

4 Rosi Braidotti, *The Posthuman* (Hoboken: Wiley, 2013); Vandan Shiva, *Staying Alive: Women, Ecology and Development* (Brooklyn: South End Press, 2010).

5 Quoted in Joanna Boehnert, 'Ecocene design economies: Three ecologies of systems transitions', *The Design Journal*, 22.1 (2019), 1735–1745 (pp. 1742–1743), https://doi.org/10.1080/14606925.2019.1595005.

6 Joanna Boehnert, 'Anthropocene economics and design: Heterodox economics for design transitions', *She Ji: The Journal of Design, Economics, and Innovation*, 4.4 (2018), 355–374, https://doi.org/10.1016/j.sheji.2018.10.002.

on our natural resources, where and how we get materials to produce our projects, who and what is affected by our decisions and what will happen to the project after it is implemented.

In this chapter, we will illuminate how teaching systems thinking to design students can help them handle a larger degree of complexity and make more responsible outcomes for their projects by considering value creation within a long-term timeframe involving a larger network of stakeholders.[7] This chapter will also reflect how systems thinking in design is different than using more traditional Human-Centered Design (HCD) methods for complex problem solving in design education. We will also discuss how teaching systems thinking to designers encourages a better and more responsible interaction between humanity and the environment (as opposed to, in HCD, where designers are concerned about how to solve only a particular user need).

Our Systems Thinking Process

The systems thinking process we used in our courses is grounded in that described extensively in Chapter Two, 'The Hawk, the Squirrel, and the Oak Tree', of the 2017 book *Design to Renourish: Sustainable Graphic Design in Practice*. In their book, Eric Benson and Yvette Perullo divide their systems thinking process into four phases that weave back in forth (circular) to avoid the linear design process (cradle to grave) that has helped place us squarely in the Anthropocene. The process described in the book is uniquely adapted for designers from previous research, namely that by Donella Meadows' *Thinking in Systems: A Primer* and Fritjof Capra and Pier Luigi Luisi's *The Systems View of Life: A Unifying Vision*.

Each of the four *Design to Renourish* phases are written using a language that designers can understand, describing systems thinking as similar to Gestalt theory (the whole is greater than the sum of its parts) and the Charles and Ray Eames' film *Powers of Ten* (1968; rereleased in

7 Peter H. Jones, 'Systemic design principles for complex social systems', in *Social Systems and Design*, ed. by Gary Metcalf, Translational Systems Sciences 1 (Tokyo: Springer Japan, 2014), pp. 91–128, https://doi.org/10.1007/978-4-431-54478-4_4; Birger Sevaldson, *Systems Oriented Design* (2009), http://www.systemsorienteddesign.net.

1977). Gestalt theory and *Powers of Ten* are common topics taught in design foundations and design history courses, and therefore already in the vocabulary of a young design student, making a complex topic like systems thinking easier to understand. Both the term Gestalt theory and *Powers of Ten* demonstrate for the designer how it is best to zoom in and zoom out of an issue to see not only the granular details, but also the larger connected reasons why the issue might exist in the first place. Systems thinking teaches us that (as environmentalist John Muir stated): '(w)hen we try to pick out anything by itself we find that it is bound fast by a thousand invisible cords that cannot be broken, to everything in the universe'.[8] In other words, everything is connected on our planet.

The four phases within the systems thinking process were embedded in each of the two projects in our fall 2017 Design Methods course, taught as an exploratory testing ground to introduce the topic to design students. The phases within the *Design to Renourish* process are (in order): *determine project goals, map out the design problem, brainstorm design outcomes and evaluate each possible design outcome*. The general concept of titled phases mimic those used within the design thinking and HCD communities, and therefore can be better understood by designers and disciplines outside of the design community as well. However, one of the biggest differences from design thinking is that the goals within a systems thinking process is that the outcomes should be circular (like our natural systems) and create zero waste. We define this as sustainable design, where there is a net zero environmental (and carbon) impact.

Systems thinking, of course focuses on people, as does the more commonly taught HCD approach. Systems thinking, however, is better suited to handle the complex concerns we face in the Anthropocene, as its process tasks the designer with visually mapping out the problem(s) in order to discover the root causes of an issue, instead of identifying solely the symptoms. Within this mapping, the designer not only considers people (the audiences), like in HCD, but also includes the Earth (water, land and air) as a key stakeholder in the process. All of these partners share equal weight and importance, forcing the designer to design circularly (zero waste) using our natural systems as a guide.

8 John Muir, *My First Summer in the Sierra* (San Francisco: Sierra Club Books, 1988), p. 110.

Despite the limitations HCD has in solving the concerns we will face in the current Anthropocene, it contains very useful tools and methods that we taught alongside systems thinking strategies in each of our three courses from 2017–2019. For example, within the second phase of the *Design to Renourish* systems thinking process (*map out the design problem*) students learned how to use storyboards, surveys and user personas, while in the fourth phase (*evaluate each possible design outcome*) students studied SWOT (strengths, weaknesses, opportunities and threats) analysis to better choose the correct possible design direction.

Case Study One: Design Methods 2017

In the fall 2017, the authors each taught a section of a required hybrid studio/seminar HCD course directed toward forty total graphic designers, entitled Design Methods. We planned the entire course using the process defined in *Design to Renourish*. Each of the two challenges (as we called the assignments) tasked each team of students to follow our systems thinking design process: *determine project goals, map out the design problem, brainstorm design outcomes*, and *evaluate each possible project outcome* to solve a social or environmental issue that affects humanity. During the process, the students used HCD tools like storyboards, surveys, user personas, and a SWOT analysis to help make collective decisions and designed outcomes that embrace nature's cyclical model. The goal of each challenge was to make the students capable of leading system change initiatives addressing complex sustainability, offering flexible access to the best learning experiences, tools and case studies.

Throughout this course we did not mention the topic of Anthropocene, despite it being implied in every one of the assignments. We hoped that if we focused on the future we wanted to have (Ecocene), we could limit apathy and paralysis in decision-making based on despair.

The course structure and lecture materials were exactly the same in both sections so we could get a larger consistent sampling of student feedback and outcomes to see how effective or ineffective the systems thinking process was. We organized the fifteen-week semester into three equal chunks. The first five weeks offered different viewpoints on design through readings/discussion, introduced systems thinking and sustainable design methodologies, and conducted workshops with

various tools and methods used by designers that focus on HCD and 'Thinking Wrong'.[9] The remaining ten weeks were broken into two five-week challenges that asked the students to use what they learned in the first five weeks to find and propose solutions to social and environmental challenges.

The two challenges stressed the importance of locality. Each proposed project by the student design teams must be, in the end, realized outside of the classroom on campus or in the community. We championed the local, so the student teams could more easily interview people, would know the area better and its issues, and could see the results (at the end of the project) in person. Most importantly, they could see themselves as part of the community they were designing for (and with) and feel greater agency throughout the process knowing that the final solution would hopefully also positively their lives as well.

The first challenge we assigned was entitled 'Local Resources', where each team was asked to pick one of the following four subtopics to explore: plastics, water, food or waste. We set fairly strict parameters in this first systems thinking project, allowing the teams access to only these four questions connected to the sub-topics provided: How can we reduce plastic consumption (on college campuses or in the local community)? How can we use design to eliminate contaminants in the local drinking water supply? How might we dramatically reduce waste by transforming our relationship with food in the community or on campus? How might we establish better recycling habits on campus?

The first challenge allowed the student teams to pick an area to explore. However, since this was the first time almost everyone in the studio had used systems thinking to design, we curated the questions in order to eliminate any extra confusion caused by a completely wide open prompt coupled with a new way of creating. But in the second challenge, we included a more open design prompt, since we felt that the experience with systems thinking in the first challenge would better prepare the students for a project of their choosing.

At the end of the first challenge, we took a portion of the following class period to debrief. We asked each class section the same questions about what they learned from using systems thinking in design and

9 John Bielenberg et al., *Think Wrong: How to Conquer the Status Quo and Do Work That Matters* (San Francisco: Instigator Press, 2016).

what could be improved upon for the next project. Overall, the students felt that using systems thinking when designing was incredibly important. They were confused along the way—as it was very new to them. However most confirmed that 'confusion was good'. Discomfort forced them not to fall into the trap of creating the same outcomes that solved one problem but created many others. With understanding the bigger picture of the design problem, they felt they could develop a better and more sustainable solution. We used what we gleaned from these two course conversations to make small and quick changes to the second challenge to improve upon the overall class experience.

This second challenge was curated into four main topics: health, education, democracy and the planet. We chose these areas as they are all affected by and have helped create the Anthropocene epoch. To help get the design teams thinking, we provided some example questions in each of the four themes. For example, in health, we provided this example project query, 'How might we make the Emergency Department (ED) waiting room more humane and user-focused?' while in the democracy issue, we furnished an idea asking 'How might we design an accessible election experience for everyone? How can we more engage people to vote?'

The students produced some interesting solutions for each of the two challenges in Design Methods that could be implemented with the possible acquisition of further funding sources but did not make tangible artifacts as they were lacking the time and monies to purchase the sustainable materials needed to have a net zero impact. Instead, the students turned in proposals in the format of digital presentations. Most of the solutions, in general, involved a digital outcome like a website or mobile application. These solutions were not necessarily driven by the lack of money or avoidance of physical solutions (to reduce environmental impact), but instead were based on a careful consideration of the effectiveness of a digital solution (in comparison to others brainstormed) after going through the entire four phase systems thinking process as a team.

At the end of the fall 2017 semester, we collected written and verbal feedback from the students to create an in-depth analysis of the project outcomes in order to tweak the syllabus and general approach for the next time the course (or similar class) was taught. The analysis verified how

much students understood about systems thinking and how and why they would include it in future school and professional design projects.

Specifically, this is the feedback that was most commonly given regarding the semester spent thinking in systems. In the first *determine project goals* step from *Design to Renourish*, it is important to suggest to the students to reach out to and speak with as many people connected to the design problem as possible. Many times, they didn't locate an important expert or community leader until later in the project, changing the way they would have approached a solution at the outset. A more experienced systems thinking team of designers will learn to research better to avoid missing connections.

In the second *map out the design problem* step, we found after mapping out the design problem, it was smart to suggest to the students to invite fresh eyes to the map to locate opportunities and issues that the design team missed. The more details and information the map holds the better it will serve the design team in choosing a final solution(s). We also confirmed that using user personas was vital for properly understanding the people involved. Interviews with actual people and surveys helped develop the personas.

In the third *brainstorm design outcomes* step, we found that if we used a strategy from the book *Think Wrong* by John Bielenberg, Mike Burn, Greg Galle and Elizabeth Evitts Dickinson, the design team could really separate themselves from standard design outcomes and find solutions that could solve the problem in ways that followed nature's cycle of 'no waste'. Specifically, the *Think Wrong* 'Moonshot' exercise10 was incredibly valuable as a tool asking the students to not constrain themselves by self-imposed parameters. This exercise asked the students to put forward potentially crazy concepts to solve a design problem. This pedagogical strategy helped the students not continue in the status quo design concepts they are used to proposing for a standard design project. They thought in a creative childlike mindset, where they began to unlearn the outdated linear design process and gave them hope that the Ecocene was indeed possible. After the 'Moonshot' exercise, the design teams created storyboards of their ideas to further detail out their plans to find issues and strengths in their solutions.

10 "When to Use the Think Wrong Moonshot Drill." Moonshot Drill, Solve Next, 2021, solvenext.com/moonshot.

In the fourth and final *evaluate outcomes* step, we found that using a more typical SWOT analysis tool was very useful in scrutinizing each possible solution to the problem. In combination with the SWOT analysis, the students had to also look at each solution in relation to the triple bottom line. They asked how each solution could create an experience that minimizes resources used and best use materials and vendors that were sustainable and used renewable energy. This was challenging of course, and many teams lacked experience or time to really locate the right materials. This was a clear opportunity for improvement in regard to what resources we provide to the students for this type of systems thinking project. Our thoughts headed into further courses, was to purchase a license to Life Cycle Analysis (LCA) software to help the designers visualize the actual environmental footprint of every material chosen in their design solutions.

This process of systems thinking defined by the book *Design to Renourish* was also tested in the fall of 2018 and spring of 2019 with two different design courses, with tweaks in the implementation learned from the fall of 2017 iteration.

Case Study Two: Fall 2018

Based on the students' feedback from the previous semester, the Design Methods course in fall 2018 (composed of, this time, only twenty undergraduate students) was organized in a way to make students more comfortable with the circularity of the systems thinking process. Undergraduate students want a syllabus that describes every activity assigned during the semester in advance, which, we found, is not possible when working in a systems thinking approach. Appropriately, too many times, designers must stop, zoom in or zoom out during this circular process, making new work and research segues that are often unpredictable from the outset of the assignment. Therefore, students feel unprepared at times for what is coming next. It is important to include this fact on the syllabus and state it vocally in class.

This Design Methods course was again divided into two challenges. This time, Priscilla Ferronato decided to build upon the previous course iteration by including real world cases with community partners. They were the Krannert Art Museum (KAM) at the University of

Illinois at Urbana-Champaign and the Champaign County 4-H Club. The decision to collaborate with these organizations was an attempt to further demonstrate how to apply systems thinking in real world projects whose tangible outcomes can serve as an incentive to grow the students' interest into systems thinking. The course followed the same structure as the previous semester in terms of the lectures' topics and recommended readings. The biggest change was to shorten the introductory five weeks down and instead create two eight-week projects with the previous exercises from the initial five weeks embedded in the first assignment.

The goal of the first project was to redesign the communication experience of the Krannert Art Museum to the community. The students were required to present to the client at mid-term and, of course, at its completion deadline. The goal of the mid-term presentation was to collect feedback from the 'clients' including the Director and Marketing Department at KAM. However, as part of the systemic approach, the students also needed to identify who the other stakeholders were in connection to the museum. When the designers identified other stakeholders (such as members of the local community, tourists, students, employees and service providers), they began to zoom out to view the causes and consequences of the 'identified problem'.

Not only human stakeholders were taken into consideration: during the stakeholder mapping activity it was necessary to identify other elements of the system that humans may interact with, like the planet. This was the most challenging of all the initial activities for the students, as they wanted to rush to create tangible solutions before measuring and evaluating the impacts on people and the ecosystem. Based on the *Powers of Ten*, students were asked to 'zoom out' ten times and expand their design problem and solution, and also 'zoom in' ten times to narrow it down. This exercise provided meaningful insights for the development of systemic solutions. (This was something new we added from the first Design Methods course.) It is important to mention that as soon as the students were able to map out the elements of the system (and especially their interactions), more sustainable solutions were developed. Everyone found that visualizing the connections between the many elements of the systems provides a way to make the opportunities tangible.

The second project, in partnership with Champaign County 4-H Club, followed the same structure as the first assignment. The students were asked to meet with the Director of the program both at the mid-term and final presentations. However, since the goal of this project was to design an experience to promote the 4-H program to increase the interest of children and teenagers in Science, Technology, Engineering, the Arts and Mathematics (STEAM), this project required a higher number of interactions with different stakeholders than the students initially thought. As soon as the students identified the different stakeholders and elements in the systems of interaction, it was easier to know who to contact and consequently understand their thoughts and opinions about the 4-H club and STEAM.

The most important finding for the students was that after using systems thinking, they realized how complex a simple visual communications project should be. With all the important yet different stakeholders, the students and Ferronato felt the best path forward was to 'design with not for'. Therefore, Ferronato decided to introduce the concept of participatory design as a method to also incorporate into systems thinking. Some of the design teams took this opportunity to develop co-design sessions with the stakeholder groups to improve the project outcomes. The design teams that ran co-design sessions received better feedback at their critiques from the 4-H Club and faculty than those who decided against running workshops.

Case Study Three: Spring 2019

Another goal of this research was to also test teaching systems thinking in a design course that did not include a component focusing on HCD tools and methods. We decided to use one section of the junior level required course entitled Ethics of a Designer in a Global Economy (EDGE) as another testing ground. The students in this ethics class were introduced to systems thinking in the fall 2018 Design Methods course, so we were interested to learn how much they remembered, how much of the process we would have to repeat and how much deeper in detail we could go if students were already on the right track. Benson taught this course with help from a teaching assistant (Miriam Salah) that also co-taught with Ferronato in the fall 2018 version of

Design Methods. The teaching assistant was therefore also aware of the subject matter and the systems thinking process, making the transition easier. Much like in the previously mentioned case studies, though the Anthropocene was an underlying theme, the course objectives were guided by the Ecocene model. We felt that an Ecocene approach that looks toward a hopeful future, rather than a fearful and catastrophic one, would better inspire students to seek out imaginative and creative design solutions.

This course was composed of eleven students and was divided into four projects that focused on ethics within the design field and also how designers connect to the current global issues facing humanity. In particular, we structured the course around ethical discussions and projects starting from our own personal values to how these values connect to a larger community and, consequently, the planet. This class organization led us to focus exclusively on environmental issues and climate change (different from the first two Design Methods courses).

The first two projects in EDGE were concerned with the individual students' own personal code of ethics and how that would carry forward and affect the final two projects. The first project asked the designer to choose a breakfast, lunch or dinner recipe that carried a significant amount of emotional significance to them and cook or bake it for a class potluck the following week. At the meal, we discussed the ethics connected to organic food, vegetarianism, veganism and the carbon footprint of what we all eat. This conversation was infused with readings (consumed the night before) on food justice and ethics in general. After the potluck and discussion, the students were assigned with creating an information graphic (in a relevant format of their choosing) that demonstrated the carbon footprint of the transportation needed to make their recipe.

This project resulted in some stimulating outcomes and the topic of 'personal values' was the segue to the second project where the students wrote their own personal code of ethics and designed individual personal brands that represented what they stood for as a citizen and designer. The course was designed in this fashion, attaching one project to the next through a similar theme. Therefore, the third project focused on ethics from the standpoint of a community that depended on the actions of one's personal value system (connecting it to both project one

and two). This third project asked the students to use systems thinking to reimagine a delivery mechanism for a sustainable product or service that was important to them. Here, the designers were introduced to the concept of a circular economy, where objects and services are created and distributed with zero waste and no carbon footprint (again, emulating nature's model of function).

We re-read *Design to Renourish*'s chapter on 'The Hawk, the Squirrel, and the Oak Tree' to reinforce what this group of students had already learned in their previous Design Methods course and input an additional two readings and four informational videos visualizing and explaining the circular economy (that included case studies). The students used this prompt to research similar or inspirational examples of circular products and services to influence their own design. The end result of this project was a proposal in the form of a website mockup or animated video that explained their idea clearly and was, of course, visually interesting and convincing.

The fourth project that followed this circular economy assignment replicated a portion of the second challenge from the first version of the Design Methods course (2017) asking here for the students to focus on the theme of 'the planet' in an attempt to better connect the everyday American to climate change concerns. We asked the students to read both a portion of the philosophy and ethics book *One World Now* by Peter Singer and the seminal 1999 article on climate change by Dr. Michael E. Mann, 'Northern hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations' to locate opportunities (using a systems thinking process) for better communication of the clear and present danger that climate change poses to our civilization.

In this third instalment of teaching systems thinking, we learned that the students had indeed unfortunately lost much of the knowledge gained about systems thinking from their previous Design Methods course. There was a real struggle in re-explaining the systems thinking process to the designers during each of the final two projects—where many only vaguely remembered reading Chapter Two from *Design to Renourish* and using the systems thinking process in their previous Design Methods challenges. We did not do as deep of a dive in collecting qualitative feedback in comparison to the first

attempt within the 2017 Design Methods course, as the sample size of eleven (compared to forty) was fairly small. We did, however, glean enough from the weekly desk critiques and one-on-one discussions, that there was a lack of information retained about systems thinking prior. It leads us to believe that systems thinking must be continually reinforced throughout the design curriculum, and not appear only in one class.

Conclusions

The results from each different course section demonstrated that systems thinking was initially a very foreign and overwhelming way to solve problems, causing confusion. It also 'forced' the students to work outside their comfort zones. However, students understood the importance of the process contrasted against the current and future global problems we all face. One of the key takeaways from the Design Methods course was to eliminate the five-week grouping of exercises and instead embed them into the two eight-week challenges. This worked more seamlessly and could also be implemented in the structure of the Ethics (or any) course as well in the next iteration.

Overall, the readings, lectures and project setups seemed to be understandable, interesting and challenging for the design students. And, as expected, the first team challenge from the 2017 Design Methods course was more confusing (and took longer) than the second, as they slowly became accustomed to this new way of thinking and working. Continually adding systems thinking into every design course in a department's curriculum will help remedy the problems associated with initial confusion about the newer creative process and aid in the retention of the core materials and methods.

There were clear areas for improvement in teaching the topic and opportunities to add new tools, methods (like co-design) and exercises to the class. Moreover, the use of systems thinking encouraged students to think beyond the insights obtained through the use of the HCD methods. Although it is not possible to say that the use of systems thinking will alone be able to reverse the climate impact of our design activity, it can be considered a more responsible approach (as seen through the projects presented by the students in our classes and

beyond). The systems thinking process is a first step toward improving design education and potentially avoiding the worst-case scenarios in the Anthropocene, instead imagining a better future (or an Ecocene).

We must design using systems thinking, and teach systems thinking, now. We are racing against the clock to prevent the worst of the possible catastrophic environmental, social and economic outcomes driven by human-made climate change. The recent 2018 Intergovernmental Panel on Climate Change (IPCC) report demands for us to level our greenhouse gas (GHG) emissions by 2020 and cut them nearly in half by 2030 to avoid irreparable damage to the climate and ourselves. The Anthropocene is upon us and systems thinking through design is the best path forward to imagine a future we would all like to have.

Although the systems thinking curriculum we implemented with our students focused on net zero (sustainable) impacts on the planet, we believe the design solutions going forward should be regenerative in outcome. Regenerative design, by definition, encourages participation with living systems in ways that increase systemic vitality.[11] As the IPCC report suggests that we must repair our climate, so too should we also clearly design in a way that helps give back to what has been stripped historically from nature to make our posters and toasters. To drawdown our greenhouse gas emissions, we must regenerate the Earth to revitalize its soil and plant life to help with the efforts to reach climate stability. This is an area for designers that is also ripe for exploration (like systems thinking) as it is an emerging research area, led by holistic scientist and designer Daniel C. Wahl.

We hope that this chapter is a valuable and useful case study for you to explore within your own design classroom. It is clear that due to global warming, overconsumption of our finite resources, and air/land/water pollution, design must change from a linear process to one that is circular. Instead of contributing to these problems, design and design education must become an agent for change to remedy these issues and renourish people and the planet instead.

11 Daniel Christian Wahl, *Designing Regenerative Culture* (Axminster: Triarchy Press, 2016); Kate Raworth, *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* (London: Random House, 2017).

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8. Inspiration from Goethe's Tender Empiricism

How to be the Person Collecting, Analyzing and Visualizing Data

Joshua Korenblat

Science, humanities and design might seem like unrelated fields. Yet, information designers, who unpack complex data involving real-world issues, can benefit from the ability to synthesize these seemingly disparate practices. To learn more integrated, humanistic approaches to data visualization, we might look to a time when science and the arts were less divided. The following chapter focuses on poet-scientist Johann Wolfgang von Goethe, the Romantic-era polymath. Goethe called his scientific method 'tender empiricism', a complementary practice to analytical empiricism. Goethe believed in portraying the same phenomena under subtle, changing conditions. While observing, collecting and visualizing, he also searched for what might be missing. A plant, for example, is not a collection of parts; it also portrays the process of growth even in static form. For Goethe, observational discoveries can change the inquiring mind. In contrast to data visualization practice today, which often focuses on summaries and abstract charts, Goethe believed that authentic, insightful truth dwells in real-world details. The second half of the chapter illustrates how Goethe's 'tender empiricism' can be applied to design pedagogy. These case studies show how a Goethean

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ecological approach can be used to model a more ethical way of working with data.

Introduction

Scientists study nature. Humanists study human experience. Designers make the artificial world. Yet today, in sustainability and digital humanities projects, these long-divided camps collaborate and co-create. For instance, when planning and implementing a sustainability project that involves data visualization and communication to the public, teams think like scientists: they collect information and analyze it, and conduct research in a structured way. To represent and communicate the data, teams must think like humanists. They try to adopt the perspective of their audience, with empathy for how it feels *not* to understand a topic. From this insight, designers determine how they present information, from simple to elaborate, and how much to guide readers with explanatory prose and pictures. Even as they design the final product on digital platforms, teams also need to remain attentive to how humans evolved to read their natural environment. These principles translate into how we read charts and maps, 'landscapes' of data, in the blink of an eye. In the end, the fields of science, the humanities and design all inform the work of interdisciplinary teams, in support of the most effective, human-centered projects.

For these sustainability teams, we need interdisciplinary people too. Each individual of the team embodies the interdisciplinary ethos. To look for role models for this type of interleaved work, we can acquaint ourselves with a time before scholars and makers specialized. Here, poets could study science and scientists could learn from poets. Visualization, meanwhile, wasn't just a tool for building abstract charts and applicable insights. Through the 'mind's eye', visualization could also be a tool for beholding and perceiving phenomena without abstract concepts in the way. This provided the beholder a sense of philosophical and spiritual well-being—and also practical benefits in creating richer inquiries.

Consider Johann Wolfgang von Goethe (1749–1832), the late Enlightenment and Romantic-era polymath. Goethe wrote masterpieces of poetry, fiction and autobiography that elevated him to Shakespearean

status in Germany and abroad. However, during his life and especially today, Goethe has enjoyed less recognition for his work in science, a lifelong body of work that included illustrated essays in botany and optics. In this oft unrecognized work, Goethe transcended a duality between the subject, the human inquirer, and object, nature. This blurring prevents people from recognizing Goethe's work as proper science. In science and philosophy, the figures most responsible for this duality included the astronomer Galileo Galilei (1564–1642) and the philosopher-mathematician René Descartes (1596–1650). Galileo is one of the early pioneers of data visualization. He relied upon sight to gather data, such as the rings of Saturn and the moons of Jupiter. He then illustrated these collections to crystallize insight and published them for the public. His aim: debunk and dispel antiquated beliefs about how the universe worked. In his book *Starry Messenger*, he wrote, 'What was observed by us is the nature of matter of the Milky Way itself, which, with the aid of the spyglass, may be observed so well that all the disputes that for so many generations have vexed philosophers are destroyed by visible certainty, and we are liberated from wordy arguments'.[1] Yet Galileo believed that the primary qualities of matter consisted of only what could be measured and quantified, and then turned into universal principles through math. He relegated much of the sensuous world, as experienced by us, to secondary qualities that fell outside of science's concern.

Descartes, meanwhile, believed that nature could be understood as a machine or instrument, with the human as the objective inquirer. Before Galileo and Descartes, science was often practiced as a type of folk 'natural philosophy', and even many non-Indigenous societies lived with a more animist concept of the natural world—as glimpsed in the concept of Mother Nature. In western societies, the Galilean and Cartesian influence on science diverted the field from the humanities and the arts. These once overlapping fields parted ways—and even occupied different orbits—compelled by distinctive principles and practices, bodies of knowledge and values.

We might stereotype Enlightenment thinkers as adherents to science, reductive and rational; the Romantic poets, aesthetes driven

1 Galileo Galilei, 'The starry messenger', *Project Gutenberg*, l. 43 www.gutenberg.org/files/46036/46036-h/46036-h.htm.

by emotion. Yet Romantic poets such as J. W. von Goethe poured over *On the Nature of Things*, an epic, ancient Roman poem of natural science by Lucretius. The poem espouses the worldview of the ancient Greek philosopher Epicurus, who believed that swerving atoms bring life into becoming and unbecoming. At once, the Romantics were swayed by the vivid observations, ethereal ideas and beautiful words of the poem. To paraphrase Lucretius, poetry's 'honeyed cup' of figurative language could help us accept a world reigned by natural laws, not gods. Here, we're left to contemplate the bitter serendipity of randomness, not fate, and the here-and-now, with no afterlife. As a poet-scientist in this tradition of 'sweet science', Goethe could alternate between literary and lab work, conducting scientific experiments in botany and optics. In his notebooks and publications, Goethe expresses his ideas often in the form of brief descriptive sketches, illustrations, anecdotes and biographical notes that infuse the scientific method with poetry and storytelling. Mindful of diverse audiences and how his ideas would be received, he even wrote a poem that attempted to popularize his botanical method. Here is an excerpt of a poem where he details a leaf, just to see how poetry can sweeten his work in botany:

> To see, each leaf elaborates the last—
> Serrated margins, scalloped fingers, spikes
> That rested, webbed, within the nether organ—
> At length attaining preordained fulfillment.
> Oft the beholder marvels at the wealth
> Of shape and structure shown in succulent surface—
> The infinite freedom of the growing leaf.[2]

Of his scientific method, Goethe writes, 'Every object well-contemplated opens a new organ of perception in us'.[3] He called this relationship a tender, or delicate, empiricism. For Goethe, the relationship between subject and object was less about mastery, interrogation and control, and more about vulnerability, relationships and pliability. In an authentic encounter with phenomena, the subject in an investigation

2 Johann Wolfgang von Goethe, *Metamorphosis of Plants*, trans. by Gordon Miller (Cambridge: MIT Press, 2009), p. 2.

3 Arthur Zajonc, 'Every object, well contemplated, changes who you are', in *Ideas on the Nature of Science*, ed. by David Cayley (New Brunswick: Goose Lane Publications, 2009), pp. 129–148 (p. 129).

can be reshaped by the encounter itself. As Arthur Zajonc, Emeritus Professor of Physics at Amherst College, writes, 'You have to live in that world of phenomena. You have to attend carefully. "Every object well-contemplated"—not just casually contemplated, but well-contemplated, attended to over time, repeatedly—changes who you are to the point where you begin to see things that you didn't see originally, and perhaps which no one before you has seen'.[4]

Unlike Galileo, Goethe lingers on observation without trying to abstract a specific encounter with his object into a universal principle. He was sensuous in an intuitive, perceptive way of a poet, rather than sensory, in an empiricist's way.[5] Goethe contrasted this experimental method—a sequential and logical elaboration of a whole picture from the particulars—with writing. In writing, the author must filter out extraneous sequences that might become boring to a reader. In Goethe's experimental method, however, the scientist so thoroughly explores every angle, creating minute variations of an experiment with, say, light and color fringes on the edges of black-and-white shapes, so that it can be understood from many points of view. The best experiments enact a series of subtle variations upon a theme. As Craig Holdrege, cofounder of the Nature Institute in upstate New York, writes, 'We need to learn to move in the world of particulars in a way that allows us to disclose their essential characteristics'.[6] Ideally, multiple people can engage in the experiment so that the whole is engaged in the singular experience.

In this chapter, Goethe's tender empiricism provides an inspirational rather than authoritative model for working with data today. This model encompasses a mindset and methods for making information-rich projects. Together, this mindset and set of methods also promote values of sustainability, the humanities and ethical design. Goethe's scientific work is an early example of thinking with a deep ecology mindset, a movement that began in literature in the 1970s. In deep ecology work, the inquirer considers the intrinsic value of all life, regardless

4 Ibid., p. 130.

5 Henry Bortoft, *The Wholeness of Nature: Goethe's Way toward a Science of Conscious Participation in Nature* (Edinburgh: Floris Books, 2013), p. 53.

6 Craig Holdrege, *Thinking Like a Plant: A Living Science for Life* (Great Barrington: Lindisfarne Books, 2013), p. 590.

of its usefulness to human enterprise. By slowing down with tender empiricism, an awareness can grow of the inherent value of the original observation and what it can disclose about the greater story, regardless of our final purposes or projects.

Goethe also suggests methods for encountering and depicting what goes unmeasured and unquantified, and what can't be mapped and patterned. Any time we create categories, we omit other categories that could have been in the collection. With this ecological mindset, researchers may also include more open-ended data collection techniques to guard against designing in their own biases from the launch of a project. Also, data are plural, and we derive meaning in data in how each entity relates to the other. In systems thinking, these relationships create a whole that's greater than the parts, just as a flower, a living system, can't be understood only by plucking it apart. Systems—and even more complex systems, networks of relationships—can't be pictured through simple and abstract charts. But systems can be portrayed in conceptual maps and drawings that show relationships and enhance our abilities in radiant thinking. Relationships can also be written about, through essaying and providing context—activities that writers excel in.

Data visualization broadens our perspectives by showing us what isn't visible in daily experience: comparisons, patterns, trends, flows, rhythms and relationships. As we read a chart or map, we're zooming far out to see the big picture. Yet we're also abstracting and generalizing from the original phenomena. Goethe's tender empiricism, meanwhile, allow us to zoom the camera back into the particulars. While Goethe provides inspiration, his writings also provide pointers for getting back into touch with the root word of technology, the ancient Greek *techne*, which meant the inner craft of the creator. In his book *Theory U*, MIT professor Otto Scharmer writes, 'Galileo transformed science by encouraging us to use our eyes, our senses, to gather external data. Now we are asked to broaden and deepen that method by gathering a much more subtle set of data and experiences from within. To do this, we have to invent another type of telescope: not one that helps us to observe only what is far out—the moons of Jupiter—but one that enables us to observe the observer's blind spot by bending the beam

of observation back upon its source: the self that is performing the scientific activity'.[7]

Goethe's way of science supports self-reflective questions, which can guide us toward better designed projects. 'How can I see this with fresh eyes?', 'Am I rushing to judgment?', 'What might I be assuming?' and 'What am I missing?' Through visualizing, sketching, portraying and writing, we can even try and answer some of these questions.

Through concrete examples, I will discuss how this deep ecology mindset and methods, as expressed by Goethe, can apply to working with data visualization projects today—especially within the scope of sustainability research and communication. More than a rigid step-by-step process, this essay intends to describe how a shift to an ecological mindset can help yield a richer relationship to objects of inquiry, which benefits makers and readers alike.

Goethe's Way of Science

Long before ecological thinking became mainstream after the 1970s, Goethe expressed similar principles in his scientific studies. Born in 1749 to a wealthy family, Goethe grew up in bustling Frankfurt. His earliest concerns revolved around human affairs. He studied law at the University of Leipzig and then at the University of Strasburg, but his restless curiosity about literature, science and medicine proved impossible to contain. Even at this early age and steeped in city life, Goethe understood that there was no division between the human world and the natural world. Even in his poetry, the supernatural anchored itself in a natural realism. Goethe, law graduate and burgeoning man of letters, would move back to Frankfurt to practice law. He also published *The Sorrows of Young Werther*, a book about matters of the heart that would garner international acclaim. In literary circles, Goethe continued to publish works that defined the Storm and Stress movement, which countered the stately prose of the Enlightenment era.

Goethe's life would change during a journey to the Rhine in 1774, when he was working on a project that would eventually become his

7 Otto C. Scharmer, *Theory U: Leading from the Future as it Emerges* (San Francisco: Berrett-Koehler Publishers, 2016), p. 15.

masterpiece *Faust*. Here, he met the Prince of Weimar, Karl August, who would soon become the Duke of Weimar. Impressed by the affable and renowned young writer, August invited Goethe to join him in his administration of the duchy. On November 7, 1775, Goethe arrived in Weimar, not knowing that his short visit would turn into a lifetime residency. Goethe would serve as the Minister of Finance, the Minister of War and the Minister of Arts, which connected him to the university at Jena, Weimar's sister city. He would have access to the university's natural science collections: bones and plants, primarily. He also immersed himself in the ducal gardens and the local forests in the duchy. This was the happiest time of Goethe's life—by his own account, like a breath of fresh air: 'I had the joy of exchanging the stuffiness of town and study for the pure atmosphere of country, forest, and garden'.[8]

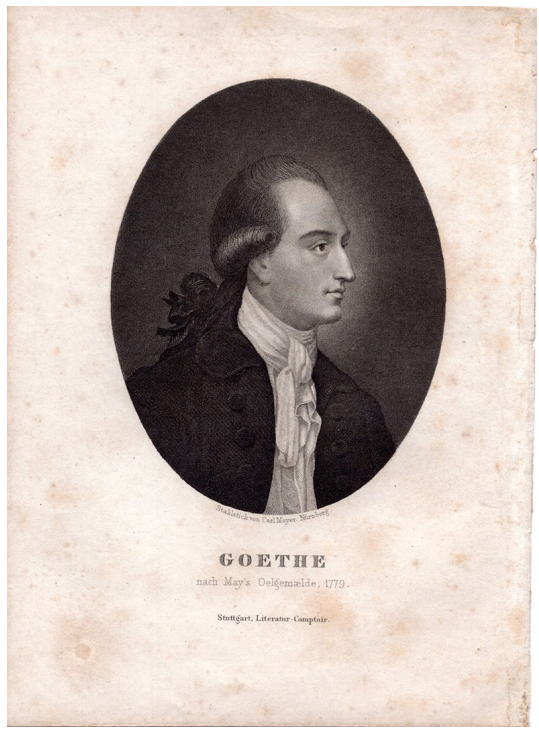

Fig. 1 Goethe in 1779. 'Zu Goethes Faust Teil 1' by ulrichzeuner, CC BY-NC-SA 2.0.

8 Ibid., p. 150.

Fig. 2 Goethe's Garden House in Weimar. '2019 Duitsland 1259 Weimar' by porochelt, CC BY-NC-ND 2.0

Goethe launched this botanical research for practical, administrative reasons. But this inquiry would soon become personal and go much deeper, into the nature of plants and our relationship to them. Here, in the garden and forest, administrative tasks led Goethe to marvel at vegetative growth. In his own words:

> Here in Weimar the forest was revealed to us in its full length and breadth [...] Conifer forests of all kinds, with their somber greenness and balsam fragrance, beech groves of more joyful appearance, the slender birch and the low, nameless underbrush, had each sought and won its place. We could survey all this in more or less well-forested regions extending for miles.[9]

In verdant forests Goethe studied roots, mosses, and flowers, and met herbalists searching for medicinal botanical ingredients. Goethe noted that his earliest studies resembled the history of botany: 'I had progressed from superficial observation to useful application, from need to knowledge'. Here, he emphasizes collecting qualitative data with the purpose of preserving the integrity of forest life:

9 Johann Wolfgang von Goethe, *Goethe's Botanical Writings*, trans. by Bertha Mueller (Woodbridge: Ox Bow Press, 1989), p. 151.

> Then when the practical utilization of trees arose for discussion, inquiries into their qualities also had to be made. The practice of tapping trees for resin, the abuse of which authorities gradually sought to restrict, led to an examination of the fine balsam juices associated with such trees from root to crown during two centuries of growth, nourishing them and keeping them eternally green, fresh, and alive.[10]

'From root to crown', Goethe sought to understand, not extract. From this experience, he created portrayals of four types of people who work with data: utilizers, fact-finders, contemplators and comprehenders. These types span the practical to the poetic, as he delineates them:

1. **The utilizers**, advocates and seekers of things practical, are the first to plow the fields of science, metaphorically speaking, and they aim at practical results. Self-confidence derived from experience gives them assurance; necessity gives them a certain breadth.
2. **Fact-finders**, those who crave knowledge for its own sake, require a calm, disinterested gaze, an inquisitive unrest, a clear mind. They are in constant contact with the first group, but work on results from the scientific point of view exclusively.
3. **The contemplators** are somewhat more original, for the mere increase of knowledge, unwittingly fosters interpretation and crosses over into it. Even the fact-finders, however much they make the sign of the crucifix at the very thought of imagination, before they realize it, they are compelled to call upon this selfsame power of assistance.
4. **The comprehenders**—in a deeper sense they might be called creators—are original in the highest sense of the term. By proceeding from ideas, they simultaneously express the unity of the whole, and it is almost the obligation of Nature to conform to the ideas.

Goethe began his research efforts as a utilizer. From the utilizers, Goethe discovered a form of research rooted in empirical observations. From the fact-finders—herbalists and botanists—Goethe encountered botanical

10 Ibid.

specimen collections and the classification system invented by Carl Linnaeus. From the contemplators, the poet-scientists such as Lucretius, Goethe learned to be at once appreciative and skeptical of mainstream science. Ultimately, he saw himself as the comprehender, the creator. In placing the comprehender in the same spectrum as utilizers and fact-finders, he may have been inspired by the ancient Roman writer Lucretius, who wrote the epic poem *On the Nature of Things*. Romantic poets such as Goethe were influenced by Lucretius and his sensuous ideas. Lucretius believed in an Epicurean philosophy that advises us not to fear death. Indivisible atoms rain down on the world. A subtle swerve could happen between atoms, creating matter and life; when these bonds coalesce, they can become an organism; when they dissipate, they die. In this way, 'Each living thing is not singular, but rather a plurality; even so far as it appears to us as an individual, nevertheless it remains an assembly'.[11]

The comprehenders can see in the parts an expression of the whole, without losing sight of the particulars. We can liken this to a potato, which is grown by planting a cut of potato in the earth. When we dig up the planted potato, we discover many other potatoes growing from the roots. Each new potato, when observed closely, is unique; at the same time, they are all expressions of one potato. Here, true theory is not abstract: it's the real-world stage on which ideas play. And here, ideas are not abstract concepts or formulas: they are insights. Visualization is a way of seeing with the mind's eye, as evidenced in the Indo-European root word for idea, *weid, to see*, which would evolve into the Greek word *oida*, to know: the root for idea.

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Goethe revered the Linnaean system, but began to question it as a sole method for relating to nature. Of Jean-Jacques Rousseau's botanical studies and similar works arranged in accord with Linnaean Classification, Goethe wrote, 'His method of narrowing down the plant world lends itself to the classification of plants according to families, as we have seen above; and since I too at that time had been led to

11 Amanda Jo Goldstein, *Sweet Science: Romantic Materialism and the New Logics of Life* (Chicago: The University of Chicago Press, 2017), p. 106.

conclusions of this kind, I was all the more forcibly impressed by his presentation [...] Nevertheless, I gradually became aware that some things on the path which he had marked out and I had taken, were holding me back, if not actually leading me astray'.[12]

Goethe, the nascent scientist, encounters Goethe, the longtime poet, and he attempts to reconcile the seeming duality. He expresses his unease with Linnaean taxonomies and hierarchical classifications, which implicitly assume dominion over nature:

> ...think of me as born poet, who, in order to do justice to his subjects, always seeks to derive his terminology directly from the subjects themselves, each time anew. Imagine that such a man is now expected to commit to memory a ready-made terminology, a certain number of words, and bywords, with which to classify any given form, and by a happy choice to give it a characteristic name. A procedure of that sort always seemed to me to result in a kind of mosaic, in which one completed block is placed next to another, creating finally a single picture from thousands of pieces; this was somewhat distasteful for me.[13]

Goethe continued to describe his discomfort with a rigid system that cuts up entities in order to understand a topic:

> I recognized the necessity of this procedure, which had as its goal the discussion of certain external plant phenomena, according to general agreement and the elimination of all phenomena that are uncertain and difficult to represent. Nevertheless, when I attempted an accurate application of terminology, I found the variability of the organs the chief difficulty. I lost the courage to drive in a stake, or to draw a boundary line, when on the selfsame plant I discovered first round, then notched, and finally almost pinnate stems, which later contracted, were simplified, turned into scales, and at last disappeared entirely.[14]

Here, Goethe has moved from emphasizing a collection of nouns—flowers, plants, and their parts—and toward a series of unfolding verbs—*contract, turn, disappear*. Note that these verbs derive from the plant's own agency, and not from the need to utilize the plant as an object. In Goethe's worldview, life exists not for a purpose but simply *to be*, integrated into an environment. Plants express themselves through

12 Goethe (1989), pp. 158–159.
13 Ibid.
14 Ibid., p. 60.

gestures and signifiers, disclosed in petals and unfurling forms—as if it were a language, a language of plants, not humans. Goethe laments the human need to understand nature to justify a theory, or even worse, so that nature can be manipulated for a purpose without first being appreciated in its own language and formative drive. Weeds, Goethe argues, are simply plants that flourish. But conceptualizing them as weeds makes them expendable to utilizers:

> Why should he not call a plant a weed, when from his point of view, it really ought not to exist?[15]

Goethe contrasts this worldview with his own botany practice, which transcends the concept of nature as an object at the mercy of humans: 'To the science of botany, the most colorful and complex flowers, the most delectable and beautiful fruits, are not more valuable—indeed, in a certain sense, are not worth as much—as a despised weed in its natural state, or a dried and seemingly worthless seed pod'.[16]

The subject-object duality, a relation of power and control, troubled Goethe, and informed his way of science as a tender empiricism. As Henri Bortoft writes in his book *The Wholeness of Nature*:

> when (Goethe) referred to his way of science as 'a delicate empiricism which makes itself utterly identical with the object,' he intended this to be taken literally. This delicate empiricism is a far cry from the assertive empiricism of Francis Bacon's experimental philosophy, which believed that, 'nature exhibits herself more clearly under the trials and vexations of art than when left to herself.' In Bacon's image of science, nature must undergo questioning and intervention with instruments by the investigating scientists, who thereby remain entirely external to the phenomena they seek to know. Here we have a prime example of the separation of humanity from nature which characterizes the modern attitude [...] this is the result of an act of will which is assertive toward nature instead of receptive.[17]

Bacon, one of the founders of modern science, promoted a concept of nature as an objectified female, where its mysteries yield themselves only through vexing trials, alluding to violence. This jarring conception

15 Ibid., p. 82.
16 Ibid.
17 Henri Bortoft, *The Wholeness of Nature: Goethe's Way toward a Science of Conscious Participation in Nature* (Edinburgh: Floris Books, 2013), p. 243.

of the objective, empirical view, we could argue, has yielded today's ecological crisis.

Goethe believes botanists can go deeper than the concepts and classifications that block true seeing. He also celebrates a poetic sensibility in structured inquiry. A weed can be as vibrant as a daisy. Poets make the familiar strange and notice what others might overlook. They seek intrinsic value in what we encounter in our experiences. We cannot get at truth by breaking it apart: once dissected, we can't reassemble the parts to create an organic, living thing. For Goethe, wholeness reigns, and by being attentive to the particulars—the individual parts of the plant in relation to the plant's environment and innate drive for growth—the wholeness and the unity of the plant can shine though.

Bortoft even argues that Goethe, the poet-scientist working with the data of experience, was not an empiricist: 'Goethe did not try to find connections between phenomena by looking at them as collections of empirical facts from which generalizations can be made through induction, in the manner [...] advocated by Bacon [...] on the other hand, he did not attempt to provide coherence in the phenomena through speculative theory, especially not one which introduced elements which are outside of experience. Goethe's aim was to stay within the experience (he was empirical) but without stopping at the sense experience of the particulars (he was not an empiricist)'.[18]

Goethe was most interested in growth, change, and our own encounter with the phenomena. He coined the term morphology, the scientific study of change. For plants, this change involved metamorphosis. Where earlier scientists studied the historical development of plants, seeking to generalize a pattern while risking losing sight of the particular, original observation, Goethe studied the development of a singular plant. He sought to understand its formative drive toward growth from seed to stem, sepals, petals, stamen, and stigma; full flowering and fruit. This process, like breathing, enacts in a series of contractions and expansions, originating from an archetypal leaf. He writes:

> We ought to have a general term with which to designate this diversely metamorphosed organ and with which to compare all manifestations of its form...we might equally well say that a stamen is a contracted petal,

18 Ibid., p. 244.

> as that a petal is a stamen in a state of expansion; or that a sepal is a contracted stem leaf approaching a certain stage of refinement, as that a stem leaf is a sepal expanded by the influx of cruder saps.[19]

For Goethe, every part of the plant and flower was a leaf transformed through contraction and expansion—as evidenced by how false petals can appear amidst the stamen in cultivar roses, or in the zinnia from a garden plot.

Fig. 3 False petal in stamen. Photograph by Sweta Pendyala, August 5, 2018.

Plants have an inherent will to grow as part of a universal pattern, a vertical thrust syncopated with a spiral; at the same time, they are shaped by the contexts of their environment. The roots shoot down into the darkness of the earth while the flower expresses the plant's manifest energies.

The morphology described here does not only refer to the object, the plant, but also to the subject: the person observing the plant. For Goethe sought to understand the phenomena by going into the sensory experience rather than away from it, as we tend to do in research that includes data analytics and visualization. 'Far from being onlookers, detached from the environment', writes Bortoft, 'or at most manipulating

19 Johann Wolfgang von Goethe, *Versuch der Metamorphose der Pflanzen zu Erklären* (n.p.: Ettinger, 1790), p. 120.

it externally, Goethean scientists are engaged with it in a way which entails their own development [...] in Goethean science, the scientist [...] has to become the instrument. This is quite a different matter from just using instruments externally, e.g., microscopes and telescopes, to augment the senses'.[20]

In contrast to the mechanical and mathematical, Goethe sought to develop senses attuned to dynamic and the concrete experience: a new organ of seeing, very much like the mind's eye. Carnegie Mellon design professor Terri Irwin outlines Goethe's process of perceiving the plant through sensuous and then super-sensuous encounter:

1. **Exact Sense Perception:** The first step on a journey through the parts to the whole of the experience. Undertake a detailed observation of the parts of the phenomenon that can only be perceived outwardly through the full range of our senses. Suspend judgment and preconceptions as you observe all aspects of the phenomenon in an open, listening mood of wonder. View it all for the first time.
2. **Exact Sensorial Imagination:** Bring your observations of the parts of the phenomenon together in your imagination to experience the unity of the generative process. What you observed as static, disconnected parts are brought inward and made fluid as a dynamic process in time. The imagination is used as a tool of perception to visualize the 'coming into being' of the organism and its journey in the future to death/decay. It is only in this way that we can come to know the absent whole of the phenomena, which is a temporal being.
3. **Encountering the Whole:** Now active perception and imagining is stilled as you assume a posture of receptive attentiveness in order to let the phenomenon reveal something of its essential nature. The dynamic gesture of the previous stage is deepened to reveal the formative gesture of the organism or its 'life principle'.

20 Bortoft (2013), p. 245.

4. **Becoming One with the Phenomenon**: After grasping the essential gesture of the organism and encountering 'the whole' in the previous step, you now go deeper into the phenomenon. The objective is to transcend the particular organism and come to recognize its archetype. Through intuitive perception *we merge* with the organism and come to recognize its archetype.[21]

In the final stage, one becomes 'utterly identical with the phenomenon' through tender empiricism. For Goethe, this represents true theory, but not in the abstract theorizing of mechanism. Rather, theory represents beholding, visualizing with the mind's eye. True theory resides in 'the mental cinema' described by writer Italo Calvino in 1984, 'always at work in all of us—and always has been, even before the invention of cinema—and it never stops projecting images to our inner sight'.[22]

Applying Goethe's Mindset for Complexity and Ecological Awareness, through Visualization and Drawing

At an October 2019 Thinking through Drawing Conference, held at the State University of New York at New Paltz, I experimented with this Goethean process for visualization. I co-created a drawing and visualization project with Denise Easton and Barb Siegel of the Plexus Institute. They lead workshops on understanding complexity for organizations such as the World Wildlife Fund. For this conference, we encouraged participants to practice visualization not as a tool for creating abstract charts that can be utilized for a purpose, but rather in the Goethean sense. This involved drawing flowers, at first as individuals, and then in small groups.

21 Terry Irwin, 'Goethean science and design: A phenomenological approach to understanding whole forms in nature & the built/designed world', www.academia.edu/18348890/Goethean_Science_and_Design_A_Phenomenological_Approach_to_Understanding_Whole_Forms_in_Nature_and_the_Built_Designed_World.

22 R. J. Andrews, *Info We Trust: How to Inspire the World with Data* (Hoboken: John Wiley & Sons, 2019), p. 42.

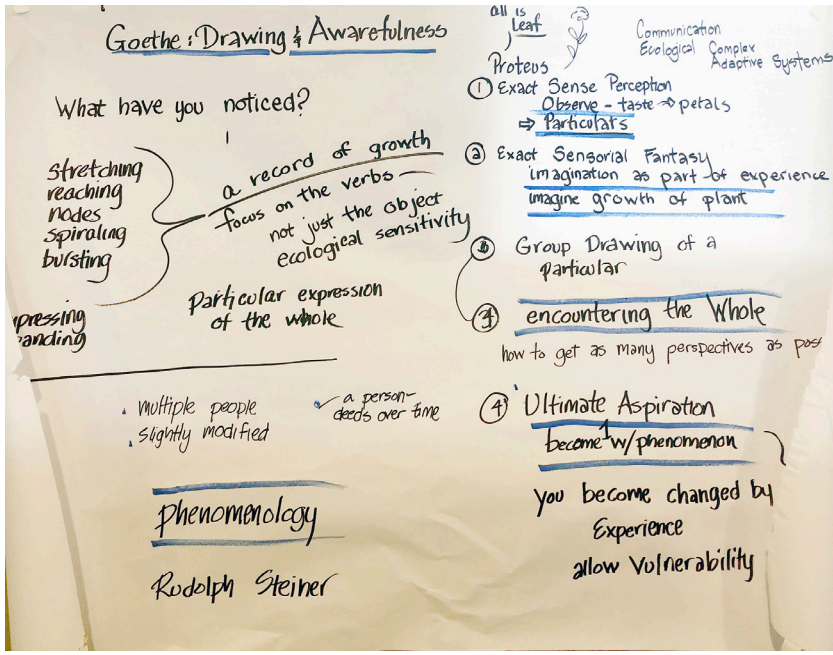


Fig. 4 Outline of workshop plan, October 6, 2019, Thinking through Drawing Conference in New Paltz, New York, by Barb Siegel of the Plexus Institute.

Participants began with Exact Sense Perception, by observing a flower placed before them using all five senses and sketching the particulars of what they saw.

Then, they practiced Exact Sensorial Fantasy (Imagination). They closed their eyes and instead of observing particulars, they imagined a process that couldn't be seen in any given moment: the growth of the plant. In people, it's difficult to see the child in the adult. Yet plants disclose the relationship between time and growth in their very form, the plant shooting upward from its stem to the crown of leaves and flowers. The earlier stages of the plant remain present even in full flower. This practice allows participants to think beyond rigid categories and nouns, and toward verbs, systems and relationships. As individuals imagined this sequence, they made further gestural sketches attempting to portray this growth.

Then, they Encountered the Whole by returning to a fresh sheet of paper to co-create a drawing of the flower that discloses its particular characteristics and portrays gestural growth.

Fig. 5 Sketch of the particulars by a workshop participant. October 6, 2019.

Fig. 6 Co-created sketch of the whole by workshop participants. Photograph by Joshua Korenblat, October 6, 2019.

Fig. 7 Details of co-created sketch. Photograph by Joshua Korenblat, October 6, 2019.

Finally, we explained how this process, when repeated, can allow the subject to attempt to Become One with the Phenomenon, in the sense that the subject's awareness has shifted to a deeper relationship with the object of inquiry. Participants shared these sketches and discussed how the earlier individual and contemplative work allowed them to co-create freely with their small groups. Participants completed a Somatic Attention worksheet, one of the Plexus Institute worksheets that help people in organizations become more bodily aware of their presence in a greater whole.

This sketching mindset can provide a complementary way of thinking and making in otherwise analytical projects. In some ways, it goes beyond systems thinking in its holistic mindset because it stays closer to the original phenomena, without transforming it into the abstractions we often see in systems diagrams and conceptual maps. Researchers working on data visualization can search for the examples

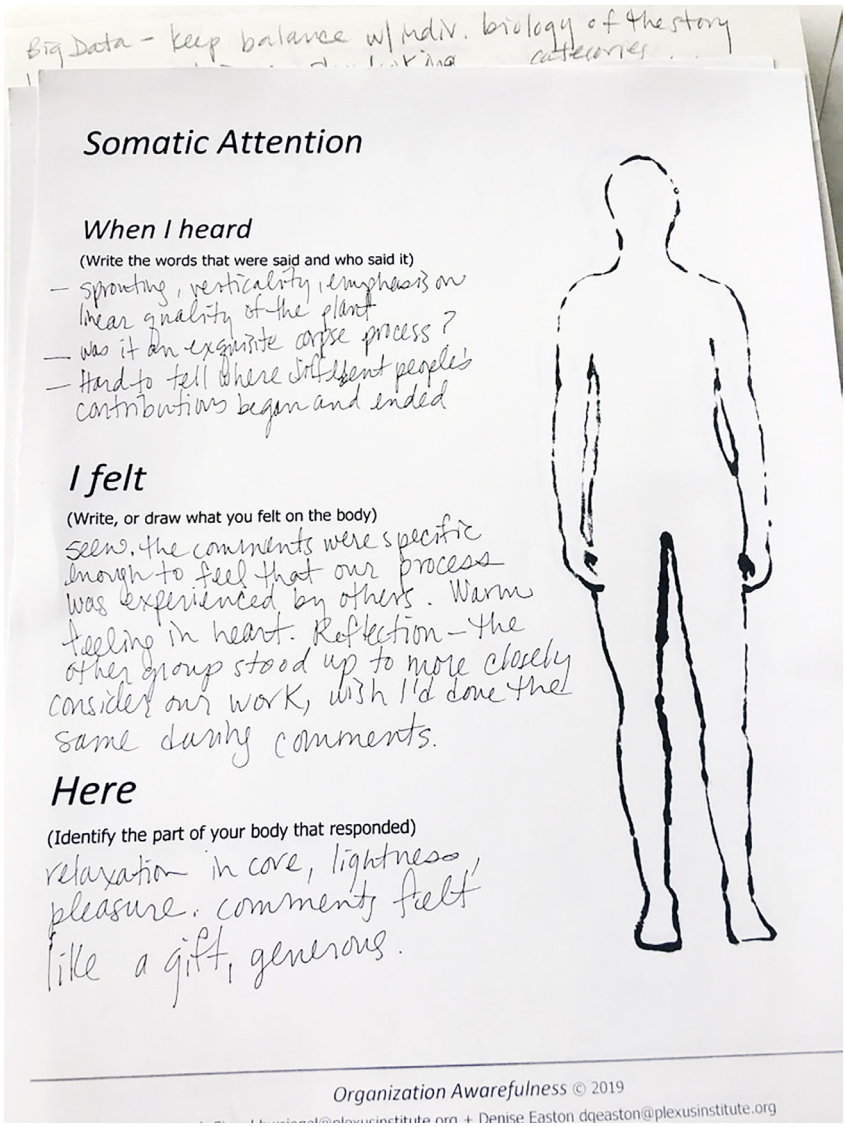


Fig. 8 Somatic Attention worksheet, by Denise Easton and Barb Siegel, Plexus Institute. Photograph by Joshua Korenblat, October 6, 2019.

of the original phenomena at the heart of their inquiry. Through writing and sketching in a notebook, they can find ways to close the distance between the subject and object of their inquiry, in all its qualities. We can hold these qualities in dialogue, with responsibility, tenderness and care, for more authentic portrayals of reality.

Goethe and Learning How to Create Data Visualizations Today

How might Goethe's way of science provide a more practical set of insights into working with quantifiable observations today? Exploratory data processes involve classification, measurable observation, analysis, and the mapping and patterning of entities. This work requires literacy in working with numbers and making charts and graphs. Yet Goethe admitted that he was 'by nature averse to counting and classification',[23] the foundations of visualization today. Goethe's methods lead us into the phenomena, to contemplation and comprehension, rather than to the explanations we utilize in everyday actions in the world. Galileo and Descartes inform data visualization in thinking, doing, and making—we make charts on Cartesian coordinates. The mechanists have their due. But what about the Romantic poet-scientist, relegated to obscure footnotes?

To answer the question of what people working with quantifiable data can learn from poets like Goethe, we can think about how a beginning student in any storytelling course might learn to gather and understand information. For a new story, the student might typically answer the Six W's—Who/What, How much/many, Where, When, How, and Why. In a data visualization course, the student can answer four of the Six W's pictorially: through bar charts, for instance, we can compare the who/what and the how much/many. With a map, geographic or conceptual, we can identify the where in the story. With line charts and timelines, we can trace the when, the sequence of events. But even with a scatterplot or multivariable plot, which measures the relationships between entities, we often can't access the how and the why. As the famous saying goes, correlation does not mean causation. Just because we might see a relationship between increased ice cream sales at the beach and shark attacks, does not mean that ice cream sales cause shark attacks, to cite one vivid example. To integrate the how and the why, the data designer must write a headline and provide guiding text so that the reader can reason through the story.

The sequential order of these questions also maps to visual perception, how we orient ourselves in any new scene through pre-attentive

23 Goethe (1989), p. 155.

processing. To situate ourselves in a setting, we only land on the how and why after rapidly processing who/what is involved, how much/many, where, and when. Yet even in the perceiving moment, we leap to conclusions in the how and the why so that we resolve ambiguity and avoid danger. This, of course, can lead to biases and misjudgments that transform reasoning into rationalization. Goethe's ideas can help us become more comfortable with delaying the how and the why in the experimental process of analyzing and visualizing data for an extensive period of time. Instead, we can devote more time to conversing with the observations themselves, taking time to reframe them to validate our reasoning.

Recall Goethe's method of picture building. As Cornell University Professor Amanda Jo Goldstein writes in her book *Sweet Science*, 'Frederick Amrine has aptly described Goethe's empiricist methodology as the controlled development of new ways of seeing as many modes of representation as possible, or better, to cultivate the mode of representation that the phenomena themselves demand'.[24] This process offers insight for anyone sketching with data in tools like Excel, Tableau, or R. When sketching with data on the computer, it's important to reframe what appears on screen by asking questions. Rutgers University professor Jane Miller recommends identifying the general picture that appears, depicted by the magnitude of comparisons and directions of change. Then, the researcher can find and describe exemplary data points, and finally, exceptions or outliers. Here, the researcher alternates between focused attention and open awareness, between letting new ideas and questions appear as a workbook fills with data sketches, in sequence on worksheets and in juxtaposition on dashboards.

For Goethe, experiments were scientific only because they involved subtle modifications and tests, from multiple angles and with attention to perception. He detested Newton's theory of light, borne out from a singular prism experiment, partially because it did not result from a process of picture building. Goethe uses the analogy of getting to know the authentic nature of a man: you can't learn much from discrete measures of intelligence, height, and weight. But see his actions in the crucible of decisions, and you can know a lot about that man. For Goethe, one arrives at truth through a biography, not a summary.

24 Goldstein (2017), p. 134.

In a conventional approach to teaching data visualization, an educator can give beginning students small, summarized sample data sets without much context, and then students work their way up to richer data sets implicated in real-world contexts. The problem with the simple to complex approach: the small sample data set lacks the 'ecological' context that Goethe's tender empiricism attends to through picture building. Goethe's approach suggests an alternate educational approach. When we learn data visualization, we can scaffold projects from the complex to the simple, rather than from the simple to the complex. Software enables students to sketch and reframe many variables almost immediately, to examine their interplay in relationship to the greater story. Students learn data visualization not from a rigid set of rules of reading, understanding, and making charts, but rather from working in complexity and multiplicity.

In a Goethean method, students begin with a more complex data set, aware of its original, situated context. I've tried this method in an introductory course I teach, Data Visualization, to students in graphic design and digital media journalism. Students work in three phases—although they don't have to be performed in rigid sequential order. I've adapted some of these ideas from Cole Nussbaumer Knaflic, and her 2019 book *Storytelling with Data: Let's Practice!*

First, the Big Idea: students interview a dataset to study an individual record and understand how many variables are present. They understand the type of data in each variable, the range of values, and the level of detail presented at the smallest scale. They detail what's missing and inquire why this information is missing. To do this, students create a data biography that provides a portrait of who collected the data and why, which leads them into contextual inquiry on the topic. They begin to articulate the purpose of their inquiry: the audience, context and message, and write their purpose in a single sentence. Then, they elaborate on that sentence through writing and storyboarding to develop a visual plan, giving and receiving feedback from their peers. They'd make a big picture sketch to capture the idea in a holistic and radiant way too.

In the next phase, Details, students gradually match the visual plan and big picture sketch to appropriate charts. To do this, students identify what they're trying to do with the chart, such as make comparisons or

show relationships. They'd select chart types that can fulfill this purpose in an accurate way. Moving onto the computer, students use software to swiftly iterate and reframe visualizations for insight, all the while reducing visual clutter and focusing reader attention on what's most important. While making these charts, students attempt to answer the 6 W's with descriptive headlines and annotations. Students understand the chart for themselves, and then attempt to relate their understanding to other people.

During the Story phase, students then structure this material into a narrative arc that's appropriate for their Big Idea. In the final phase, Crafting, students make sure that abstract charts also have pictures nearby, to remind the reader of the original phenomena and what's at stake in the story. Crafting involves attention to the visual surface of the data visualization, to make the reading experience more intuitive and to draw readers in emotionally.

Below, I've provided examples of this process from one student's work in my introductory data visualization course. These projects emphasize sustainability and human-centered deign principles as well.

Table 1 Emma Noyes: Data interview from Viz for Social Good: United Nations in Papua New Guinea, April 2020.

Interviewing the data	
Questions	Answers
1. Granularity (What does a single record mean?)	One individual's answer to one question
2. Rows (How many total records?)	186821
3. Columns (How many different variables?)	7
4. Types (are variables nominal, ordinal, interval, or ratio?)	Age: Ratio Answer: Nominal District: Nominal Gender: Nominal ID: Interval Province: Nominal Question: Nominal

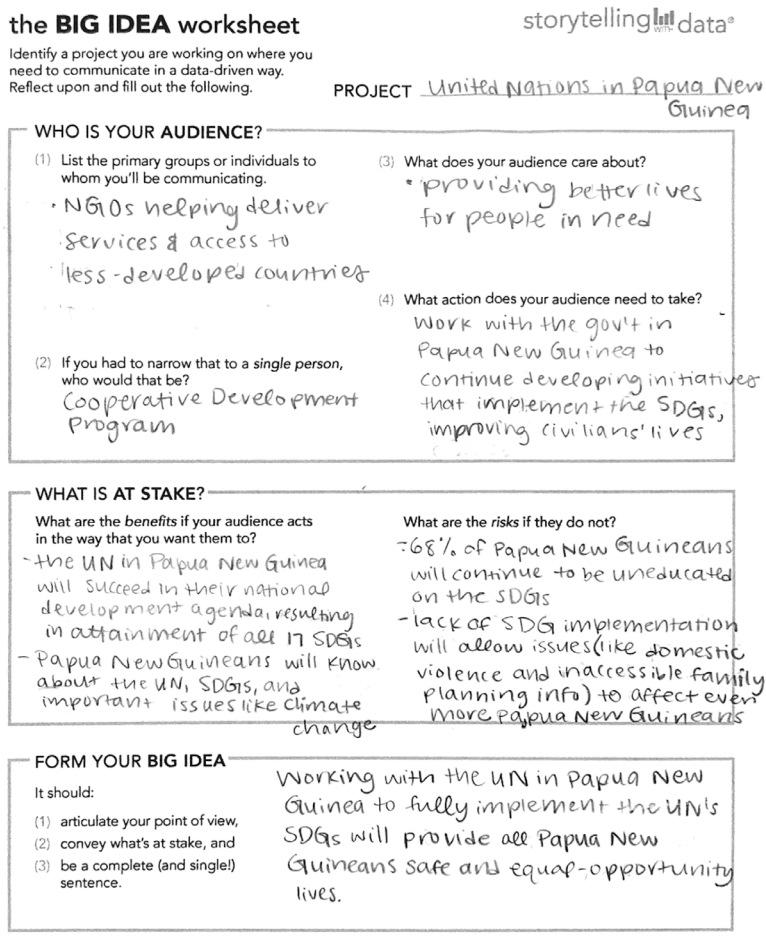
Interviewing the data	
Questions	Answers
5. Unique Key (Is one of the variables unique?)	No
6. Boundaries (min & max of quantitative variables)	Age: min 0 1 max 79927561 (l am still trying to figure out why this is…) ID: min 1 1 max 7817
8. Levels (What are the values of the quantitative variables?)	Age ID: Numbered from 1 onward for each response to a particular question. Ex: 1—93 for " Do you know about the Sustainable Development Goals in Bougainville province; 94–167 for the same question asked in Central province
9. Hierarchies (Do some levels form hierarchies?)	Hierarchy between Province and District
10. Nulls (Are there any missing values? Why?)	There are missing answers to many questions. I think this is because certain questions do not apply to some people (for a question like "Where were your children immunised?" some do not have children), and/or because people just did not provide an answer.

Table 2 Emma Noyes: Data biography from Viz for Social Good: United Nations in Papua New Guinea, April 2020.

Data Biography	
Questions	Answers
Dataset Name	United Nations in Papua New Guinea
Goals	"The UN System in Papua New Guinea has worked extensively with the Government to localize the SDGs and integrate them into the national development framework. The goal is to visualize data sets related the SDGs indicators gathered from over 8,000 SMS survey participants across 22 provinces in Papua New Guinea."
How was the data collected	Data was collected "by using an innovative SMS platform." I was unfortunately unable to find more information about this on the UN Papua New Guinea website.

Data Biography	
Questions	Answers
Link to data source	https://docs.google.com/spreadsheets/d/17YZMzzrs0VqmHYjuMaUzkdAosoHB3sQotubm-Yh4PyO/edit#gid=693674619
Link to storage source	https://www.vizforsocialgood.com/join-a-project/2017/11/10/united-nations-in-papua-new-guinea
Notes on data quality	The dataset is organized quite well for data viz use… but I think that was intentionally done by someone at VFSG
Sample Size	8,000 people
Topic	Data is collected on 35 areas of SDGs related indicators as well as the overall perception on the SDGs. Each data contains information on the survey answer, province, gender, and age. *All quotes from VFSG project page: https://www.vizforsocialgood.com/join-a-project/2017/11/10/united-nations-in-papua-new-guinea
Variables	Age Answer District Gender ID Province Question
When was the data collected	Not entirely clear but sometime before November I O, 2017, when the VFSG project was started.
When was the data last updated	Not entirely clear but sometime before November I O, 2017, when the VFSG project was started.
Who collected the data	"The UN Communication Group, made up of UN Communication Specialists in Papua New Guinea"
Who owns the data	The United Nations

Data Biography	
Questions	Answers
Who was included/ excluded fr..	Because data was "gathered from over 8,000 SMS survey participants," I would assume that whoever chose to not participate is excluded.
Why was the data collected	"With 85 percent of the country's population living in rural areas with underdeveloped infrastructure, and approximately 30 percent of the population not accessing any form of media, such inaccessibility to people also limits data availability, particularly disaggregated data. As identification of the most disadvantaged is key to implementing the SDGs, the UN Communication Group, made up of UN Communication Specialists in Papua New Guinea, has undertaken a project to collect disaggregated data by using.



the BIG IDEA worksheet

storytelling with data

Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and fill out the following.

PROJECT United Nations in Papua New Guinea

WHO IS YOUR AUDIENCE?

(1) List the primary groups or individuals to whom you'll be communicating.
- NGOs helping deliver services & access to less-developed countries

(2) If you had to narrow that to a *single person*, who would that be?
Cooperative Development Program

(3) What does your audience care about?
- providing better lives for people in need

(4) What action does your audience need to take?
Work with the gov't in Papua New Guinea to continue developing initiatives that implement the SDGs, improving civilians' lives

WHAT IS AT STAKE?

What are the *benefits* if your audience acts in the way that you want them to?
- the UN in Papua New Guinea will succeed in their national development agenda, resulting in attainment of all 17 SDGs
- Papua New Guineans will know about the UN, SDGs, and important issues like climate change

What are the *risks* if they do not?
- 68% of Papua New Guineans will continue to be uneducated on the SDGs
- lack of SDG implementation will allow issues (like domestic violence and inaccessible family planning info) to affect even more Papua New Guineans

FORM YOUR BIG IDEA

It should:
(1) articulate your point of view,
(2) convey what's at stake, and
(3) be a complete (and single!) sentence.

Working with the UN in Papua New Guinea to fully implement the UN's SDGs will provide all Papua New Guineans safe and equal-opportunity lives.

Fig. 9a Emma Noyes: Working process examples from Viz for Social Good: United Nations in Papua New Guinea, April 2020 [Worksheet].

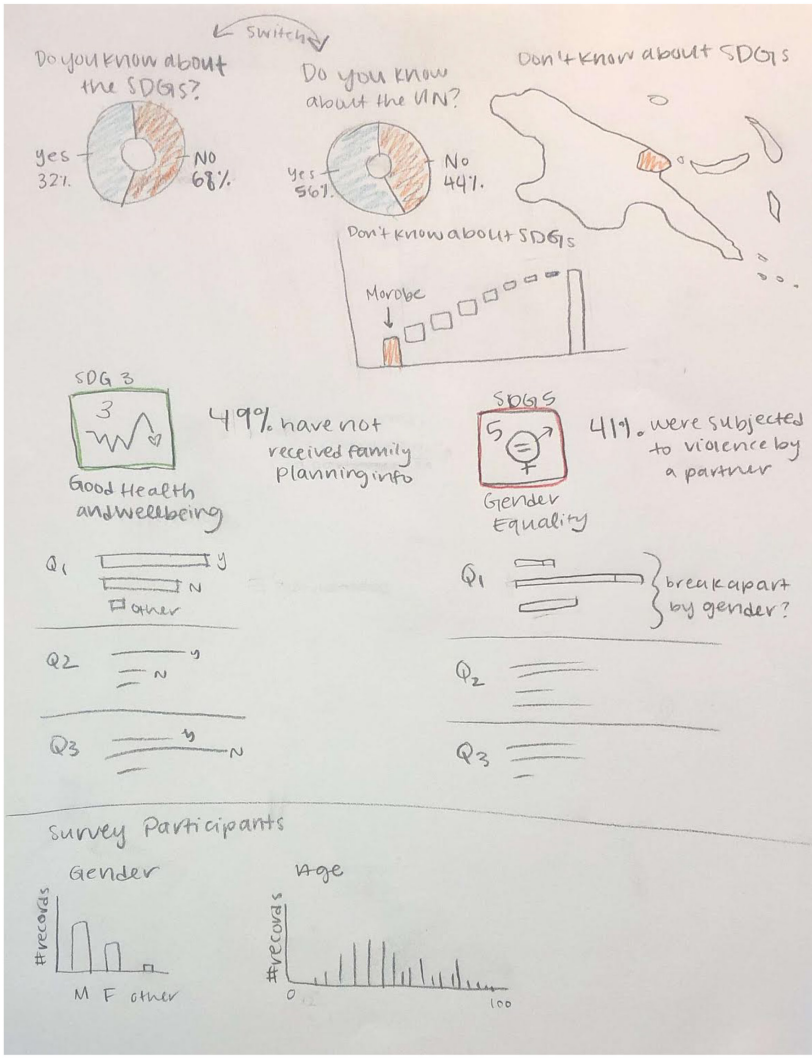


Fig. 9b Emma Noyes: Working process examples from Viz for Social Good: United Nations in Papua New Guinea, April 2020 [Sketch].

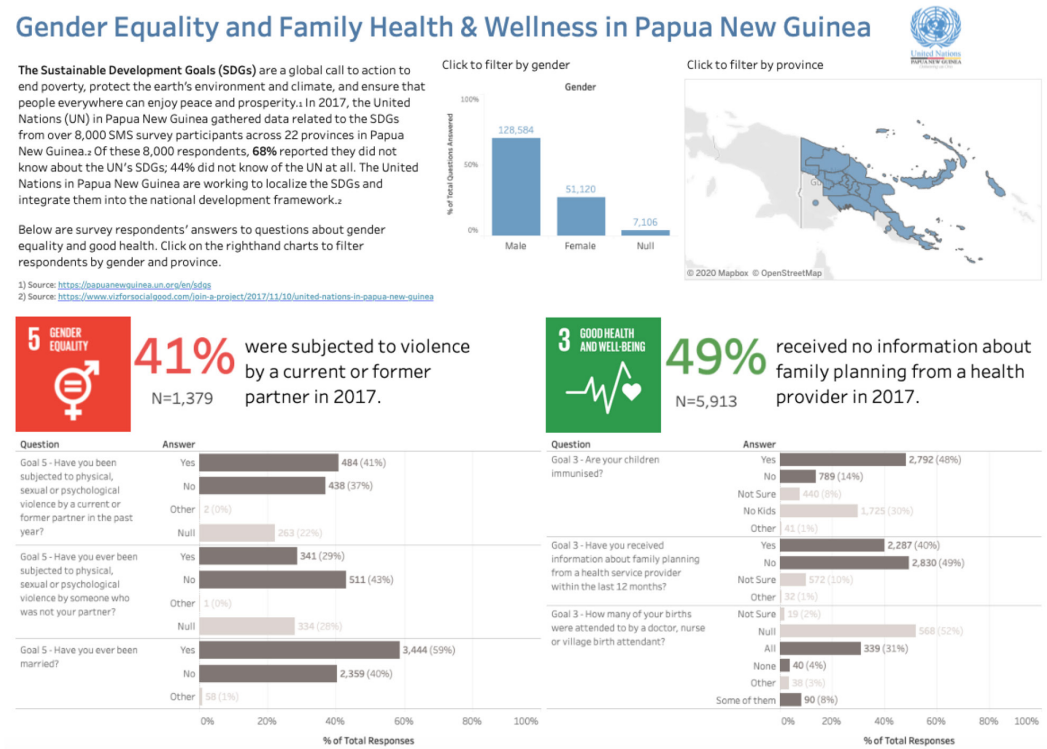
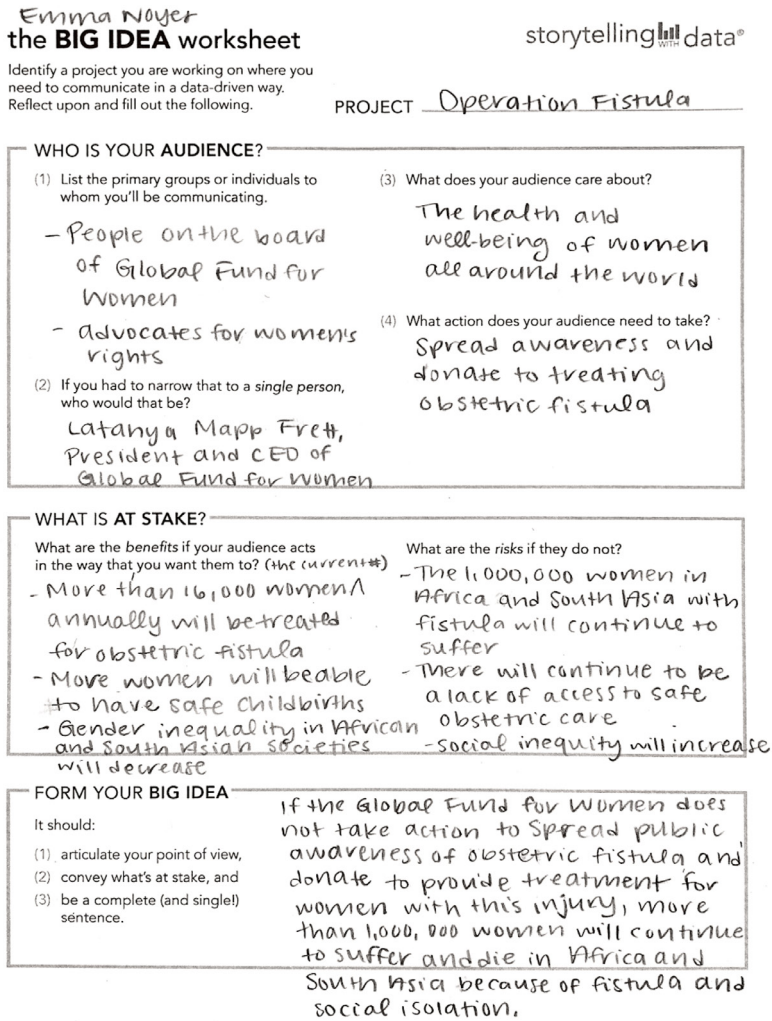


Fig. 9c Emma Noyes: Working process examples from Viz for Social Good: United Nations in Papua New Guinea, April 2020 [Final project].



Emma Noyes

the **BIG IDEA** worksheet

storytelling with data

Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and fill out the following.

PROJECT Operation Fistula

WHO IS YOUR **AUDIENCE**?

(1) List the primary groups or individuals to whom you'll be communicating.

- People on the board of Global Fund for Women
- advocates for women's rights

(2) If you had to narrow that to a *single person*, who would that be?

Latanya Mapp Frett, President and CEO of Global Fund for Women

(3) What does your audience care about?

The health and well-being of women all around the world

(4) What action does your audience need to take?

Spread awareness and donate to treating obstetric fistula

WHAT IS **AT STAKE**?

What are the *benefits* if your audience acts in the way that you want them to? (the current ##)

- More than 16,000 women annually will be treated for obstetric fistula
- More women will be able to have safe childbirths
- Gender inequality in African and South Asian societies will decrease

What are the *risks* if they do not?

- The 1,000,000 women in Africa and South Asia with fistula will continue to suffer
- There will continue to be a lack of access to safe obstetric care
- social inequity will increase

FORM YOUR **BIG IDEA**

It should:

(1) articulate your point of view,
(2) convey what's at stake, and
(3) be a complete (and single!) sentence.

If the Global Fund for Women does not take action to spread public awareness of obstetric fistula and donate to provide treatment for women with this injury, more than 1,000,000 women will continue to suffer and die in Africa and South Asia because of fistula and social isolation.

Fig. 10a Emma Noyes: Working process examples from Operation Fistula, May 2020 [Worksheet].

Fig. 10b Emma Noyes: Working process examples from Operation Fistula, May 2020 [Idea board].

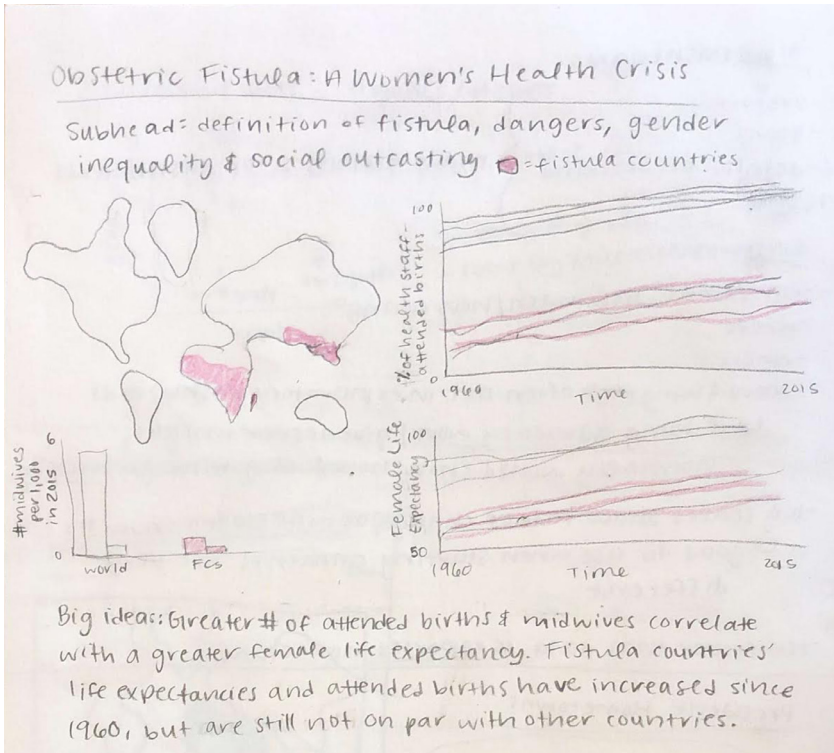


Fig 10c Emma Noyes: Working process examples from Operation Fistula, May 2020 [Sketch].

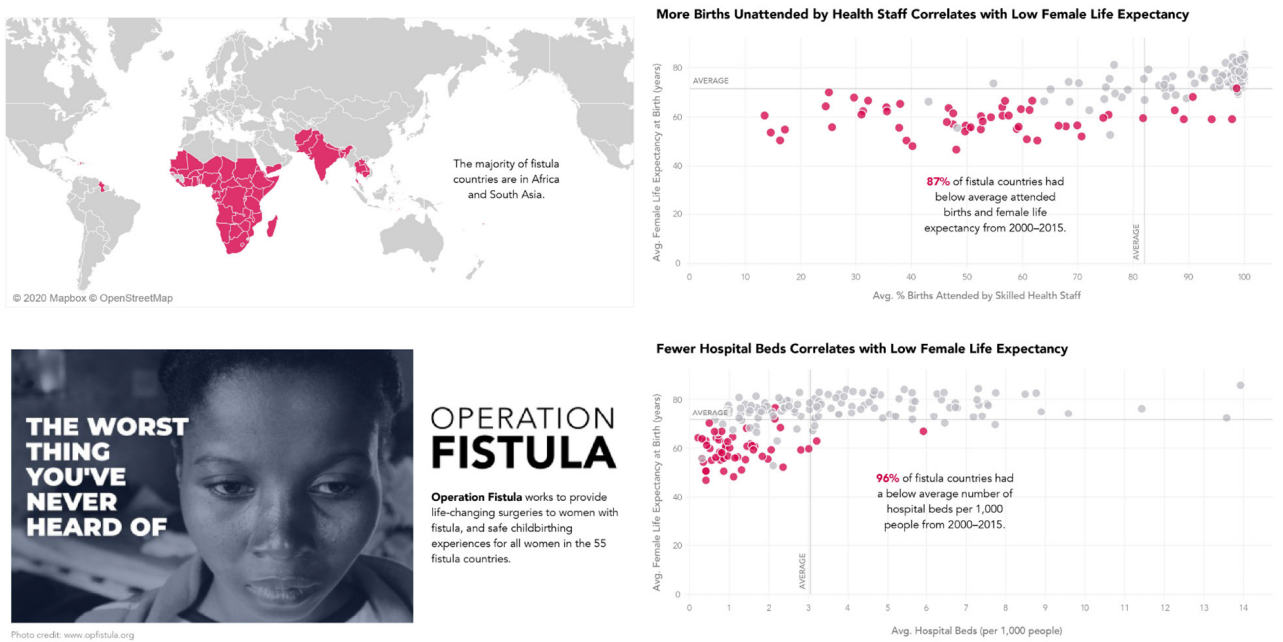


Fig 10d Emma Noyes: Working process examples from Operation Fistula, May 2020 [Final project].

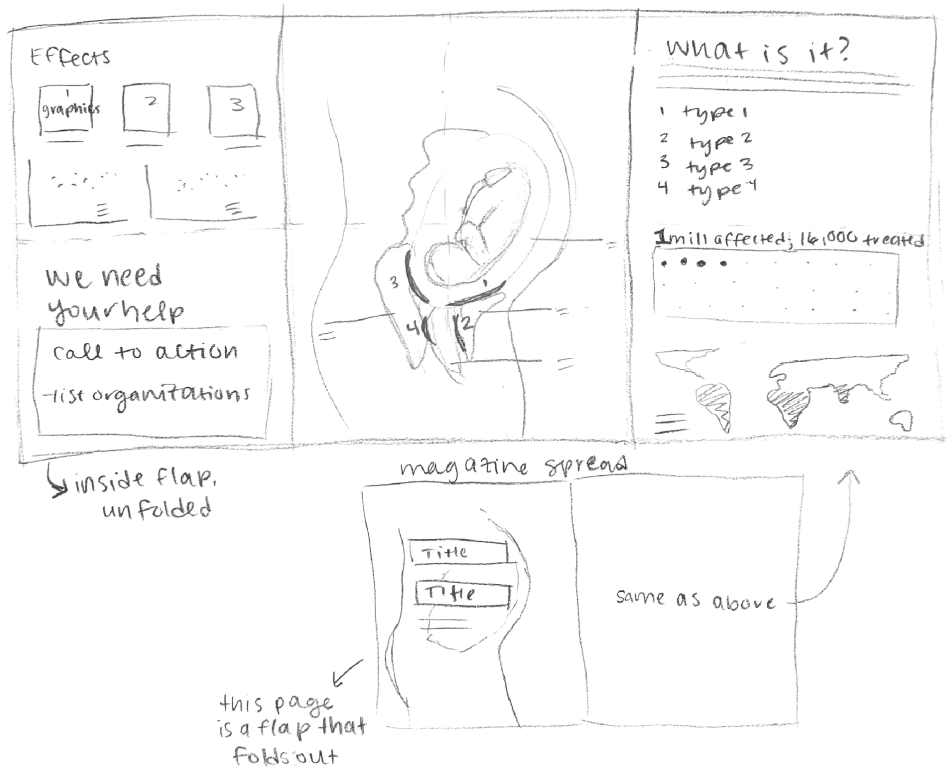


Fig. 10e Emma Noyes: Working process examples from Operation Fistula, May 2020 [Final sketch]. The final sketch shows the plan to introduce more pictorial imagery in the final crafted project, so that abstractions do not become barriers to what is happening in lived reality.

Nina Guido, a Data Visualization student, shows the benefits of attending to all four phases—Big Idea, Details, Story and Crafting—in her makeover of the Bee Informed Partnership dashboard, which tracks honeybee colony loss in the United States.

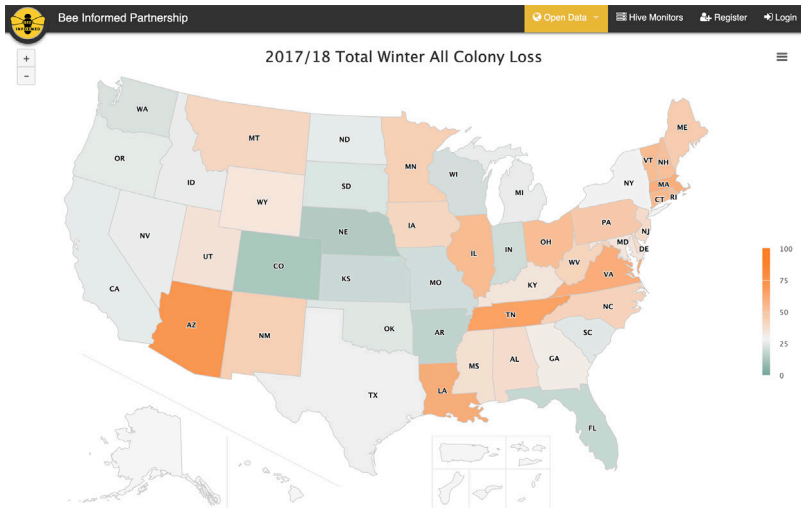


Fig. 11 Nina Guido: Bee Informed Partnership dashboard, before the makeover, April 2019.

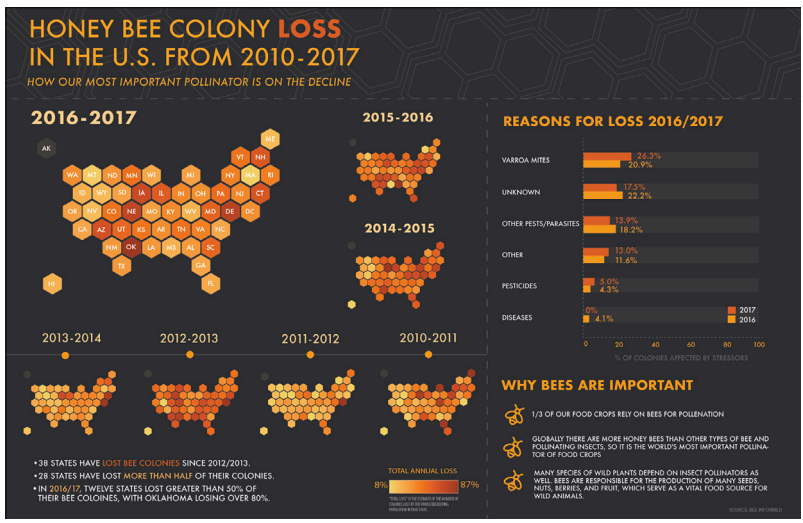


Fig. 12 Nina Guido theguardian.com/books/2016/oct/28/amitav-ghosh-where-is-the-fiction-about-climate-change-: Bee Informed Partnership dashboard makeover, April 2019.

Summary: Remaining in Touch with the Phenomena While Visualizing Data

Goethe teaches patience with his practice of careful picture building, and in this patience, we cultivate analysis by examining the particulars of a phenomenon, synthesis by scaling out to the whole, and most neglected of all, seeing with the mind's eye. In his introduction to his *Theory of Colour*, Goethe writes, 'The desire for knowledge is first stimulated in us when remarkable phenomena attract our attention. In order that this attention be continued, it is necessary that we should feel some interest in exercising it, and thus by degrees we become better acquainted with the object of our curiosity'. He continues to describe the working process of understanding phenomena:

> During this process of observation we remake at first only a vast variety which presses indiscriminately on our view; we are forced to separate, to distinguish, and again to combine [...] to accomplish this [...] requires an unremitting and close application; and we find for this reason, the men prefer substituting a general theoretical view, or some system of explanation, for the facts themselves, instead of taking the trouble to make themselves first acquainted with cases in detail and then constructing the whole.[25]

A contemporary reviewer of Goethe's way of science listed techniques that appear in the poet-scientist's notetaking and writing. Here, I apply Goethe's techniques to working with data today, mindful of not muting the original phenomena.[26]

1. Essay

To essay means to sift through an idea. Like a filter, this allows a reader to focus on a particular observation and appreciate it in its own right. This can be an exemplary observation from the dataset or an exceptional one. To get back to original, individual things, consider writing brief essays about your data observations. For instance, working with the original Titanic passenger manifest (a popular sample dataset that unlike other

25 Johann Wolfgang von Goethe, *Theory of Colours: Translated from the German*, trans. by Charles Lock Eastlake (Cambridge: MIT Press, 1970), p. 11.

26 Goethe (1989), p. 222.

sample sets, comes with a lot of context), a researcher can look up a family in the record and attend to them through some writing that creates a living portrait. For example, who were the Goodwin family, who appeared on the passenger manifest? By conducting some research, we can give a face to the data, a story, and remind ourselves what is at stake in the dataset.

This is also the Nature Institute's approach in essays such as *The Flexible Giant: Seeing the Elephant Whole*. Characteristics of the elephant are described in an essay format, constantly relating the particulars—the trunk, the head and so on—to not only the whole elephant, but also its existence in an environment, which is no less a part of the elephant. By essaying and sketching our observations, we begin to go beyond object thinking and see the observation in its own interest. The elephant, or even the most minute observation, can become a 'small world', as Goethe puts it.

2. Organize

Some new tools, such as Palladio, by Stanford University, and the commercial app Airtable, allow researchers to see their data collections in multiple views, such as in spreadsheets or on cards. Images and links can be added to the cards, creating a rich exploratory environment unmoored from the constraints of the spreadsheet. By creating pictorial sets that can be rapidly rearranged, we discover new insights in the relationships between observations. Perhaps this is why Goethe wished he could write less and draw more.

3. Combine with Biographical Material

The researcher can acknowledge their own worldview and also the biography of whomever collected the data. By becoming mindful of the biographies involved in the data collection process, the researcher can become more aware of what biases might exist in the collection. For example, in Hans Rosling's popular Gapminder visualizations, he measures relationships between health and wealth of countries around the world over the past two hundred years. Based on his variable selections, he paints a justifiably optimistic trend. But what if he were to

measure an index of happiness instead on one of the axis lines? Would new shapes and inferred stories emerge? The kingdom of Bhutan, for example, measures the happiness of its people, and not just their productivity—but it is not a common question to ask in the capitalist countries. What do we miss when we make assumptions about how the world works? The same holds true for the data analyst and designer. Consider writing in the first-person voice to acknowledge that designing with data is not an objective experience.

4. Deductions and Inductions

Goethe was skeptical of both of these methods—they either lead to hypothetical proofs or toward abstractions. Yet he did rely upon deduction and induction, which involve moving from the big picture to the details and back again. To do this, consider keeping a notebook or sketchbook next to the computer. Pen and paper excel in big-picture thinking, which eventually will lead to the details; the computer excels at working with the details and building them up into a whole, the big picture. This dialectic helps the final visualization product become more human and relatable.

5. Poetic Infusion

Recall that poets can make bitter ideas sweeter to imbibe, a tradition that harkens back to Lucretius and that Goethe continued. Poetry also helps readers attend to even a humble weed with wonder. The goal of poetry: Transcend the conceptual barriers we place between ourselves and the phenomena-filled world.

6. Accessible Examples: Appropriate for Beginners

Goethe's writing is much more accessible than many of the academic writers who write about Goethe. His literary sensibilities even allow for metaphor in writing about scientific ideas, which might seem anathema to objective, empirical descriptions. Indeed, metaphors accentuate what two entities have in common, while the metaphor risks losing sight of how the entities differ. Yet metaphors remain a primary way we reason with the world. They help us understand the unfamiliar through

familiar terms. How might we use metaphor in explaining topics, or make charts that also resemble the topic to make it more memorable, and harken back to pictorial rather than abstract experiences? For example, in Nina Guido's geographic maps of honeybee colony loss, she chose a honeycomb shape for each state and honeyed colors, enriching our abstract reasoning with what's at stake in the real world.

7. Share Ideas, Cooperate, Criticize, Oppose as Needed

One theory in entrepreneurship states that five people, well suited for each other, can accomplish just about anything. Several people focused on one subject can produce the most outstanding results, as Goethe understood and championed.

8. Make your Projects Remixable

Goethe documented his poet-scientist process and elaborated upon it in great detail. Through his experiments, illustrated writing and poems, he advocated for the spiritual, philosophical and practical benefits of his way of working and tried to popularize it. Craig Holdrege reflects on the Goethean approach, which begins in experiments—a conversation between the subject and the object so that the particulars of an experience are not harmed. Here, the subject is vulnerable to the object of inquiry: the object, the manifold experience we try to understand, can only be more fully grasped when one becomes humble enough to admit multiple subjects into the inquiry:

> In this work you make your own observations, but you also interact with and utilize the work of others [...] Here is where a research community evolves [...] As Goethe writes, 'What applies in so many other human enterprises is also true here (in science): the interest of many focused on a simple point can produce excellent results. [...] I have always found working together with others so advantageous that I have every reason to continue doing so'.[27]

From these multiple points of view, a rich and salient portrait can be created, the biography of an idea. This idea—radical collaboration—is

27 Craig Holdrege, 'Doing Goethean science', *Janus Head*, 8.1 (2005), 27–52 (p. 48).

often touted in systems thinking and design thinking. The most wicked problems yielded in sustainability research require the integrative perspectives of scientists, humanists, and designers. To make your data visualization projects more vivid, shareable, and credible, consider posting them to open platforms so that communities can examine and remix them with the source data. In mindset and method, this type of convivial, co-creative work corresponds with the broadened perspectives that data visualization affords.

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9. Solidarity Seeds

Situated Knowledges in Bishan Village, Wang Chau Village and Aarey Forest

Michael Leung

Between 2015 and 2018, artist-researcher Michael Leung visited three sites—in China, Hong Kong and India—each facing destruction as the result of land development. Leung worked with local farmers and activists on creative projects, with the goal of increasing the visibility of these local land struggles as well as strengthening transnational solidarity. In this chapter, Michael Leung revisits the 'three seed projects', as documented in artefacts and photographs, in order to explore what it means to use situated knowledge to enrich existing narratives. He posits a rhizomatic approach to research-creation as embedded within social practice, in which the making of objects—seed packets, critical maps, fictional stories, photographs, zines and other actors—is a generative act, the objects themselves becoming 'seeds' that nurture, grow and exchange local knowledge.

https://doi.org/10.11647/OBP.0213.09

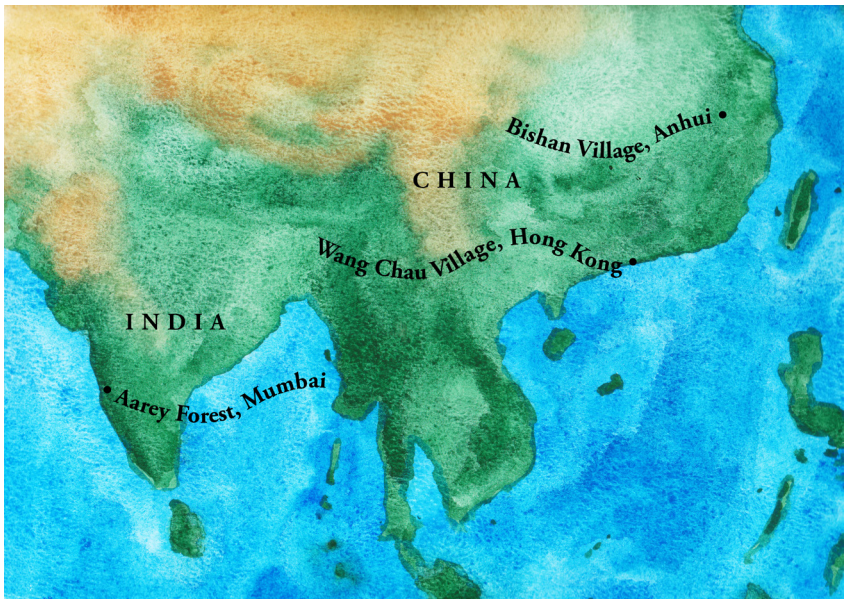

Fig. 1 Hand-painted map showing three places. Illustration by Michael Leung (2019). 29.7 x 21 cm.

> Situated knowledges require that the object of knowledge be pictured as an actor and agent, not a screen or a ground or a resource, never finally as slave to the master that closes off the dialectic in his unique agency and authorship of 'objective' knowledge [...] Actors come in many and wonderful forms. Accounts of a 'real' world do not, then, depend on a logic of 'discovery', but on a power-charged social relation of 'conversation'.
>
> — Donna Haraway[1]

Introduction

In 2015, I visited Bishan Village in Anhui (China) to learn from a rural commune and its members. During my visit, artist-researcher Elaine W. Ho, anthropologist and commune member Zhao Kunfang and I started a project that involved sharing organic seed varieties with farmers in the village. At the time, this gesture and its accompanying map was intended to be a small but fruitful interaction. However, in February

1 Donna J. Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991), p. 198.

2016 the map became a politically-sensitive document showing a history that the Chinese government decided to erase.

Two additional seed projects followed: one in 2017 in Hong Kong's Wang Chau Village, a community that had been designated for redevelopment and eviction; and the other in 2018 in Mumbai's Aarey forest, which is in the process of being cut down to build the city's third metro line.

In this text I revisit the three seed projects, as documented in artefacts and photographs, in order to explore the following questions: What happened individually and collectively during each seed project? How can a theoretical base inform a research-creation methodology? What are 'Solidarity Seeds' and what role do they play as part of the commons and on a transnational level?

These three case studies highlight the land struggles of local farmers and activists against neoliberal development plans that put profit over people as well as underscore the need to build towards a transnational solidarity. In reflecting on these seed projects several years later, I demonstrate how *situated knowledges* can enrich the existing narratives

Fig. 2 Village entrance 20 minutes before an eviction, Ma Shi Po Village, Hong Kong, May 2016. Photograph by Wen.

through the creation of artefacts such as: seed packets, critical maps, fictional stories, photographs, zines and other *actors*. The result is a rhizomatic approach to research-creation as embedded within a social practice that is generative and part of the commons (free and accessible to all).

Anthropologist Anna Lowenhaupt Tsing teaches us that, '[...] only an appreciation of current precarity as an earthwide condition allows us to notice this—the situation of our world'.[2] The following chapter likewise situates 'seeds' in Bishan Village, Wang Chau Village and Aarey Forest *as an actor and agent* that shares stories and farming knowledge and increases the visibility of the local land struggles led by these three different communities.

Methodology

Fig. 3 Mango King pointing at the papaya trees that are fruiting, Hong Kong, July 2014. Photograph by Michael Leung.

2 Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton: Princeton University Press, 2015), p. 4.

> A revolution isn't the act of physically 'changing' something. But rather, to come upon a realization through a shift in one's own perception, that a revolution has already been happening. This is a type of methodology; not so much about 'changing', but about 'expanding'. It is the skill of realizing that there are countless numbers of ways to 'live'.
>
> — 坂口 恭平 Kyohei Sakaguchi[3]

I have a background as an industrial designer, designing mobile devices for a global brand for three years in London, which is also my place of birth and where I lived for twenty-six years. Learning from global design consultancies, I applied my design research methodology and completed a Masters of Design programme in Hong Kong in 2010. After graduating I focused on urban farming, and with friends farmed on four terrace/rooftops using rich organic topsoil collected from agricultural land that was acquired by property developers, for speculation.

My social practice was catalysed by an Art/Activist in Residence programme at a community art space called Woofer Ten (活化廳) in 2013.[4] I was invited by the art space to work on a project in the neighbourhood of Yau Ma Tei for three months, and do a public sharing to conclude the residency. Knowing that I was passionate about guerrilla gardening, friends from a nearby vegetarian cooperative cafe called So Boring informed me that there was a street dweller growing food in public space in-between two busy highways.[5] This was where I met a man who called himself 'Mango King'. A short residency programme bloomed into a three-year collaboration, where Mango King and I planted over thirty edible plants and fruit trees together and composted local food waste collected from a community space nearby called Kai Fong Pai Dong (街坊排檔, English for 'neighbourhood market stall').[6]

Sharing our (HK Farm group) whole seed box with Mango King gave me the opportunity to learn from his radical permaculture

3 Kyohei Sakaguchi, *Build Your Own Independent Nation* (Tokyo: Doyosha, 2016), p. 17.

4 Alice Ko, et al., *Wooferten's Art/Activist in Residence 2013–2015,* 活化廳藝術行動者駐場計劃 *2013–2015*, ed. by Lee Chun Fung (Kaifong Meeting: Wooferten, 2016), www.issuu.com/leechunfung/docs/aair2-1-53.

5 'So Boring', *Facebook*, www.facebook.com/wearesoboring.

6 'Community farming project, Mango King', *Facebook*, https://www.facebook.com/pg/communityfarmingproject/photos/?tab=album&album_id=539877076141587, 'Kai Fong Pai Dong, community farming project', *Tumblr*, https://paidong.tumblr.com/search/communityfarmingproject.

practice—techniques such as his 'Beaver Water Collection' that blocks/releases government-installed stormwater drains and his 'Volcano Planting' method that keeps the roots of papaya trees well-hydrated. Reflecting now on this period between 2013 to 2016 (before a rigorous research methodology was in place), it seems that action research, semi-structured interviews, spreadsheet diaries, photographs, object analysis, collaborative work with other communities such as So Boring and Yau Ma Tei Gardener,[7] knowledge co-production and mutual aid evolved into a mixed methodology that resembles the 'patchwork ethnography' mentioned in Tsing's book *Friction: An Ethnography of Global Connection*:

> The interviews also confirmed the practical usefulness of the kind of patchwork ethnographic fieldwork I had been doing on these issues [deforestation in the Meratus Mountains of South Kalimantan, Indonesia]. On the one hand, I was unwilling to give up the ethnographic method, with its focus on the ethnographer's surprises rather than on a pre-formulated research plan. On the other hand, it is impossible to gain a full ethnographic appreciation of every social group that forms a connection in a global chain.[8]

My urban beekeeping and farming experience naturally encourages a hands-on and immersive approach. My fluency in Cantonese (spoken in Hong Kong) and Chinese illiteracy moreover puts great importance on the encounter and being present, in situations such as hiking mountains early in the morning to collect wild beehives and organizing with farming communities. W. Lawrence Neuman defines participatory action research as, 'a subtype of action research, emphasizes democratizing the knowledge-creation process, revealing injustices, highlighting social inequality and conflict, and engaging in collective action to improve conditions'.[9] In the past few years, I have learnt that such an approach to research can be objective, transformative and emancipatory. At that point, boundaries between the individual and collective, local and transnational, become blurred, giving form to new artefacts and evolving a local citizen/activist humanities that may have never existed before.[10]

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7 'Yau Ma Tei Gardener', www.ymtgardener.wordpress.com.

8 Anna Lowenhaupt Tsing, preface to *Friction: An Ethnography of Global Connection* (Princeton: Princeton University Press, 2005), p. x.

9 W. Lawrence Neuman, *Social Research Methods: Qualitative and Quantitative Approaches* (Boston: Pearson, 2011), p. 30.

10 Michael Leung, *Solidarity Street* (Hong Kong: Black Book Press, 2017).

In their discussion of practice-based research, Linda Candy and Ernest Edmonds describe the methodology as 'an original investigation undertaken in order to gain new knowledge, partly by means of practice and the outcomes of that practice'.[11] Both practice-based research and citizen/activist humanities informed my approach to the three seeds projects and inspired me to think about the publicness of research practices and about methods of disseminating artefacts in new ways. In particular, how might we explore other means, apart from the world wide web, of sharing knowledge and making it more freely and easily accessible?

First Seed: Bishan Village

Fig. 4 Village houses, Bishan Village, August 2015. Photograph by Zhao Kunfang.

The Bishan Project was part of a larger move towards the Chinese countryside, a move that was initiated through New Rural Reconstruction Projects during the course of the 1990s, and that has intensified since the mid-2000s with the involvement of urban artists. These urban artists

11 Linda Candy and Ernest Edmonds, 'Practice-based research in the creative arts: Foundations and futures from the front line', *Leonard*, 51.1 (2018), 63–69 (p. 63), https://doi.org/10.1162/leon_a_01471.

> created their own versions of the rural reconstruction project, in which rural art festivals have been a predominant model. The vantage point for the projects are, however, often small-scale units such as a commune, a farm or a youth house, and they focus on exchanges, engagement and conversations.
>
> — Mai Corlin[12]

I first met curator and writer Ou Ning (欧宁) in an elevator after his sharing of the rural utopian Bishan Commune Project (founded 2011) as part of After Occupy: Art, Gentrification and Civil War, a two-day workshop on the art and culture industry and gentrification at Asia Art Archive in January 2014, Hong Kong.[13] He kindly invited me to visit Bishan Village in Anhui, a province in east China. During an art and farming residency at Spring Workshop, a non-profit art space in Hong Kong, artist-researcher Elaine W. Ho and I visited Bishan Village (referred from here as Bishan) for ten days in May 2015.[14]

I arrived in the afternoon to see an opening ceremony with firecrackers taking place outside the School of Tillers (理農館)—an open space in a skywell garden, a shop selling some villagers produce, a small cafe area, an event/exhibition space and a library on first floor—all frequented by villagers and visitors.[15] That night I met all of the commune members at dinner and slept nearby in Huizhou-style architecture village house with the door unlocked.

Over the next few days, I learnt about the commune and saw how they established relationships with the local authorities and elderly farming community—who have small gardens sustaining their families, to larger plots growing rapeseed and mulberry trees. Anthropologist and commune member Zhao Kunfang was kind enough to introduce

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12 Mai Corlin, 'Trojan horses in the Chinese countryside: Ou Ning and the Bishan Commune in dialogue and practice', *Field*, 9 (2018), www.field-journal.com/issue-9/trojan-horses-in-the-chinese-countryside-ou-ning-and-the-bishan-commune-in-dialogue-and-practice.

13 Doxa, 'Day 1 / After Occupy: From Cities to Rural / Ou Ning / Map Office', *Vimeo* (February 12, 2012), www.vimeo.com/86557186.

14 Spring Workshop, *HK Farm* (2015), www.springworkshop.org/?lang=en#/hong-kong-farm.

15 The School of Tillers (www.facebook.com/schooloftillers) is named after the 'anarchist movement of peasant intellectuals who set out to create egalitarian communities in the cracks and fissures between states' (David Graeber, *Debt: The First 5,000 Years* (New York: Melville House Printing, 2011), p. 237).

Fig. 5 Mr. Hu's garden, Bishan Village, May 2015. Photograph by Michael Leung.

us to the villagers that she had met since moving to Bishan in January 2015.[16] They welcomed us into their houses for tea and showed us their gardens and produce, such as longevity spinach (觀音菜) and Laba Tofu (腊八豆腐)—named after Laba, a traditional Chinese holiday celebrated on the eighth day (eight, 八) of the La month (臘月 the twelfth month of the Chinese calendar).

Following several garden visits, Elaine, Kunfang and I decided to share some organic seed varieties with the farmer villagers in a creative way that values the soil, seed saving and seed sharing, and shifts away from the genetically modified seeds that were easily accessible to the villagers). I had brought the following five seed varieties from Hong Kong: Magnum Habanero Hot Pepper, Early Jalapeño Hot Pepper, Snowy Eggplant, Yellow Pear Cherry Tomato and Rainbow Blend Chard. We discussed invasive plants and introducing migrant seeds into Bishan but chose to prioritize and focus on how the seeds and future

16 I would like to share my gratitude to Zhao Kunfang in supporting this text. Her ethnography and close relationships with the Bishan villagers and commune members are inspiring and continue to influence me.

Fig. 6 Jalapeño chilli pepper seed packet, Bishan Village, China, May 2015. Illustration by Sun Yunfan. 21 x 21 cm. English translation: 'Very Spicy Friend. Organic seeds. Save seeds and share with other villagers. Sow and harvest information (number of days)'.

produce/recipes could be shared together, contributing to a community resilience, amidst new developments happening inside the village and in nearby villages rapidly shifting towards tourism.[17]

Fig. 7 Making seed packets with commune members, School of Tillers, Bishan Village, May 2015. Photograph by Michael Leung.

17 Sun Yunfan and Leah Thompson (dir.), 'Down to the countryside', *ChinaFile* (December 15, 2014), www.chinafile.com/multimedia/video/down-countryside.

In the School of Tillers library, we created hand-painted seed packets that resembled Chinese couplets (red paper with calligraphy usually placed at door entrances bearing good wishes such as 出入平安 meaning 'Peace Wherever You Go'). We were inspired by an in-situ mapping project by Ecologies of the Excess where rural village houses in Amaravathi village (426 kilometres from Bangalore, India) stamped the outside of their houses indicating if: (1) They raised cows and depend on them for milk and/or dairy products (2) They did not raise cows (3) They do not raise cows and depend on packaged dairy products (4) They do not raise cows and depend on neighbours' cows for milk and/or dairy products.[18] For our seed project we imagined that the seed packets would be stuck outside the villagers' houses, with their consent, and used to communicate to other villagers that they have unique organic seed varieties and are happy to share seeds.

Fig. 8 Kunfang sharing seeds with Grandma Huihua at her home, Bishan Village, May 2015. Photograph by Michael Leung.

18 Naveen Mahantesh, Ankit Bhargava and Srajana Kaikini, 'Negotiating routes: Ecologies of the byways part IV', *Ecologies of the Excess* (April 19, 2015), www.foa-flux.net/wp-content/uploads/2015/04/naveen-mahantesh-19-april-2015.pdf and www.ecologiesoftheexcess.wordpress.com.

We visited Grandma Huihua, Mrs. Ling[19], Wang Yuanqing, Wang Huilan and Li Chun's village houses and their gardens/small farms. We took notes and photographs of what was being grown seasonally at the time. We shared our seed project and distributed the seed packets to the villagers. They were intrigued about the fictional names that we gave the seeds such as 葫芦娃番茄 (English for 'Baby Gourd Tomato', originally called Yellow Pear Cherry Tomato) and 好辣朋友 (English for 'Very Spicy Friend' which phonetically sounds like 'jalapeño' in Putonghua, originally called Early Jalapeño Hot Pepper).

The next day Elaine and I started drawing the village map in the Bishan Bookstore and later shared it with Kunfang in the School of Tillers, where we also had additional support from YanZi, a villager working at the School of Tillers. The map developed quickly and included landmark locations such as the bust of Wang Dazhi (汪达之), a Chinese educator that Ou Ning admires, and a nine-square metre former frog catcher's hut that became an independent artspace called WOW Space.[20] Geographer and activist Zonia Baber taught her students to create their own approach to cartography, and that their maps should correspond to 'real places and real people'.[21]

The double-sided A2-sized map that followed several months later, now serves a document that captures the activities of Bishan and its villagers in May 2015.[22] On the front is a map of Bishan and information about the five villagers who kindly accepted to join our seed project, and on the back are illustrations of the villagers' seasonal produce grown at the time of our visit. We printed 200 maps in Hong Kong and distributed them in Bishan and as part of *The HK FARMers' Almanac 2014–2015* (edition of 100), which concluded our art and farming residency at Spring Workshop.[23]

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19 For a video of Mrs. Ling receiving seed packets, that Michael recorded after his first visit to Bishan Village in May 2015, see Michael Leung, 'Bishan Village, May 2015', *Vimeo* (21 May, 2015), https://vimeo.com/128492051.

20 Zhao Kunfang, 'Beyond Bishan', in *The HK FARMers' Almanac 2014–2015* (Hong Kong: Spring Workshop, 2015) 17, www.tinyurl.com/BeyondBishan.

21 Leila McNeill, 'The women who transformed how we teach geography', *Smithsonian.com* (January 18, 2018), www.smithsonianmag.com/science/woman-who-transformed-how-we-teach-geography-180967859.

22 Elaine W. Ho, Zhao Kunfan and Michael Leung, 'Beyond Bishan map', *Bishan Project* (2015), www.tinyurl.com/BeyondBishanMap.

23 *The HK FARMers' Almanac 2014–2015* (Hong Kong: Spring Workshop, 2015), www.springworkshop.org/?lang=en#/the-hk-farmers-almanac-online.

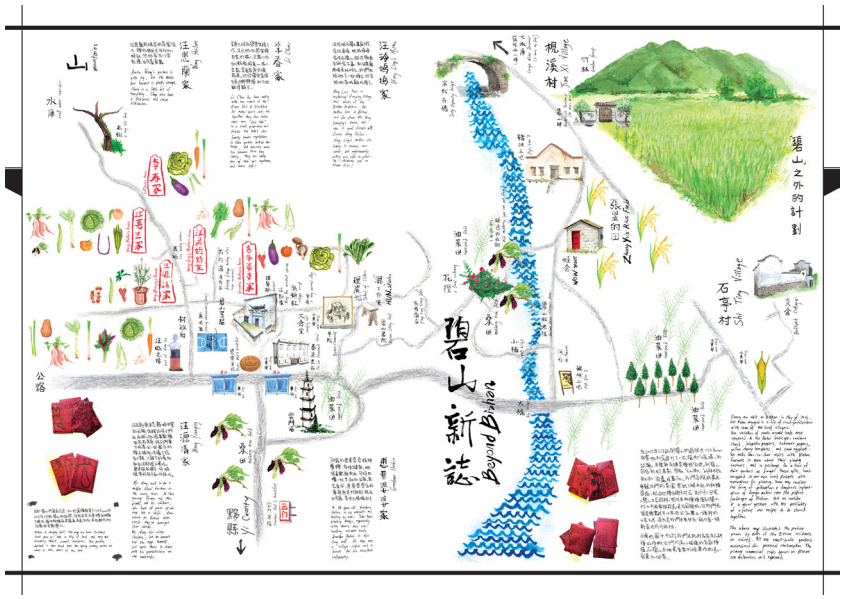

Fig. 9 Beyond Bishan map front, November 2015. 42 x 59.4 cm. Created by Elaine W. Ho, Zhao Kunfang and Michael Leung.

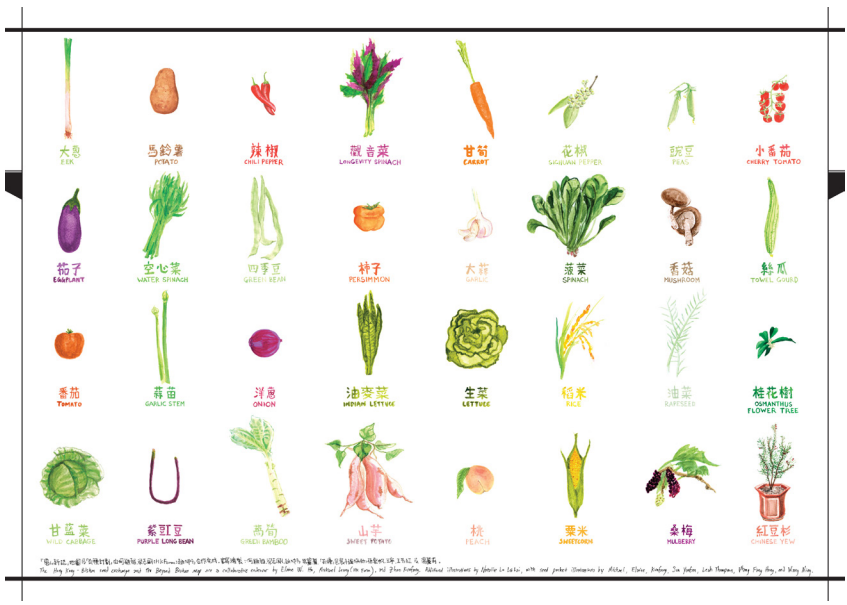

Fig. 10 Beyond Bishan map back, November 2015. 42 x 59.4 cm. Created by Elaine W. Ho, Zhao Kunfang and Michael Leung. Additional illustrations by Natalie Lo Lai Lai.

During my ten days in Bishan, I wrote two short fictional stories, a practice that I started in July 2014. The first story is called *Fang Fang Shang Dian* (芳芳商店 and translated in Chinese) and was inspired by an abandoned shop in the village that has the same name. It features film photographs by Wen, a Hong Kong commercial photographer who has been documenting land struggles in Hong Kong.[24] The second story is called *Upstairs* (untranslated) and was written on my last evening in Bishan. Both stories develop a narrative in relation to the *patchwork ethnography* from the previous days. The stories take place in some of the aforementioned places such as the School of Tillers cafe and the first-floor library. In an article called 'Becoming more than it never (actually) was: Expressive writing as research-creation', researcher Sarah E. Truman writes that, 'both research-creation's more-than-representational approach, and creative writing's differential potential, have the ability to bring new events into being rather than merely report on them'.[25] In parallel with the utopian values of the Bishan Project, both stories were shared with all commune members and aimed to support the project by expressing ideas relating to gift economy, food sovereignty and post-capitalism. I had planned to write one more story to complete the trilogy, but then something unexpected happened.

Fig. 11 Mr. and Mrs. Fang reading *Fang Fang Shang Dian* in their home, Bishan Village, August 2016. Film screen capture by Michael Leung.

24 Wen, 'North East new territories', *Tumblr*, www.dungbak.tumblr.com.

25 Sarah E. Truman, 'Becoming more than it never (actually) was: Expressive writing as research-creation', *Journal of Curriculum and Pedagogy*, 13.2 (2016), 136–143 (p. 138), https://doi.org/10.1080/15505170.2016.1150226.

In February 2016, the government decided to close the Bishan Project in an abrupt manner, a form of political censorship/oppression. Our map suddenly became a sensitive document, showing a history that the government decided to erase—all places that Ou Ning helped to set up, such as the School of Tillers and the Bishan Commune (home to him and his family and the commune members).[26] I returned to Bishan in August 2016 to find the bust of Wang Dazhi removed and villagers reluctant to speak about Ou Ning and his activities (under instruction of the authorities). With the map, I retraced our footprints from one year ago, shared more red seed packets, gifted maps and *Fang Fang Shang Dian* to villagers and also to Mr. and Mrs. Fang, who own the abandoned small shop. Shortly after my visit they decided to reopen their shop and sell everyday items again (it had been closed since the 1990s). I was delighted to hear this news from Kunfang.

Fig. 12 Villager Wang Huilan's plants from our seed project, Bishan Village, August 2015. Photograph by Zhao Kunfang.

26 Zhao, Ho and Leung (2015).

Since the closure of the Bishan Project, Kunfang revisits Bishan a few times per year and we often speak about the changes that have happened since. She also kindly shares photographs relating to our seed project and even unfortunate mishaps when villagers were unsure of when to harvest. We wrote planting information on the seed packets but the thin red paper weathers badly outdoors. On reflection, we should have printed the sow and harvest times on the map or used thicker red paper.

Fig. 13 Villager Wang Huilan showing two seed packets posted on her wall, Bishan Village, August 2015. Photograph by Zhao Kunfang.

Almost four years have passed since I first visited Bishan and a lot has changed. The old supplies village-cooperative shop, where we first bought the red paper for the seed packets, has been developed into a 'D&DEPARTMENT HUANGSHAN by Bishan Crafts Cooperatives' store, and numerous hotels have opened since. All the commune members now live in different parts of China and Ou Ning lives in New York with his family.[27] As the villagers continue their rural village life,

27 Bishan Crafts Cooperatives, *D&DEPARTMENT HUANGSHAN*, www.d-department.com/ext/shop/huangshan.html.

in what Kunfang now calls 'Bishan 3.0', I wonder how they remember those four years of the Bishan Project, what they think about the developments happening in their village now, what dishes they make from their harvests grown from the organic seeds, did they save seeds and share them with others, and where they keep their maps and copies of *Fang Fang Shang Dian*—and if they ever show them to their children or grandchildren.

Fig. 14 Mrs. Ling receiving seed packets in a short film that I made following my first visit to Bishan Village, May 2015. www.vimeo.com/128492051.

Similar to the time when I first met Mango King, the seed project in Bishan helped to form new relationships and communities, not only between commune members, villagers and Elaine and I, but for those who have yet to visit and will only see Bishan 3.0 and beyond. I look forward to visiting Bishan, meeting the villagers again and writing the third story, perhaps collaboratively—opening another chapter of the Bishan Project.

Second Seed: Wang Chau Village

Fig. 15 Wang Chau Village, Hong Kong, December 2017. Photograph by the Wang Chau Green Belt Concern Group.

> Realizing the promise of communism contained in the world's fragmentation demands a gesture, a gesture to be performed over and over again, a gesture that is life itself: that of creating pathways between the fragments, of placing them in contact, of organizing their encounter, of opening up the roads that lead from one friendly piece of the world to another without passing through hostile territory, that of establishing the good art of distances between worlds.
>
> — The Invisible Committee[28]

In October 2015, the Hong Kong government proposed the displacement of 500 villagers and the destruction of a greenbelt area into 17,000 social housing units (later reduced to 4,000 units) in Wang Chau Village, located in northwest Hong Kong. The three villages planned for development are Wing Ning Village, Fung Chi Village and Yeung Uk San Village (referred from here on as Wang Chau) and have been resisting a top-down government development plan for over three years, employing many tactics from petitioning to camping outside the Legislative Council.

28 The Invisible Committee, *Now* (Cambridge: Semiotext(e), 2017), p. 45.

My first encounter with the Wang Chau villagers was in a seventy-eight-storey office building in Wanchai, a busy commercial district on Hong Kong Island. I was invited by a friend from another land struggle in the northeast New Territories, and she kindly introduced me to the villagers in the cramped corridor filled with journalists and security guards.

Fig. 16 2017 Wang Chau Jackfruit Festival, Wang Chau, July 2017. Photograph by Ng Cheuk Hang.

The second seed project happened in August 2017 in Hong Kong, and involved the distribution of jackfruit tree seedlings following the inaugural 2017 Wang Chau Jackfruit Festival. The festival was collectively organized by villagers, the Wang Chau Green Belt Concern Group and people who have come to support the villagers' struggle such as myself.[29] The event, which included jackfruit tasting, village tours, painting a giant jackfruit, a music show and a traditional villager feast, differed from the gatherings and protests organized previously, and attracted new visitors to the village from all over Hong Kong.

The jackfruit seeds collected from the jackfruit festival were planted into donated pots at Kai Fong Pai Dong two weeks later. Wang Chau Green Belt Concern Group member Amy Wu also brought several seedlings she had grown at home to the market stall. Together we planted the seeds with rescued soil as curious neighbours walked by and asked us what we were doing. Shortly after, architect and researcher Yelta Köm and designer Elif Çak Köm visited to conduct an interview as

29 'Wang Chau green belt concern group 橫洲綠化帶發展關注組', *Facebook*, https://www.facebook.com/wangchaugreen.

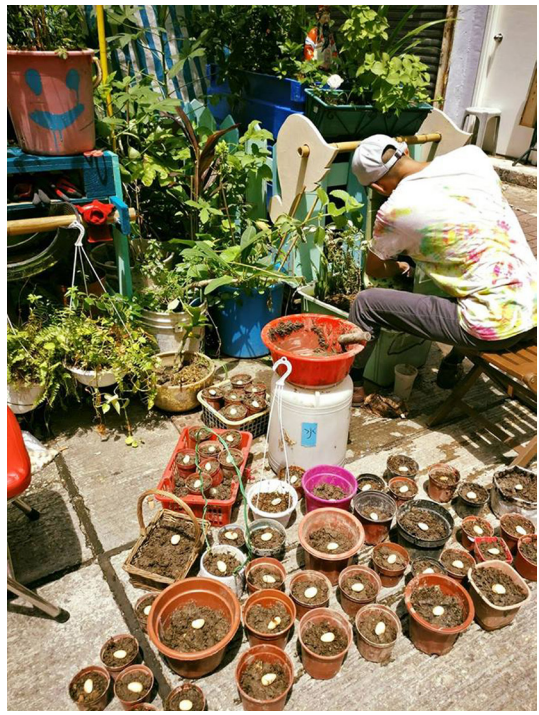

Fig. 17 Planting jackfruit seeds at Kai Fong Pai Dong, Hong Kong, August 2017. Photograph by Amy Wu.

part of their research into Commoning Practices and 'collective groups and their relations with common space, re-thinking the concept of commons and design within communities'.[30]

The 52+ seedlings that were planted developed into the Wang Chau Jackfruit Adoption Project, and they were shared on the concern group's Facebook page and through individual networks.[31] A spreadsheet was created to organize the distribution of the seedlings, and adoptees were invited to join a Whatsapp group to share their seedlings' progress, ask for growing advice and for the concern group to update people on any

30 Michael Leung, 'Seeds of Awareness', *XXI Architecture and Design Magazine* (March 28, 2018), www.xximagazine.com/c/seeds-of-awareness.

31 'Wang Chau Jackfruit Adoption Project poster', *Facebook*, www.facebook.com/wangchaugreen/photos/a.1737684636460983/2048343148728462/?type=3&theater and www.facebook.com/wangchaugreen/photos/a.1737684636460983/2250636105165831/?type=3&theater.

Fig. 18 Selected photographs from the Wang Chau Jackfruit Adoption Project Whatsapp group. Locations from top left to bottom right: Tung Chung*, Sheung Wan*, Foshan (China), Lau Shui Heung* (*Hong Kong), 2019.

political developments related to the village. After a year and half the Whatsapp group, composed of twenty-five people, is active and was even used by a villager to freely share her koi fish, in preparation for a village eviction. I cannot imagine how many other separate groups, both digital and physical, have emerged from the villagers' three-year-plus struggle. How might these groups be activated in unconventional and creative ways? On reflection Elaine, Kunfang and I could have created a WeChat group to support the Bishan seed project, with consent, adding the five villagers and perhaps their family members if they do not have access to smartphones.

Revisiting Yelta and Elif's interview, entitled '*Seeds of Awareness*', reminds me of how the seed is a *tool*—something tangible, living and full of potential. Within land struggles such as Wang Chau Village, if we perceive everything in-situ as a tool/actor to be re-imagined, what creative opportunities could arise to build knowledge and solidarity as part of the existing movement?

Since December 2018, villagers, the Wang Chau Green Belt Concern Group and people who have come to support the villagers' struggle

Fig. 19 Michael and Amy at Kai Fong Pai Dong, Hong Kong, August 2017. Photograph by Yelta Köm and Elif Çak Köm.

have started a project relating to the Chinese medicinal herbs in the village. A public tour group and an arts university student group have visited villagers' gardens in the past few months, the latter illustrated many herbs. Miss Cheng, a Wang Chau villager, has created a detailed document of all forty-four herbs with photographs taken by herself. Other members of the public have joined the project hoping to do research relating to villagers and their herbs and how they are used. As we are working on this zine/book/poster together, we hope that it can be shared with the public before the government-proposed village eviction this year.

Third Seed: Aarey Forest

> This is the meaning and the strength of the many struggles that people are waging across the planet to oppose the expansion of capitalist relations, defend the existing commons, and rebuild the fabric of countries destroyed by years of neoliberal assault on the most basic means of our reproduction.
>
> — Silvia Federici[32]

32 Silvia Federici, *Re-enchanting the World: Feminism and the Politics of the Commons* (Oakland: PM Press, 2019), p. 1.

Fig. 20 Mango Station on the cross junction of Dinkarrao Dessai Road and Konkan Vikas Mahamandal Road, Aarey forest, May 2018. Photograph by Michael Leung.

In recent years, infrastructure projects such as Heathrow's Third Runway (London),[33] the Guangzhou–Shenzhen–Hong Kong Express Rail Link (Hong Kong)[34] and Jeju Island's second airport (South Korea) have met fierce opposition from environmentalists, villagers and land protectors.[35] Capitalist expansion continues and local struggles such as the Taoyuan Aerotropolis (Taoyuan City)[36] and the Turin–Lyon high-speed railway movements[37] may seem unstoppable.

33 'Grow Heathrow—transition Heathrow', *Facebook*, https://www.facebook.com/transitionheathrow.

34 Martin Krenn, 'Choi Yuen Village scheduled for demolition' (2009), www.martinkrenn.net/choi_yuen_village/info.html?fbclid=IwAR1D_9S9Sjntcn8F6J0BuTDbmPHOv7lZI_p7oiFTDAAgjFG76iMnxMdVMmI.

35 Pagans We Are, 'Substantial victory for Indigenous villages opposing 2nd airport on Jeju Island, South Korea?', *Pagans We Are* (November 14, 2017), www.pagansweare.com/2017/11/14/substantial-victory-for-indigenous-villages-opposing-2nd-airport-on-jeju-island-south-korea.

36 Rose Bridger, 'Taiwan: residents resist forced eviction for 'Aerotropolis' megaproject', *Ecologist: Journal for the Post-Industrial Age* (December 16, 2014), www.theecologist.org/2014/dec/16/taiwan-residents-resist-forced-eviction-aerotropolis-megaproject.

37 Comitato NO TAV—Torino, www.notavtorino.org/documenti/inglese/indice.htm.

In May 2018, a fortuitous change in an artist exchange project, organized by Art Together (Hong Kong) and ArtOxygen (Mumbai), led myself and three other Hong Kong artists to stay in Aarey forest in north Mumbai (India) for six days.[38] Neuman wrote in his aforementioned book that, 'A thick description of a 3-minute event may take several pages. It captures exactly what has occurred and places the drama of events in a larger context. It permits multiple interpretations or perspectives and gives a broader social-cultural context, allowing the reader to infer deeper cultural meanings'.[39] With this in mind and the relatively recent trip to Mumbai, I would like to share an autoethnographic text entitled *Solidarity with Aarey*, that was written in May 2018—outdoors in the forest, inside a mosquito net surrounding my mat and sleeping bag.

Solidarity with Aarey

[dated 18th May 2018, Aarey forest]

Fig. 21 Vanita, a Warli tribal, teaching a child how to open an Indian Almond, Aarey forest, May 2018. Photograph by Michael Leung.

38 Art Together, [*en*]*counters public art project* (2018), www.arttogether.org/dailyration.html.

39 Neuman (2011), p. 424.

> Maybe, but only maybe, and only with intense commitment and collaborative work and play with other terrans, flourishing for rich multispecies assemblages that include people will be possible. I am calling all this the Chthulucene—past, present, and to come.
>
> – Donna Haraway[40]

Fig. 22 Aarey forest and urban sprawl (already on former forest lands), Aarey forest, May 2018. Photograph by Michael Leung.

Tonight is our third night in Aarey, a 3,166-acre (1,281-hectare) forest in Mumbai, that has experienced deforestation by a new metro line and metro carriage depot (Mumbai Metro Rail Corporation Ltd. supported by the Japan International Cooperation Agency).[41] Similar to other grand infrastructure projects around the world, speed and convenience often prevails, in the courts and public's imagination, over rights to the land, the environment and biodiversity.

Last April 2017, around 300 tribals (Indigenous people) were displaced/evicted from their villages (tribal hamlets know as *padas*).[42] Following the deforestation of 82 acres (33 hectares) with 3,000+ trees,

40 Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham and London: Duke University Press, 2016), p. 101.

41 Mumbai Metro Rail Corporation, *Project Funding*, www.mmrcl.com/en/project/project-funding.

42 Jyoti Shinoli, 'Caged in concrete', *Peoples Archive of Rural India* (March 6, 2019), https://ruralindiaonline.org/articles/caged-in-concrete-an-adivasi-urban-nightmare/.

I think about what feminist scholar Donna Haraway encourages us to do, collaborate with all *terrans* that inhabit this earth—everything living.

Similar to the 3,000+ trees and 300 tribals, biodiversity (some even discovered in Aarey forest) such as the buthid scorpion (*Lychas aareyensis*), tarantula (*Heterophrictus aareyeneis*) and Atlas moth (*Attacus atlas*) faced eviction through violent deforestation.[43] Urban development and such infrastructure projects are a new form of colonization, creating the irony where the once colonized becomes the new colonizer—a self-inflicted wound by the government, at the expense of present and future terrans.

I recall how much Mahatma Gandhi valued the village and villagers' ways of life during India's struggle for independence against the British Empire.[44] Today this Empire is biopolitical and we negotiate our complicity in our daily lives—how we think, who we work for, where we spend our money, etc.[45]

In the past few days, members of ArtOxygen and the Save Aarey Facebook group[46] have spent valuable time with us in Aarey forest. They guided us through the capillaries in the forest; showed us many of the thirty-two cattle sheds and a couple of the twenty-seven *padas*; created seed sharing opportunities with Warli tribals; entered the (disused?) 1954 UNICEF-supported milk processing plant and research labs filled with Swedish machinery[47]; introduced us to the hardworking fruit hawkers at each crossroad; drove past the epic, closed down

43 Zeeshan Mirza, *Biodiversity of Aarey Milk Colony and Film City* (report submitted to Government of Maharashtra and The Forest Department of Maharashtra, 2010), www.researchgate.net/profile/Zeeshan_Mirza2/publication/235698986_Biodiversity_of_Aarey_Milk_Colony_and_Film_City/links/0912f512b572f2e5fb000000/Biodiversity-of-Aarey-Milk-Colony-and-Film-City.pdf; Badri Chatterjee, 'Aarey home to many known, unknown species: reveals study', *Hindustan Times* (March 9, 2015), www.hindustantimes.com/mumbai/aarey-home-to-many-known-unknown-species-reveals-study/story-0BdiHEFC6FL5AQQmZP3VeN.html.

44 Mahatma Gandhi, *Gandhi on Villages*, ed. by Divya Joshi (Mumbai: Mani Bhavan Gandhi Sangrahalaya, 2002); Mahatma Gandhi, *Village Swaraj*, ed. by H. M. Vyas (Ahmedabad: Navajivan Publishing House, 1962).

45 Woodbine NYC, 'Coordinates', *YouTube* (April 30, 2018), www.youtube.com/watch?v=K1FPW-_j-Mw.

46 'Save Aarey', *Facebook*, www.facebook.com/groups/saveaarey.

47 UNICEF, *Our History*, http://unicef.in/WhoWeAre/History; Maggie Black, 'Civilization follows the cow', in *The Children and the Nations: The Story of Unicef* (New York: Unicef, 1986), pp. 141–167, www.unicef.org/about/history/files/Child-Nation-M-Black-Ch06-p141-167-civilzation-follows-cow.pdf.

Fig. 23 Villagers outside a cattle shed sharing *padas* locations, Aarey forest, May 2018. Photograph by Michael Leung.

Imperial Grand Palace Hotel;[48] met paper bag makers working in their homes; and visited the Aarey Dairy Butterfly Garden that was grown in memory of Shri Vinay Athalye, whose family planted over 5,500 saplings in Aarey.[49]

I remember a couple of conversations in the past few days that may add momentum to the Save Aarey movement. One was about the twenty-seven *pada* leaders being all male, and the second, my email exchanges with the Indian Anarchist Federation.[50] The former conversation likely echoes Gandhi's views towards women and adds an urgency to Haraway's all-inclusive future.[51]

48 See 'Save Aarey short film by Asana, 2018', www.studioleung.com.

49 'Aarey dairy butterfly garden—in memory of Shri Vinay Athalye', *Facebook*, www.facebook.com/Aarey-Dairy-Butterfly-Garden-In-memory-of-Shri-Vinay-Athalye-402679483235670.

50 Indian Anarchist Federation, *The Coming Anarchy: Indian Anarchist Federations' Blog*, www.thecominganarchy.wordpress.com.

51 Dalit Diva, 'Why it is time to dump Gandhi', *Medium* (June 14, 2017), www.medium.com/@dalitdiva/why-it-is-time-to-dump-gandhi-b59c7399fe66.

Fig. 24 Making organic seed packets together, Aarey forest, May 2018. Photograph by Michael Leung.

Fig. 25 Leopard Tomato seed packet in Hindi and Marathi, Aarey forest, May 2018. Photograph by Michael Leung. English translation: 'Organic seeds. Save seeds and share with other *padas*. Justice for all terrans living in Aarey'.

Learning from Vanita, a Warli tribal, and later watching her interview online teaches me that such a movement can only keep flourishing and go from strength to strength.[52] I felt the same way when Amrita, a Save Aarey group member, spoke to me about the importance of organising in horizontal ways—confronting what we may have experienced in other stagnant movements.[53]

Today and yesterday the Indian Anarchist Federation inspired me to think about prospective participants to the movement (I will follow up with them tomorrow). This text is partly written for them, as well as anyone who is not yet engaged with what is to come at Aarey, in this destructive neoliberal world where governments and corporations collude and put profit over people, all terrans and future generations. Perhaps one day we will be more responsible like the Indigenous people in North America who think seven generations ahead.[54]

Fig. 26 Map sharing with young villagers. Fifty A3 maps with the ethnographic text on the back were. distributed to the public on 20th May 2018, Aarey forest, May 2018. Photograph by Michael Leung.

52 Scroll, 'Mumbai metro a threat to Aarey', *Facebook*, www.facebook.com/scroll.in/videos/1478604038889138.

53 'Horizontalidad', *Wikipedia, The Free Encyclopaedia* (August 8, 2019), https://en.wikipedia.org/wiki/Horizontalidad.

54 *Constitution of the Iroquois Nation: The Great Binding Law, Gayanashagowa*, http://resources.utulsa.edu/law/classes/rice/Constitutional/Six_Nations_Const.htm.

Solidarity with the ZAD (Notre-Dame-des-Landes), Little Miyashita Garden (Tokyo), Wang Chau (Hong Kong), Aarey (Mumbai), and many more, and the courage to go beyond.

Fig. 27 After six days living in Aarey forest, on May 21, 2018 the original 102 x 100 cm map was gifted to the Save Aarey movement. Photograph by Michael Leung.

***

Since visiting Aarey in May 2018, I have kept in contact with most of the people in the *Solidarity with Aarey* text, sharing weblinks, photos, texts and anything that could help the movement against the deforestation and evictions caused by the metro infrastructure project.

Living in the forest, albeit for only six days, had a lasting impression on me and I found myself writing a short fictional story about Aarey in late May 2018. The story was called *Planet Earth: Mumbai's Leopards* and speculates about a more critical approach by broadcaster and naturalist

Richard Attenborough for his documentary series *Planet Earth*. The story was shared with the Save Aarey Facebook group[55] and even the Planet Earth team, who serendipitously emailed me a day after I finished writing the story.

When Art Together started to organize the other part of the artist exchange in Hong Kong in November 2018, I decided to turn *Planet Earth: Mumbai's Leopards* into a zine.[56] I contacted Mahesh Bariya, a Warli artist that I had met in Aarey, and asked him if he would be interested to create two artworks in response to my story. I was curious to know what he would imagine from my story and how he would apply the unique Warli line drawing technique.

Fig. 28 Warli artwork showing the coexistence between tribals, leopards and biodiversity, November 2018. Artwork by Mahesh Bariya. 21 x 30 cm.

55 'Save Aarey', *Facebook*, www.facebook.com/groups/saveaarey.

56 'Daily Ration @Peng Chau [en]counters: Hong Kong-Mumbai art exchange project—4 November 2018', *Facebook*, www.facebook.com/events/177165356522189.

Mahesh asked environmental journalist Hrushikesh Patil to kindly translate the story into Marathi, the main language spoken in the Maharashtra state. At a later date 20 books were posted to Mumbai and shared during an event that Aarey land protectors attended.

The collaboration with Mahesh was a *new creation process* for me, in that it was generative and has potential to be further interpreted, and even adapted if willing, by its viewers. I am reminded by the power of storytelling and points four and seven in *Uncivilisation: The Dark Mountain Manifesto*:

4. We will reassert the role of storytelling as more than mere entertainment. It is through stories that we weave reality.
7. We will not lose ourselves in the elaboration of theories or ideologies. Our words will be elemental. We write with dirt under our fingernails.[57]

Fig. 29 Artist and teacher Jeetin sharing seeds in a *pada* in the centre of the forest, Aarey forest, May 2018. Photograph by Michael Leung.

57 Dougald Hine and Paul Kingsnorth, *Uncivilisation: The Dark Mountain Manifesto* (Croydon: The Dark Mountain Project, 2014), p. 31.

I wonder what seeds Vanita has stuck/stored on the mud wall at the entrance of her home, if she planted the 'Red Farmers' Fingers' organic seeds (in Marathi तंबड़ा शेतकरी बोटा, originally called Burgundy Okra) that I gave her, and if all the other seeds exchanges that happened in those six days sprouted into something else, both inside the forest, and beyond.

Coda: Future Growth

Fig. 30 Organic seed sharing during the *Reclaim the Fields 2019 European Assembly*, Florence, February 2019. Photograph by Michael Leung.

> Solidarity means not having to be alone in feeling the weight of the world.
>
> — Anonymous, sticker from wares in Singapore[58]

The three seed projects aim to highlight a rhizomatic research-creation methodology situated alongside land struggles against neoliberal development plans, that put profit over people.[59] They are rhizomatic

58 'wares', *Facebook*, www.facebook.com/waresnotwarehouses.

59 Michael Leung, 'Insurrectionary agricultural milieux', *Graph Commons*, www.tinyurl.com/insurrectionaryam.

in that the seed projects roam freely as part of the commons and the seeds are disseminated through visible and invisible networks—the seed projects are recursive. In the book *A Thousand Plateaus, Capitalism and Schizophrenia*, philosophers Gilles Deleuze and Félix Guattari described a rhizome as 'an acentered, non-hierarchical, non-signifying system without a General and without an organizing memory or central automaton'.[60] The seeds and seedlings (both actors) are a central tool to the three seed projects, but during the creative group packaging activity, the conversations that happen on soil or the collective pedagogy that happens after planting, the seeds and various situated knowledges evolve and become shared and transformative through each season and harvest. A seed ontology happens—they have agency, and each following gesture, becomes an act of solidarity.

In *The Three Figures of Geontology*, anthropology and gender studies scholar Elizabeth Povinelli writes that, 'The question THE ANIMIST poses is what happens when we extend one mode of being to all modes of existence'.[61] Amidst the neoliberal development plans in Bishan Village, Wang Chau Village and Aarey Forest soil, seeds, mangoes, Very Spicy Friends, jackfruits, Chinese medicinal herbs and leopards all still exist and have ingrained knowledge and rich narratives to tell, before they are unwillingly forced to disappear. Research-creation gives the opportunity to work *under new conditions of cultural creation* and join existing/future movements, in solidarity, and contribute to a local and transnational citizen/activist humanities—one that is disseminated to *students, peers and the general public*. I hope that research-creation can be spread like organic seeds across different communities, activating a critical mass, that will protect people, biodiversity and the environment, for many future generations to come.

> People often ask me what one thing I would recommend to restore relationship between land and people. My answer is almost always, 'Plant a garden'. It's good for the health of the earth and it's good for the health of people. A garden is a nursery for nurturing connection, the soil

60 Gilles Deleuze and Félix Guattari, *A Thousand Plateaus, Capitalism and Schizophrenia* (Minnesota: University of Minnesota Press, 1987), p. 21.

61 Elizabeth Povinelli, 'The three figures of geontology', in *Anthropocene Feminism*, ed. by Richard Grusin (Minneapolis: University of Minnesota Press, 2017), pp. 49–64 (p. 61).

for cultivation of practical reverence. And its power goes far beyond the garden gate—once you develop a relationship with a little patch of earth, it becomes a seed itself.

— Robin Wall Kimmerer[62]

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62 Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* (Minnesota: Milkweed Editions, 2013), pp. 126–127.

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10. *e-Waste Peep Show*

A Research-Creation Project on the (In)visibility of Technological Waste

Lai-Tze Fan

The following chapter by Lai-Tze Fan is a critical and creative reflection that describes the research-creation project *e-Waste Peep Show; or, on Seeing and not Wanting to be Seen* (*EWPS*). Since research-creation as an academic practice challenges scholars to merge creative approaches in various disciplines and to apply theory to practice, it allows scholarship to address twenty-first-century issues in innovative ways. Constructed as an art installation, *EWPS* features original footage of an e-waste (electronic waste) plant in Northern Hong Kong through a peephole in its walls. The camera captures a masked woman taking apart mounds of technological trash. Suddenly, she throws technological debris at me: *don't look at me; don't film here*. In this chapter, the author describes the process of constructing the installation such that spectators can experience the act of peeping onto sites and sights that they are not 'supposed' to see. The three parts of the paper describe the fragments that came together to produce the research-creation project: first, the author discusses the toxicity of e-waste and the exploitation of e-waste labourers, with a focus on East, Southeast and South Asia; second, she describes the fieldwork that she completed in December 2017 to collect video footage at an e-waste plant in Hong Kong; third, she details the creation process of the installation and the intended experience for the spectator-as-user. In doing so, this chapter aligns creative methods in sustainable research with an ethical intervention into global technological consumerism.

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e-Waste Peep Show; or, on Seeing and not Wanting to be Seen (*EWPS*) premiered as an art installation in 2018 at the *multiple contingencies* exhibition at the Society for Literature, Science and the Arts conference in Toronto, Canada. It is based on my findings from a research trip to an e-waste (electronic waste) plant in Northern Hong Kong. I shot original footage of the plant through a hole in its sheet metal walls, capturing a masked woman taking apart mounds of technological trash. The final installation projects this footage onto a screen, but this footage is only visible through a series of peepholes that I drilled into a corrugated plastic sheet wall. *EWPS* therefore tries to replicate the process of peeping onto sites and sights that we, media device users, are not 'supposed' to see: sights of invisible, dirty and corrupt practices in technological consumerism and consumption.

The Politics and Ethics of e-Waste and e-Waste Labour

The term 'e-waste recycling' is presented as an ethical and even sustainable alternative to throwing away old, broken and otherwise unwanted electronic devices. As a global focus on natural resources surmounts—whether the focus is on the difficulty of acquiring or making these resources, on humans' overreliance upon them, or on models of sustainable futures in spite of diminishing resources—media users are becoming more aware of where their devices come from and where they go after they are done using them. For instance, countless editorial features have stressed the difficulty of mining the mineral coltan in an *ethical* way, with a high percentage of coltan coming from the Republic of Congo specifically. *The Washington Post*[1] and *The New York Times*[2] have documented the use of exploitative labour in coltan mining in

1 Sudarsan Raghavan, 'How a well-intentioned U.S. law left Congolese miners jobless', *The Washington Post* (November 30, 2014), https://www.washingtonpost.com/world/africa/how-a-well-intentioned-us-law-left-congolese-miners-jobless/2014/11/30/14b5924e-69d3-11e4-9fb4-a622dae742a2_story.html?utm_term=.139024bca33a; Laura Kasinof, 'An ugly truth behind "ethical consumerism"', *The Washington Post* (April 19, 2018), https://www.washingtonpost.com/news/theworldpost/wp/2018/04/19/conflict-free/?utm_term=.86540fcdca75.

2 Nicholas Kristof, 'Death by gadget', *The New York Times* (June 26, 2010), https://www.nytimes.com/2010/06/27/opinion/27kristof.html.

Congo, even through the employment of children. Meanwhile, coltan is needed in all lithium-ion batteries, found in laptops, smart phones and electric cars, and conversations about sustainability present lithium-ion batteries as a responsible form of energy use when compared to disposable batteries and natural gas and petrol.

The incentive to participate in e-waste recycling is high for many Western consumers, who are now told that it is a good and sustainable practice. Major technological companies promote e-waste recycling programs, such as Apple's 'Trade In' program that is intent on salvaging older Apple devices for 'free recycling', meanwhile offering a trade-in credit that consumers can use towards purchasing a new device.[3] Apple's website states of the Trade In program: 'You may be done with your device, but chances are it still has more to give. If it's in good shape, we'll help it go to a new owner. If not, we'll send it to our recycling partner, so we can save more precious minerals and take less from the earth'.[4] Elsewhere the website notes: 'If it's not eligible for credit, we'll recycle it for free. No matter the model or condition, we can turn it into something good for you and good for the planet'.[5] What Apple neglects to highlight is the fact that the precious minerals are resold in the form of their new devices. While it is indeed a positive practice to take fewer natural resources from the earth, it is worthwhile to trace what happens to e-waste after it is traded in, how it is properly or improperly treated, and *who* is doing that post-consumption labour of disposal or repurposing.

E-waste recycling is costly to do in a safe environment, as it is toxic if not handled with the proper equipment and training for human labourers. Therefore, much of the work of recycling through taking apart devices and essentially re-mining them for precious minerals such as gold, silver and copper is outsourced to poor labourers in parts of East, Southeast and South Asia—a veritable network of unseen hands in invisible spaces.

3 Apple briefly changed the name of its 'Trade In' program to 'GiveBack' in 2019, but then has since reverted to 'Trade In'. For more information on the 'Trade In' vs. 'GiveBack' renaming, see https://9to5mac.com/2019/04/25/apple-trade-in-vs-giveback/.

4 Apple, 'Apple trade in', *Apple*, https://www.apple.com/ca/trade-in/.

5 Ibid.

In her article, 'E-Waste Hazard: The Impending Challenge',[6] Violet N. Pinto offers some context into these labourers and their exposure to e-waste, noting that 'most of the people working in this recycling sector are the urban poor with very low literacy levels and hence very little awareness regarding the hazards of e-waste toxins'.[7] Sometimes working without face masks, gas masks, proper ventilation or even gloves, labourers are exposed to common toxic materials such as lead and mercury. They are also exposed to lesser known toxic materials such as cadmium (used in electric and rechargeable batteries), which causes long-term cumulative poisoning, especially in the kidneys, and to polycyclic aromatic hydrocarbons (PAH; distributed into the air through burning coal and other biofuels), which causes cancers of the lungs, skin and bladder.[8] While Pinto offers a comprehensive information chart on the general health problems of e-waste recycling labourers, she adds in necessary context that her facts are derived from studies on male labourers and therefore do not yet account for the women and children in this area of labour, of which there is a high percentage.

In the global technocultural circuit, the Special Administrative Region of Hong Kong plays a major role due to its status as a global financial hub as well as its proximity to China's technological epicentre, Shenzhen. In the area of e-waste, the mega city of Hong Kong has, in Rolien Hoyng's description, 'become a site where imported e-waste accumulates and lingers', owing to changed regulations and e-waste governance in mainland China.[9]

While mainland China forbade e-waste devices from being transported into the country without being taken apart into smaller components, just outside of its borders is Hong Kong, which now serves as a main Asian Pacific location for e-waste recycling. From 2017–2018, I was an Assistant Professor at Lingnan University in Hong Kong, where I joined the Open Repair e-waste group at the Chinese University of Hong

6 Violet N. Pinto, 'E-waste hazard: The impending challenge', in *Medianatures: The Materiality of Information Technology and Electronic Waste*, ed. by Jussi Parikka (London: Open Humanities Press, 2011), n.p., http://www.livingbooksaboutlife.org/books/Medianatures.

7 Ibid.

8 Ibid.

9 Rolien Hoyng, 'Logistic of the accident: E-waste management in Hong Kong', in *Logistical Asia: The Labor of Making a World Region*, ed. by Brett Neilson, Ned Rossiter and Ranabir Samaddar (London: Palgrave MacMillan, 2018), p. 200.

Kong. One activity in this group's work was to visit e-waste plants in the Northern region of Hong Kong, close to the border of Shenzhen, and this we did together in December 2017, as part of an organized conference at Lingnan University, 'Digital Media and Borders: Infrastructures, Mobilities, and Practices across Asia and Beyond'.

Fieldwork and Footage

On a school bus, we drove to a location that looked like a landfill of technology, with computer screens collapsed into each other like folded cardboard boxes, bound up in twine (see Fig. 1). The dirt road was littered with trash that had been blown off to the sides by passing vehicles, and two stray dogs wandered slowly a hundred feet from us. Their fur was dirty and matted, their bodies thin and their eyes cautious (see Fig. 2).

Fig. 1 A pile of e-waste at an e-waste plant in Northern Hong Kong, December 2017. Photograph by Lai-Tze Fan.

Fig. 2 Stray dogs wander around the e-waste plant, December 2017. Photograph by Lai-Tze Fan.

The reason we had come was for that which we could not see: an e-waste plant hidden behind sheet metal walls that had been hammered into the ground, forming a long barricade wall. Someone had spray painted the traditional Chinese words for 'stop' (停) and 'leave' or 'go away' (走) every few feet (see Fig. 3). No one knew where the entrance was, and we would not seek it, as we were there to witness from the outside, or to listen. On the other side of the wall were sounds of deconstruction. There was the occasional high-pitched electric drill, unwinding screws from a device. We could hear people—their mouths silent, their feet pitter pattering—scraping metal against metal. A short while later, we heard the sound of crashes, as objects collided in a heap.

Fig. 3 Signs warn us to keep away (here, they say STOP), December 2017. Photograph by Lai-Tze Fan.

Our guide spoke during all of this, explaining why were in the boonies and close to farmland: there was ample space, unlike the rest of Hong Kong, and we were far away from prying eyes. We had driven so far North in Hong Kong that we neared the Chinese border that would lead us to the technological epicentre of China—Shenzhen—into and out of which transportation flowed (see Fig. 4). We listened and wandered, taking photos and videos, talking quietly amongst each other, and wondering if the people on the other side (who were they?) could hear us.

In the sheet metal walls, I noticed a few perfectly symmetrical holes the size of green peas and brought my eyes to one. It was difficult to see—the hole was too small to even peer through—but I did make out a mound of technological scrap in front of me, pushed up against the wall. I brought my cell phone camera to the hole, and through my screen, I could make out a person wearing bright yellow who stood in front of the heap and handled something before them at waist height. A few moments later, I double tapped on my phone screen to focus in

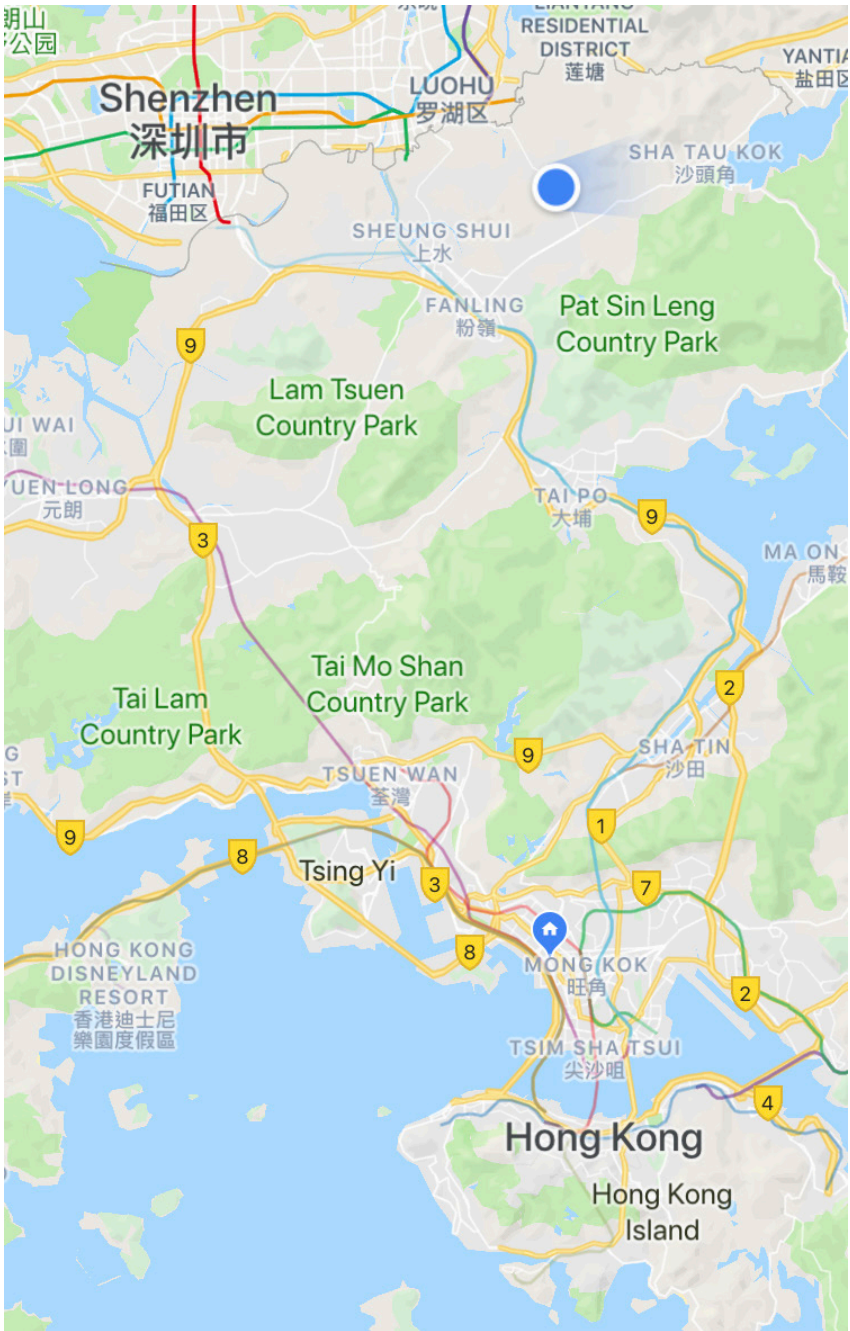

Fig. 4 Our approximate location in Hong Kong, December 2017. Photograph by Lai-Tze Fan. Map data: Google, 2017.

on the image and I saw her more clearly: an East or Southeast Asian woman in a bright yellow raincoat, her black hair gathered back under a fisherman's hat and her face hidden behind a thin blue mask—the kind worn by medical professionals. The mask would not protect her from the fumes let off of the devices. She wore ill-fitting gloves to take apart what looked like a desktop CPU, tossing the odd fragment or cluster of wires at the mound of technological trash before her, between us—a giant pile of e-waste. I didn't know if she heard us or perhaps heard my footsteps stop in front of her, but suddenly, she threw a long metal strip in my direction.

Don't look at me. Don't record here.

Creation of the Installation

In my art piece *e-Waste Peep Show*, I have tried to replicate the experience of watching the labouring woman behind the wall, including the trespassing, the atmosphere, the structures and the act of peeping at someone who is not meant to be seen and who also does not want to be seen.

I took inspiration from an existing art project, Marcel Duchamp's last major work, *Étant donnés*,[10] translated to *Given*. This piece features a wooden door in front of a statue of a naked woman laying on her back, holding a candle and surrounded by twigs. In the background is a landscape collage of greenery. To experience the piece and receive its content, a spectator peers into a peephole, seeing the woman in the foreground, against the landscape. The piece might be described as fetishistic, and in following Duchamp's other works that renew spectators' consideration of capitalism, we could call *Étant donnés* a critical piece on consumption practices. To view the woman involves the spectator's engaging in an act that objectifies her body and turns it into something to consume. Put another way, the act of voyeuristic or forbidden peeping is simultaneously the act of objectifying that which is seen and the act of consuming the resulting object.

The act of peeping may also be compared to the male gaze as described in critical film studies, a similar process in which the camera's—and by

10 Marcel Duchamp, *Étant donnés* (1946–1966), mixed media assemblage, Philadelphia Museum of Art, United States.

extension, the spectator's—eye fragments the on-screen woman's body into consumable, sexualized parts such as the legs, breasts or lips.[11] The woman may know that she is being looked at or she may not, but either way, her agency is suspended by the gaze and her identity is abstracted into parts over a whole.

I didn't want to in any way repeat the violence of this potential gaze in filming the labouring woman, and I realized that her labouring body represented a similar fragmentation and abstraction. This woman played a part in the lifecycle of devices, some stages of which are socially discussed and highlighted (design, distribution and consumption) and some of which (extraction and disposal) are horrifying reminders of the conditions encountered by exploited people in the Global South. Their experiences are too harsh for the sterile, user-friendly message of media, and so, they are cast out of sight, out of mind.

I wanted to avoid treating this labouring woman as an object of consumption through her role in the life cycle of devices as well as through capturing her for content in a recorded video (see Fig. 5). While I had received ethical research clearance for my fieldwork, and while it was my intention to foreground her individuality, I also did not have her expressed permission to capture her image for consumption, and thus, to see her at work felt forbidden—an act of peeping that fragments the Other into object. Because she could not speak to me—even the words above are projected through her gestures—I worried about how to view her in any way that afforded her agency.

The problematic practice of fetishism that abstracts the whole in favour of the parts also runs deep in the dominant logic of technological infrastructure, owing to the sociocultural design and aesthetic illusion of media immateriality, which is described by media scholars such as Rita Raley[12] and Lori Emerson.[13] For instance, Emerson focuses on Apple, arguing that the brand's notion of:

> *user-friendly*[*ness*] is used quite deliberately to distort reality by convincing users that this very particular notion of a user-friendly device—one that

11 Laura Mulvey, 'Visual pleasure and narrative cinema', *Screen*, 16.3 (1973), 6–18, https://doi.org/10.1093/screen/16.3.6.

12 Rita Raley, *Tactical Media* (Minnesota: University of Minnesota Press, 2009).

13 Lori Emerson, *Reading Writing Interfaces: From the Digital to the Bookbound* (Minnesota: University of Minnesota Press, 2014).

Fig. 5 The woman filmed from behind the peephole, December 2017. Photograph by Lai-Tze Fan.

> depends on and then celebrates the device as entirely closed off both to the user and to any understanding of it via a glossy interface—is the only possible version of the user-friendly, one that claims to successfully bridge the gap between human and computer. In reality, the glossy surface of the interface further alienates the user from having access to the underlying workings of the device.[14]

Similarly, Olia Lialina explores the logic of interface design as one that deliberately misdirects from media materiality. She quotes a 2012 iPad trailer: 'We believe technology is at its very best when it's invisible, when you're conscious only of what you're doing, not the device you're doing it with. An iPad is the perfect expression of that idea. It's just this magical pane of glass that can become anything you want it to be [...]

14 Ibid., p. xi.

It's a more personal experience with technology than people have ever had'.[15]

Like other ultra-cool technology companies, Apple's promise of advanced technology is undergirded by a rhetoric of perpetual newness, which results in the idealization of and cultural preference for newer media devices.[16] Insofar as the newer device is always already anticipated in the production line, the consumption of newness for the sake of newness is a condition of contemporary post-industrial capitalism that has no time for older models, let alone 'old' media. The doing away with older media also does violence, as the old is unwanted and shipped off to parts of the world where consumers no longer have to seen them. This model of perpetual newness, however, is utterly unsustainable.

In thinking of how *e-Waste Peep Show* could encourage sustainable practices while resisting a rhetoric of perpetual newness, I needed to negotiate the politics of the labour that keeps the technocapital machine running, as well as how to responsibly represent it. How, I wondered, could I receive the image of the woman labourer and represent her in a way that did not reinforce my role as a consumer who exploits the Other or that abstracts them as an object? How could I discourage others from participating in ignorant consumption practices in Western societies? How could I renew the role of the user, moving away from socially unjust practices that discard Others and objects out of sight, out of mind?

Toward a research-creation project that is framed by these questions, *e-Waste Peep Show* is mindful of the receiver of the project (as additionally a media user and a consumer). It seeks to defamiliarize the receiver's experience of the consumption of objects, subjects and images that are circulated by technological infrastructure. For *e-Waste Peep Show*, I sought to defamiliarize e-waste and garbage by making them visible. Upon approaching the installation, it does not look like art, but rather, like literal garbage. For its premiere at the *multiple contingencies* exhibition,[17]

15 Olia Lialina, 'Not Art & Tech', in *Across & Beyond: A transmediale Reader on Post-digital Practices, Concepts, & Institutions*, ed. by Ryan Bishop, Kristoffer Gansing, Jussi Parikka and Elvia Wilk (Berlin: Sternberg Press, 2016), pp. 135–145 (p. 139).

16 Here, I am using the term 'cool' as it is described in Alan Liu's *The Laws of Cool* (Chicago: University of Chicago Press, 2004), which understands cool in relation to information culture and technological industry.

17 Lai-Tze Fan, *e-Waste Peep Show; or, on Seeing and not Wanting to be Seen*, 15–18 November, 2018, installation at the Multiple Contingencies exhibition, the Society for Literature, Science and the Arts conference, Toronto.

I was assisted in setting up the installation by curator Belinda Kwan and assistant Bertha Lee. We 'decorated' the site with stacks of cardboard boxes and littered the space with obsolete media, including non-digital media such as rotary phones and dead batteries, as well as digital media such as lithium-ion batteries, broken laptops and the computer servers that had once been in the cardboard boxes (see Fig. 6). We swept leaves and twigs around the site to evoke the now-naturalized mix of trash and nature that is in the urban outdoors.

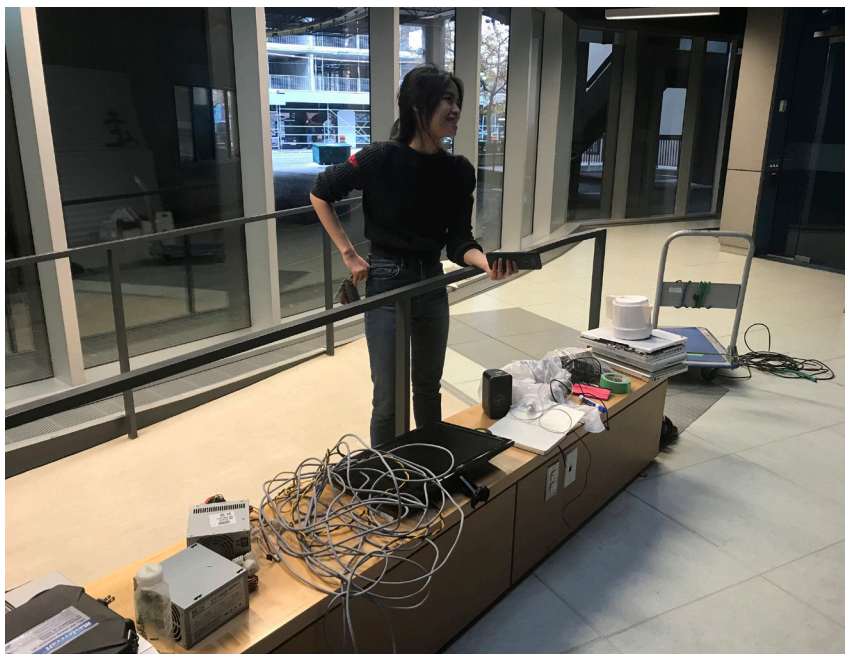

Fig. 6 Curator Belinda Kwan at the first installation of *e-Waste Peep Show*, November 2018. Photograph by Lai-Tze Fan.

All of the media objects and boxes were borrowed from the storage spaces of our exhibition site at OCAD (Ontario College of Art and Design), Toronto, Canada. The servers, I was told, had been purchased five years before (2013) and were now out of use, as a new model had been invented and ordered. While I only featured two physical servers in the installation, we used all of the empty boxes, which in total, represented $1.5 million CAD in e-waste. One of my particular foci was to foreground the project's 'glocalization', a term that describes

local problems, practices and techniques that maintain consideration of global contexts, societies, politics and futures. 'Glocality' is therefore an apt framework to think about how e-waste found on the OCAD campus could represent e-waste generated in the city of Toronto, and by extension, the participation of large cities such as Toronto in a global technocapital circuit.

The installation, again, looked like a pile of garbage that did not even belong in the exhibition. In truth, many visitors originally walked past the installation, not recognizing it as an art piece. In response, I placed speakers behind the boxes to loop loud sounds of construction, and it was this noise that invited visitors to take a second look and to understand this aesthetically displeasing and uncomfortable pile of garbage as a deliberate production (see Fig. 7).

Fig. 7 The completed installation of *e-Waste Peep Show*, November 2018. Photograph by Lai-Tze Fan.

I screened the footage so that it played behind large, dirty sheets of corrugated plastic that were spray painted in a similar manner as the original e-waste plant. I drilled tiny holes into the sheets at varying

heights to allow spectators to peep inside. The experience is one of watching someone who is doesn't want to be looked at—a forbidden feeling that hopefully repeats the process of negotiation that I first went through at the e-waste plant in Hong Kong. In particular, drawing upon the experience of *Étant donnés*, I wanted the spectator to confront the unseen or not-to-be-seen in a way that makes more transparent their own viewing practice as a violent consumption practice.

In another version of *EWPS*, the installation was re-created at Rutgers University, Camden campus, in New Jersey, USA. In April 2019, Rutgers-Camden's Digital Studies Center hosted a Digital Ephemera Conference (now an annual event) on the topic of 'Trash', and I proposed to discuss and re-create *EWPS* to compliment the Center's efforts in re-thinking objects' original conditions. The theme of 'Trash' in particular begs the reconsideration of media objects beyond their original contexts, use-values, intended audiences and users, and accessibilities.

The project became a collaborative effort. The conference organizers generously sectioned off the end of the conference as a workshop period for all participants to focus on the construction of *EWPS*, starting by splitting up conference participants into four work groups that represented stages of media objects' lifecycles: excavation, production, consumption and disposal. Led by myself as well as young scholars at the University of Waterloo—Dr. Phil Miletic, Dr. Jason Lajoie and Megan Honsberger—these groups challenged participants to confront physical media artifacts according to their work group, asking critical questions about otherwise familiar technological objects and their sustainability, ethics and wastefulness. We then gathered around a screen on which my footage of the masked woman was being projected, collectively constructing a wall around the screen with the artifacts from each group. It was an exercise in mindful, engaged making.

Sustainability sounds great on paper, but its execution necessitates so much more awareness on the part of the consumer, as the practice of responsible consumption continues to be a global challenge. What is needed is transparency of the term 'e-waste recycling', which, while seemingly sustainable, is not as effective as sustainable action at the stage of production. That is, the most effective point of social intervention and responsible action is before resources are excavated in the first place. The point of using obsolete media in *e-Waste Peep Show*

was to offer an alternative form of e-waste recycling, where instead of breaking down devices to be resold into the capital circuit, materials and devices could be used for creating greater awareness of the capital circuit, completing the picture of *what comes before production and after consumption*. I will continue to re-build *e-Waste Peep Show* as an ongoing, travelling project, the objective of which is to demonstrate to spectators their own complicity in what are absolutely unsustainable practices. Confronted with the residue of their own technological consumption, spectators must therefore consider how to avoid fetishizing media devices—including the labour that produces, promotes and processes these devices, as these devices also produce and process so much waste.

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11. Art, Ecology, and the Politics of Form

A Panel Revisited

Natalie Loveless, Andrew S. Yang, Karin Bolender, Christa Donner, Scott Smallwood, Leanne Olson and Jesse Beier

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The following forum emerges from a panel called *Art and/in the Anthropocene: A Debate on Sustainability and Ecology* that was co-organized by Natalie Loveless and Jessie Beier for the Kule Institute for Advanced Study's Around the World econference in May of 2018. The conference panel invited discussion by six artist-scholars in addition to the organizers—Karin Bolender, Christa Donner, Mia Feuer, Leanne Olson, Scott Smallwood and Andrew Yang. Together they discussed two pre-circulated questions: one on sustainability and one on ecological form. Organized and edited by Loveless, the contributions in this forum respond to these questions. Yang argues for systems thinking in the context of art and ecology; Bolender considers multispecies care practices; Donner makes a plea for intergenerational empathy and collective problem-solving; Olson examines our disavowed relations to waste; Smallwood grapples with problems of representing the Anthropocene; Beier reflects, in a speculative-fictive form, on the folly of attempting to sustain our current ways of living and dying; and Loveless concludes with a reflection on art, ecological form and climate change. Together these short essays invite the

reader to consider the role of art in creating new conditions for climate justice thinking and action.

Interventions

a. Natalie Loveless: Art and/in the Anthropocene

b. Andrew S. Yang: The Aesthetics of Hidden Ecologies

c. Karin Bolender: R.A.W. Arts of Barnyard Becomings

d. Leanne Olson: From Repulsion to Care

e. Christa Donner: Nurture/Future/Sculpture

f. Scott Smallwood: Thoughts on an Unfinished Composition…

g. Jessie Beier: Against Frontier Sustainability (or, Breaking Up with *The High Frontier*)

h. Natalie Loveless: Aesthetic Attunements

Art and/in the Anthropocene

Natalie Loveless

The following contribution is the result of a panel, *Art and/in the Anthropocene: A Debate on Sustainability and Ecology*, co-organized for the Kule Institute for Advanced Study's *Around the World* econference in May of 2018.[1] The panel invited discussion of two pre-circulated questions:

Question 1: 'Sustainability' has become a catchword *du jour*. Although it is defined in various ways, it is most often understood as a practice or way of doing things that can be maintained—or sustained—at a certain level indefinitely. For instance, when we talk about ecological sustainability in light of Anthropogenic climate change, we typically still understand it in terms of a battle between nature and human-made interventions (i.e., industry), where 'we' (humans) are able to 'sustain' nature as we prefer it. That is, we preserve the resources and practices needed for human consumption, whether that means energy consumption or aesthetic consumption. In this way, it might be argued that sustainability is undergirded by the (often) unquestioned imperative for 'progress' and 'growth', in spite of the growing realization that the planet on which we reside is, indeed, *finite*. When we talk about sustainability, then, what is it that we hope to sustain? How might we (re)define and (re)imagine sustainability beyond Anthropocentric desires, towards more livable futures for all? And what role might art and performance play in such (re)imaginings?

Question 2: The term 'Anthropocene' has been hotly contested over the past few years, and debate generated under its sign has been crucial to new thinking in the arts and humanities.[2] While the current state of

1 The panel was co-organized by myself and Jessie Beier. Rather than co-edit this forum, she has opted to write one of the responses.

2 Many critical alternatives have been proposed. These include Capitalocene (Jason W. Moore, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* (London: Verso Books, 2015)), Plantationocene and Cthulucene (Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), Planthroposcene (Natasha Myers, 'From the Anthropocene to the Planthroposcene: Designing gardens for plant/people involution', *History and Anthropology*, 28.3 (2017), 297–301, https://doi.org/10.1080/02757206.2017.12

 https://doi.org/10.11647/OBP.0213.11

ecological affairs requires responses from across the spectrum of human ingenuity, from the development of new technologies and innovation in engineering to far-reaching policy changes, the arts have an important—and often overlooked—part to play. Rather than providing either more information *on* the Anthropocene or new *representations of* the Anthropocene, artistic practices can work to shape cultural imaginaries in new ways through care-filled attention to *form*. In your practice, do you make a distinction between art that is *on* ecological topics and art that works with an ecological aesthetics (sensorium) or that takes ecological *form*? If so, how do you make and navigate such distinctions?

This last question was mine.[3] It emerges from my current research, a project tentatively called *Sensing the Anthropocene: Aesthetic Attunement in an Age of Urgency*. I borrow the title for the project from a short coda to Joanna Zylinska's *The End of Man: A Feminist Counterapocalype*. In it, she writes: 'the Anthropocene is not to be sensed only, or even primarily, on a visual level: we literally breathe it, day in, day out. The Anthropocene can therefore also be tasted, smelled, walked through, touched, and heard [...] We could thus go so far as to say that we already sense the Anthropocene before we can come to terms with it; this is the case even if we ignore or deny it [...] Picking up the [...] injunction to see and sense better, I want to cast *The End of Man* as an invitation, issued to those embodied humans who still recognize themselves as such, to look around, take a deep breath, and set out to carve a new path between the familiar and the possible'.[4]

Zylinska's call, while not excluding material actions of protest, intervention, advocacy, policy and political engagement, is, additionally, an invitation to investigate other modes of being in the world, modes of

89934), and Gynocene (T. J. Demos, 'V. Anthropocene, Capitalocene, Gynocene: The many names of resistance', *Still Searching: An Online Discourse on Photography*, Fotomuseum Winterthur: Switzerland (June 12, 2015), https://www.fotomuseum.ch/en/explore/still-searching/articles/27015_anthropocene_capitalocene_gynocene_the_many_names_of_resistance). Each of these alternative terms, in their own way, underscore the degree to which 'Anthropocene', with its generalizing anthropocentric focus, can too easily mask the uneven work of petro-capitalism, settler-colonialism, patriarchy, and other interlocking systems of domination.

3 The first question was Beier's.

4 Joanna Zylinska, *The End of Man: A Feminist Counterapocalype* (Minneapolis: University of Minnesota Press, 2018), https://manifold.umn.edu/read/the-end-of-man/section/5d7ceb69-ee09-4924-8aa7-55341fdeb5ab.

being that work toward carving out new spaces of possibility that impact our local sites of exchange and engagement at the level of *relational* being within a human and more-than-human world. Responding to this call, the artists gathered together in this forum investigate the interplay of art, ecology and the Anthropocene—a term that carries within itself the very problem that it names: the *Anthropos*, an anthropocentric worldview that is, at its core, racist, sexist, speciesist and extractivist; that is, one that is fundamentally un-ecological. Together we argue that, while we are in desperate need of technological, economic and social restructuring, we are also in need of serious retraining in how we, as disparate yet interlocking individuals, collectivities and societies, move through, *with*, *as* and *of*, this world. How we breathe it, see it, and sense it. Day in, day out.

In what follows, five of our six original participants, together with the panel organizers, offer responses that, in some cases, reflect what they said in session during the panel, and, in others, have been significantly reworked.[5] Each contribution implicitly or explicitly addresses itself to the question of what art can do to unsettle our given relations under the sign of the Anthropocene. Andrew Yang argues for systems thinking in the context of art and ecology; Karin Bolender considers multispecies care practices; Christa Donner makes a plea for intergenerational empathy and collective problem-solving; Leanne Olsen examines our disavowed relations to waste; Scott Smallwood grapples with problems of representing the Anthropocene; Jessie Beier reflects, in a speculative-fictive form, on the folly of attempting to sustain our current ways of living and dying; and I conclude the forum with a reflection on art, ecological form and climate justice ethics. Together, these short essays invite the reader to consider the role of art in creating new conditions for climate justice thinking and action.

5 Due to unforeseen circumstances one of our original participants, Mia Feuer, was not able to participate in this publication.

The Aesthetics of Hidden Ecologies

Andrew S. Yang

The advantage that art seems to have over writing, law or science is that an artwork is free to take absolutely whatever form suits its function, to unapologetically make a medium the embodiment of its message. Given that freedom, it is incumbent on artists to strive to create work that is ecological in form and not only 'content'.

It is in vogue to call all sorts of things 'an ecology'. Trained as an ecologist, I am critical of the term when it is applied to situations in which the non-human isn't taken seriously, or when a systems-understanding of relationships aren't a focus. That said, I think many things—even art itself—could be seen through an ecological lens in virtue of having inputs and outputs that complexly feedback on each other, and from which an integrated system emerges over time. To the extent that art is committed to the circulation of ideas, images and involves the exchange of material and economic resources, the art system is also an ecosystem. The question is just how much those aspects are acknowledged intentionally within artworks themselves. An early example might be Hans Haacke's work entitled *Shapolsky et al. Manhattan Real Estate Holdings, A Real Time Social System, as of May 1, 1971* that revealed MoMA's economic entanglement with urban slum lords in New York City. Haacke's project one year later, *Rhinewater Purification Plant* (1972), likewise engaged a kind of *systems aesthetic*, or, in that particular case, an *eco*systems aesthetic around the pollution of rivers.[6]

The ecological form that an artwork might take is always going to be partial for the simple fact that showing every aspect, connection or detail of a system is impossible. Because every representation is a model, it is necessarily incomplete, but richly so. The incompletion urges interpretation. An artwork, as a part, can point a viewer's or participant's

6 Jack Burnham first proposed the idea of systems aesthetics in his essay 'Systems esthetics', *Artforum*, 7.1 (1968), 30–35. For more on the notion of 'ecosystem aesthetics', see Andrew Yang, 'Second laws, two cultures, and the emergence of an ecosystem aesthetics', *Interdisciplinary Science Reviews* 40.2 (2015), 168–181, https://doi.org/10.1179/0308018815z.000000000111.

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imagination towards what isn't explicitly shown, but must certainly be there. What are the active connections and important details teeming just out of view? To bring those imagined and very real things closer to the surface—and make one's participation within them palpable—would seem to be the aspiration of an authentically ecological art.

In the project *Flying Gardens of Maybe* (2012–2020),[7] I sprout plants from seeds that I've recovered from the stomachs of birds that die in collisions with Chicago's skyscrapers. While that one sentence sums up the project, the work of the art is to make the fuller equation—not only its sum—more perceptible and ponderable. Photographs, text, and diagrammatic wall drawings accompany the seedlings so that the complex eco-logic of connectivities involved can come into view. At minimum, these include: the light pollution and mirrored skyscrapers that scrape the sky of migrating birds; the all-volunteer Chicago Bird Collision Monitors that collect fallen birds throughout the city;[8] the Bird Lab at the Field Museum of Natural History where the dead birds are brought to become part of the museum's archive;[9] the museum garbage bin from where I reclaim the seed-rich innards; and the birds themselves, cooperative vehicles by which plants have distributed themselves throughout the landscape for the past 125 million years. The idea is to, in some small way, point to how an ecology of interruptions might be rewoven through the connections of different communities, institutions, and non-human species to each other. Is this an example of authentically ecological art? Possibly yes, likely no, but maybe it is an experiment in that direction.

Where does this notion of ecosystems aesthetics leave writing, photography, painting, or collage? Art in these mediums might explore ecological topics, but where within these two-dimensional formats can 'ecological form' take substantial shape? As artifacts within an ever more digitally-dominated world, perhaps text and image-based work would seem at special risk of becoming figuratively and literally immaterial—informational, maybe cybernetic, but not ecologic. Even if this were true (and it is not—every medium can engage an ecosystems

7 'Flying Gardens of Maybe', https://www.andrewyang.net/maybe.
8 'Chicago Bird Collision Monitors—CBCM', https://www.birdmonitors.net/.
9 'Bird Specimen Collection', *Field Museum of Natural History*, https://www.fieldmuseum.org/node/5131.

aesthetic), the digital is material through and through. Our technosocial system invites us to neglect the fact that every PDF, JPG, and webpage owes its existence to the coal, oil, rivers and metal of a physical planet. The effectiveness with which digital media are able to screen-off their fossil-fueled nature or their exploitative manufacture is a testament to extractive capitalism's skill at evading direct perception. But it is also due to the elusive nature of the pollution that seems to disappear into thin air. If the average American's Internet usage produces 300 lbs (36 kg) of carbon dioxide a year—about the same as the combustion of 15 gallons (57 liters) of gasoline[10]—then this essay's contribution to global greenhouse gas emission appears quite small. But if there is any defining character of the Anthropocene, it is the uncanny and counterintuitive way in which minute increments manifest as large and looming totalities. The nature of global warming is parts-per-million—a marginal fraction distributed and diffuse, however in ways that are not only countable, but also that seriously count.[11]

Our habitual obliviousness to how visual culture is powered by the fossil fuel econo-ecology is what Brett Bloom has described as a lack of 'petro-subjectivity'.[12] Maybe these last two paragraphs are small gestures towards trying to activate that subjectivity in ecological form—to recognize this electronic text to be *of* an ecology and not just a means to communicate *about* it. How might we construct an aesthetic in the original sense of the word (*aisthetikos*, Greek—'of or for perception by the senses', or 'perceptible things') that aids in our perception of the active entanglements of every form within an active system of innumerable others? While aesthetics is often understood in the terms of visuality and art history, my hope is that aesthetics can be reclaimed in relational and naturalcultural ones of ecology; form transformed.[13]

10 Christopher Helman, 'Berkeley Lab: It takes 70 billion kilowatt hours a year to run the Internet', *Forbes* (June 28, 2016), https://www.forbes.com/sites/christopherhelman/2016/06/28/how-much-electricity-does-it-take-to-run-the-internet/#54860bc81fff.

11 The Internet accounts for just 2% of the U.S.'s total electricity use–proportionally small, but absolutely large considering that generating 2% takes the equivalent of eight nuclear reactors, or twice as much as the output of all the solar panels currently operating in the United States. Ibid.

12 Brett Bloom, *Petro-Subjectivity: De-Industrializing Our Sense of Self* (Fort Wayne: Breakdown Break Down Press, 2015).

13 Donna Haraway has written that 'Form, like nature, is one of the most complicated words in the English language. Form is about shape, number, figure, beauty,

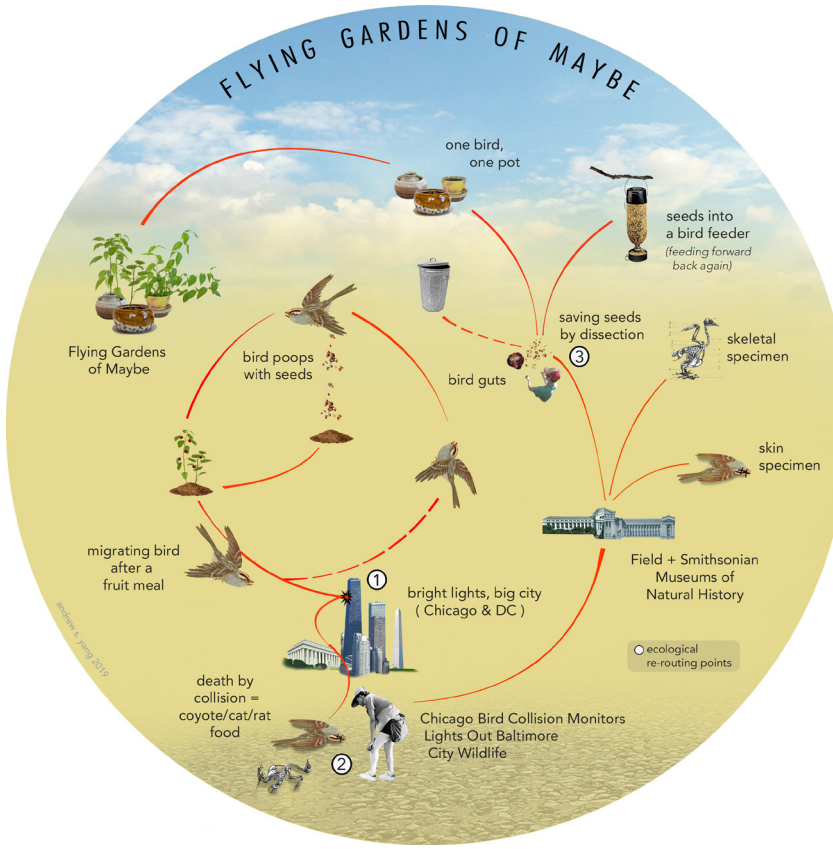

Fig. 1 An eco-logic diagram of key relations in the *Flying Gardens of Maybe*. Andrew Yang, 2012–2020.

making, ritual, image, order, cause, relationship, kind, conduct, and character. 'To have good form' describes a way of doing something that is at once about ethics, technics, and practice', Donna J. Haraway, *Crystals, Fabrics, and Fields: Metaphors That Shape Embryos* (Berkeley: North Atlantic Book, 2004), p. xvii.

Fig. 2 Two vehicles: A Hermit Thrush, a 'birdstrike' victim of collision with building glass (left); and the seeds from that thrush sprouting within a hand-thrown pot (right). Andrew Yang, 2013.

R.A.W. Arts of Barnyard Becomings

Karin Bolender

From the small ass farm where I live with a multispecies family in the U.S. Pacific Northwest, I am excited to share a short video,[14] which illustrates certain ways that the Rural Alchemy Workshop (or R.A.W.) practice explores questions arising within this larger conversation. Borrowing Donna Haraway's guiding question, 'Whom and what do I touch when I touch my dog?', this barnyard-bound performance practice for the past eighteen years has investigated the question, 'Who and what do I kiss when I kiss my ass?'—with the caveat that one's 'ass' is never what one thinks it is.[15] And of course, the gift of this question resides in the fact that there is no one simple or respectful way to answer it, as such. What matters is the practice of asking it, over and over again, in loving respect, humble wonder, and slow deliberation, and in every way imaginable… and then some.

Grounded in webs of care, desire, uncertainty, and fraught complexities of intraspecies intimacies, this little video illustrates aspects of the R.A.W. practice I draw from to address important questions posed by this wonderful gathering of thinkers and makers around questions of Art and/in The Anthropocene, beginning with:

What is it we hope to sustain?

As I was pondering this question in the context of the discussion, the final passage from Cormac McCarthy's post-apocalyptic novel *The Road* came to mind. Actually, the last word, which is 'mystery'. In case you haven't read it, or don't remember it exactly, the passage goes like this:

> Once there were brook trout in the streams in the mountains. You could see them standing in the amber current where the white edges of their fins wimpled softly in the flow. They smelled of moss in your hand. Polished and muscular and torsional. On their backs were vermiculate patterns that were maps of the world in its becoming. Maps and mazes. Of a thing which could not be put back. Not be made right again. In the

14 See https://vimeo.com/user41106277/review/486976557/e3e20bd20b.

15 Donna J. Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), p. 3.

 https://doi.org/10.11647/OBP.0213.13

> deep glens where they lived all things were older than man and they hummed of mystery.[16]

The sense of what the earth has lost because of human extractions and overblown hungers is profound and gut-wrenching. But also, in the midst of this stark evocation of loss, I find shimmers of hope in the last line, the last word. Because the mystery, old as it is, is always here. So if I had to narrow my response to the question 'what do I want my practice and worldly actions to sustain?' to a word, what I call up is this: mystery.

We are aware of devastated earthly places, where untold lives are plundered and erased or pushed to the edges of extinction by human activities and effluents. But even in these places, mystery survives, because enmeshed lives are always full of untold stories and unreckoned possibilities.

Reckoning with the so-called Anthropocene demands humility in a variety of forms. Art provides vital tools for honoring what we cannot know by empirical means, or sometimes grasp at all. Embracing indeterminacy, performance in particular makes vital spaces in which to cultivate humility and various kinds of joyful unknowing and passionate wonder. By the same token, such spaces may actively RESIST dominant and often devastating assumptions of growth and progress. Alongside more overtly political forms of resistance, artful openings allow us to slowly but steadily reimagine becomings within subtle meshes of mystery—maps and mazes, where we wander and invite others to wander with us, following nameless passions and tracing hopes for lively futures, full of mysterious mud and microbes and mammals and untold others.

On Ecological Forms

I am immensely grateful to all of the artists, critics, curators and others who have cultivated practical spaces that allow artists to fully embody, explore and live messily inside the frames of our deepest questions, quandaries, and passions. Guided by these practices and theories, I can both creatively and critically dwell inside of what Natalie

16 Cormac McCarthy, *The Road* (New York: Vintage International, 2006), p. 287.

Loveless frames as an ecology of care in the R.A.W. barnyard.[17] In the logic of art practice that formally embraces complex interconnection and care in order to do purposeful and responsible imagining within specific naturecultures, it's all ecological. I most admire situated but wildly expansive art practices that resonate with Deborah Bird Rose's observation that ecologies may not just be more complex than we think they are, they may be more complex than we CAN think.[18]

I would call the R.A.W. an ecological art practice, not because it considers multispecies matters but rather because, more than anything else, it questions the wisdom and value of making certain distinctions between forms of life, versus the value of sustained attention to interdependencies. Creative practices seek and often find new ways of thinking and perceiving. What is most exciting to me is when we find unforeseen modes of becoming right in our own backyards, entangled bodies and beloved muzzle tongues.

17 Natalie Loveless, 'Maternal ecologies: A story in three Parts', in *Performing Motherhood: Artistic, Activist, and Everyday Enactments*, ed. by Amber Kinser, Kryn Freehling-Burton and Terri Hawkes (Ontario: Demeter Press, 2015), pp. 149–169. See also Natalie Loveless, *How to Make Art at the End of the World: A Manifesto for Research-Creation* (Durham: Duke University Press, 2019).

18 Deborah Bird Rose, *Reports from a Wild Country: Ethics for Decolonization* (Sydney: UNSW Press, 2004), p. 188.

From Repulsion to Care

Leanne Olson

I met thirty-something Shoe in midsummer. It appeared after a layer was scraped back off the Clover Bar 'Landfull' in Edmonton.[19] Deemed in its end phase of life as pre-determined by discard culture,[20] it was told: your span has ended, please retire to the pile. Yet, just look at Shoe! It's quite intact—not wasted away at all, barely decayed—though it *is* missing its pair.

By pausing, by shifting the gaze, I alter the process. What was the physical process of discarding Shoe? A quick flick of the wrist and into the can/luggage compartment that took Shoe to the Edmonton Waste Airport and onward to its final destination?[21]

But: freeze frame. Still image; a scenario where we can ultimately 'sustain' time. Here's a photo:

Fig. 3 *Shoe Knew?*, 33 in x 51 in, digital photograph. Leanne Olson, 2018.

19 Educators leading tours at the Edmonton Waste Management Centre use the word 'landfull' when describing a full landfill to visitors.

20 See, e.g., https://discardstudies.com/about/. Discard Studies is a term used 'to ensure that the categories of what is systematically left out, devalued, left behind, and externalized are left open'. See Liboiron, Max. "Why 'Discard Studies'? Why Not 'Waste Studies'?" Discard Studies, 4 Sept. 2014, discardstudies.com/2014/09/04/why-discard-studies-why-not-waste-studies-2/.

21 'Edmonton Waste Airport' is how I describe the Edmonton Waste Management Centre, as most materials leave the facility and board ships, train cars, or enter sea cans, before they are sent to an array of individualized destinations.

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Now Shoe has emerged again, via the industrial combines, to be found through a lens. By creating a photo of Shoe, I immortalize the sight of Shoe. This is not a familiar sight of Shoe, nor is the site readily accessible. By making Shoe a four-foot art piece, I ask for an expansion in visual memory. I ask to set aside a slot in our minds for decay. With Shoe soon to be in a gallery, I wonder, will there be any empathy for Shoe?

I recently completed a year-long artist residency at the Edmonton Waste Management Centre, a program funded by the Edmonton Arts Council. Embedded in the operations of waste managing and processing, I became more and more comfortable with discards, becoming visually familiar with the materials and working up to an embrace of decay.

Fig. 4 *The Clay at Ryley*, 33 in x 51 in, digital photograph. Leanne Olson, 2018.

As James K. Rowe asserts in his essay, 'Is a fear of death at the heart of capitalism?',[22] to combat and interrogate the fear of death (or time), we must first acknowledge the fear, observing where it arises and how it permeates. Knowing this, we can familiarize. We can learn, we can say Hello to the land that holds these materials. Through acknowledgement, we learn which land holds these materials, reflecting on the proximity of that land to the city and power structures that created the materials.

Let's take a closer look at other skins of consumption.

22 James K. Rowe, 'Is a fear of death at the heart of capitalism?', *Ernest Becker Foundation* (April 26, 2016), https://ernestbecker.org/is-a-fear-of-death-at-the-heart-of-capitalism/.

Is waste the visual reminder of what we pay to hide?

Stacked in a pyramid, an undeniably hierarchical formation, are the leftover carcasses of corporate slogans. Viewing corporate advertising as a muddled slew for a year has been a refreshing experience. Cleansing, even. By documenting materials in these formations—as decaying slogans or word puzzles—I introduce an additional view of consumption:

Fig. 5 NOW, 33 in x 51 in, digital photograph. Leanne Olson, 2018.

Nurture/Future/Sculpture

Christa Donner

Fig. 6 *Conversations about the Future*, ink on polypropylene on window. Christa Donner, 2015.

The language of sustainability is used to describe a sensibility of shared ecological values, inspiring new tools to mitigate the harm that humans inflict upon our own planet. These days you can find an endless supply of 'green' products that are both innovative and familiar, allowing consumers to pursue a comfortable lifestyle while reassuring them they're doing something nice for the world. This approach is premised on the idea that humans are the ones in charge here, that we are an inherently aggressive and invasive species tamed through the possessions we choose to buy. Of course, we are more vulnerable than we like to believe, and none of this is especially 'sustainable' in the long run. My own working definition of sustainability requires an investment in relationships built among the complex network of organisms that live in and around us. It is a messy, slow process of inquiry, failure, and mutual respect. When considering how humans can live in balance with the ecosystems we so heavily rely on, what role can artistic practice play?

If we are to find a way forward, we will need to do so with creativity, and with care. When I say 'care' here, I mean carefully, but also with respect to those who care for others, whose knowledge and labor

 https://doi.org/10.11647/OBP.0213.15

have always been devalued by capitalist culture. Giving care greatly expands our capacity for improvisation and creative problem-solving, both critical resources in this time of rapid change. Creative caregivers can play many roles in reimagining and redefining sustainability. Some of us are already doing and living this in interesting ways, both public and private.

As an artist, I move between the imaginative space of the studio and more social, hands-on engagement. I use painting and drawing to propose speculative systems, often borrowing models from other organisms to investigate what we can learn from them, and how we might co-evolve. While drawing tends to be a solitary activity, I approach it as a collaboration with many 'future foremothers', working across time and space to shape a new domain. These foremothers are writers, artists, and activists, some well-known and some less so. They include the Buddhist environmentalist Joanna Macy, who facilitates conversations with beings two hundred years in the future, the writer Marge Piercy, whose work proposes a holistic restructuring of society after environmental and economic collapse, and my daughter, Stella, who has radically altered my relationship with the natural world and with time itself. I translate what I learn from these foremothers not only into drawings but also toward workshops, interview-based projects, and guided visualizations that aim to activate intergenerational empathy and collective problem-solving.

This process extends to my work as a parent, and as a college educator working with themes of care and sensory experience in my classes. Raising a child and institutional teaching are not activities that we typically consider 'art', partly because they're so personal and intimate in scale—but I recognize them as part of the larger creative practice of modeling systems I hope to see in the world. Caring for the next generation has changed my relationship with the past and the future, compelling me to speculate beyond my own lifespan and to consider my role more carefully. If I involve my daughter in the process of growing and composting things, it makes these processes visible, accessible and integrates them into her larger world view. I consider this a sort of ecological form, one which may—or may not—be disseminated further, holding the potential to grow and evolve as others pass it along.

Most recently I've been taking my interest in social sculpture[23] and nature-based adventure playgrounds into some practical, hands-on work with my community. We've been working to create situations where—even in the middle of an intensely urban place like Chicago—future generations can develop an ongoing relationship with nature. When young people explore the natural world on their own terms, they develop new skills and create potent sensory memories. They become more mindful members of the local ecosystem. If we're lucky, some of these children may become future stewards of the environment. This broader ecological form feeds back into my more speculative, studio-based practice, and vice versa. As artists and scholars, as parents, as people, we play a critical role in transmitting information from the past and the possible future to the next generations, who will help shape what is to come.

Fig. 7 *Saying goodbye*, digital photograph. Christa Donner, 2018.

23 Social sculpture is a term coined by the twentieth-century artist Joseph Beuys. See Allison Holland, *Joseph Beuys and Rudolf Steiner: Imagination, Inspiration, Intuition* (Melbourne: National Gallery of Victoria, 2007); Carin Kuoni, *Joseph Beuys in America: Writings by and Interviews with the Artist* (New York: Four Walls Eight Windows, 1990); Shelley Sacks, 'Social sculpture and new organs of perception: New practices and new pedagogy for a humane and ecologically viable future', in *Beuysian Legacies in Ireland and Beyond*, ed. by Christa-Maria Lerm Hayes and Victoria Walters (Münster: Lit, 2011), pp. 80–97.

Thoughts on an Unfinished Composition...

Scott Smallwood

As I consider the provocations offered—about climate change, sustainability, what it is we are sustaining and why it matters—I am in the midst of working on a new artwork that addresses these very questions by working sonically with data on climate change. The data I work with includes temperature changes over time, per country or per region; humidity changes; the frequency of catastrophic storms; deforestation and the loss of our planet's *lungs*; the loss of ice in Greenland, the Arctic, Antarctica; our glacier inventory... and on the list goes.

When my partner and I first immigrated to Canada, one of the first things we did was visit the Athabasca glacier in Jasper National Park, nestled in the Rocky Mountains that follow the Alberta-British Columbia border. As we began our walk from the parking lot to the edge of the glacier, we noticed along the way a series of small signs—monuments really—with a simple year printed on each. We realized that these signs marked the edge of the glacier in that year, showing how far the glacier has receded over time. Upon realizing this, Jen and I each entered into a state of mourning, stepping away from each other to contemplate the glacier, hiding our silent tears from each other and the other people there. I recalled that I had come this way before when I was only three years old, with my parents, as part of a long road trip to Alaska. I don't remember much about this trip, of course. But I thought about this as I searched for the sign that was closest to the year 1972.

With these memories front and center, I asked myself: should my new work be about glacier loss? Should it be Canada-specific? Should I insert myself into it—by engaging with aspects that are personally meaningful to me? I want people to *feel* these changes, to feel the loss, the disappearance and the continuing slide...

 https://doi.org/10.11647/OBP.0213.16

Fig. 8 Athabasca Glacier, Canadian Rockies, Alberta, July 2012. Photograph by Scott Smallwood.

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I grew up in the mountains of Colorado, and mountains have always been very special to me. I'm not a religious person, but I think of mountains as living things, as spirits. To my young eyes, they were the edges of my world, always snow-covered, even in the hottest of summers. Travelling through flat places like Kansas or the panhandle of Texas was a bizarre experience to my young brain, as the world seemed to go on forever. It was almost dizzying.

Recently, when I was visiting my parents in Colorado, I found (in the garage) my grandmother's dinner bell. It's about thirty-five cm tall, and has a beautiful floral pattern etched into its bronze body. I picked it up and rang it. The sound of that bell startled me. I was immediately transported to my grandparents' home in Stephenville, Texas, circa 1981 or so.

The bell hung on the wall separating the living room from the kitchen, and I recall annoying everyone by ringing it loudly before dinner. Even though it has been over thirty years since I've been in my grandparents' home, I remember every room: the feel of the carpet on my feet, the tile of the kitchen floor, the smell of the garage where my cousin's skateboard hung on the wall, the homemade ladder my grandpa made, the strange feeling of moist Texas dirt in my hands as I made mud pies in the backyard.

On and on the memories flood in, all because of this bell.

I made recordings then and there, and now they sit on my computer, playing through my studio speakers back in Edmonton, as I contemplate climate change and my family. My grandparents' Texas oil money that helped put me through college. The mysterious pump jacks in their gentle up and down motions as far as the eye can see on the infinitely flat expanse of the panhandle of Texas as we drive from Colorado. Linda Ronstadt and John Denver on 8-tracks.

'Are we there yet?' I keep asking my dad.

Fig. 9 My grandmother's dinner bell, Buena Vista, Colorado, August 2018. Photograph by Scott Smallwood.

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I'm not a scientist, and as I pour over the climate change data I've gathered for this new work, I can't understand much of what I'm seeing. I have to rely on people who can. What I do have are my senses. Other animals have different senses, different ways of measuring and knowing. If only we could harness the knowledge of our non-human companions. The octopus with its many tentacles. The birds and forest creatures who can predict a storm. The hummingbird who can somehow find its way across the world. The cat who somehow knows when a human is about to die.

What is it we want to sustain? To the best of our ability, and with the understanding that there are many layers of time and space in our universe that we will never be able to contemplate, the human project must be to sustain maximal joy, and minimal suffering. We need to own our planet, to be good stewards of it as a precious creation, whether given to us by gods, or spontaneously generated by some mysterious process. We must work with our non-human counterparts to make our time joyous, and for as many of us as possible. What else is there?

Time marches forward. Bells mark time and events. Data drifts, as the conditions they outline become unmoored and they float away into an unknowable future. As we drift, and try to understand the data and each other, perhaps we can turn the tide.

Against Frontier Sustainability (or, Breaking Up with *The High Frontier*)

Jessie Beier

Dearest [redacted],

I finally received the promotional pamphlets you sent. The illustrations look great. *The High Frontier* (THF) is lucky to have such a formidable artist on the team. And only a few parts of your letter were redacted this time—here's hoping my words also get back to you without too many interferences.

The pamphlets arrived at just the right time too. Just last week, the annual EOD[24] was declared (arriving even earlier this year) and, as has been the case the last three years, rations have now been imposed on every citizen. Meanwhile, state officials have, *again*, extended unlimited access to [redacted]. People are frustrated, but also too exhausted to do anything about it.

And so, as you can imagine, looking at your gorgeous illustrations of life on THF has made me consider, once again, taking the leap to join you up there. You were right: the brochure really does sell it! I know the orbital real estate model has really taken off (so to speak), but the marketing team at THF, armed with amazing artists such as yourself, really leads the way in terms of selling a rather stellar (!) vision of sustainability. 'Love the Earth? Leave it!'[25] —genius slogan. The section titled 'Project Human 2.0'[26] is also really compelling: the pitch that THF has been able to develop a 'safe operating space' for human

24 Earth Overshoot Day (EOD) marks the date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year. Retrieved from https://www.overshootday.org/about-earth-overshoot-day/.

25 Adapted from actual slogans developed by *L-5* space activists in the 1970s, such as: "Declare the Earth a wilderness area"; "If you love it, leave it"; and "Decentralize — get off the planet". See Michael A. G. Michaud, *Reaching the High Frontier: The American Pro-Space Movement, 1972–1984* (New York: Praeger, 1986); Gerald K. O'Neill, *The High Frontier: Human Colonies in Space* (New York: William Morrow & Co, 1976).

26 J. Zylinska, *The End of Man: A Feminist Counterapocalypse* (Minneapolis: University of Minnesota Press, 2018).

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preservation and perpetuation through sustainable energy (i.e., those solar power satellites that provide 'unlimited clean energy' enabling infinite growth and higher productivity for industry and agriculture) is really powerful. (Although I can't help but wonder, *how* powerful? Like, how are things actually working up there? You mentioned last time that there were problems with [redacted] and [redacted]—any new updates there?)

It is very tempting though; the thought of taking a long bath gives me goosebumps while memories of fresh herbs make my mouth water. Not to mention the job opportunities—the Representational Innovator (RI) position you mentioned in your last letter does seem to fit with my skills. After reading the material, and especially after taking in all of those persuasive illustrations, I was *this* close to heading to the local Expansionist Agency to sign up for work duty abroad. (BTW: The recruiters are still doing weekly visits, touting all of the opportunities 'up there' by comparing it to the bleak reality of living 'down here'.) But, like I've expressed to you before, I am finding it harder and harder to get behind the project. I can't help but think about how the accumulation of things up there, is also the accumulation of extinction (or worse, the aggregation of antagonisms, oppression and suffering) down here.[27] Just yesterday, for instance, [redacted]. Despite the ongoing protests from people refusing the options given, [redacted]. I could hardly believe it. But, unfortunately, such examples are now the norm. It seems that the promise of mining asteroid and lunar materials has been swiftly replaced by 'alternative' extraction projects down here, which have [redacted], leaving the rest of us behind. As this year's EOD makes clear, THF's 'sustainable' endeavours have not only carried forward the same old risks, including [redacted], but have also introduced radically new risks that are still, even as we are experiencing them, difficult to fathom.

As I contemplated the material you sent, I couldn't help but be reminded of all of those long, and often heated, debates we used to have about these things. Remember that time when things almost came to blows after our argument about the very tenability of this thing we

27 Justin McBrien, 'Accumulating extinction: Planetary catastrophism in the Necrocene', in *Anthropocene or Capitalocene: Nature, History and the Crisis of Capitalism*, ed. by J. W. Moore (Oakland: PM Press, 2016), pp. 116–137.

call sustainability? It was right after THF made its official public launch and you finally told us about your position as Visual Communication Manager. At the time, it was hard for me to articulate my discomfort with the situation, but now I know it was because all of these pitches for a 'sustainable' human empire, no matter how artfully presented, could only ever be made possible via the continuation of our exploitative, extractive, and expansionist legacies. Not to mention, [redacted]. While THF is pitched (and sold) as a seemingly endless frontier movement, which, through sustainability rhetoric, has been able to 'solve' the apparently threatened plenitude of (human) Life as we know it, it has also perpetuated an untenable vision of human supremacy that has now occluded the very possibility of challenging human rule from our range of vision. It is simply taken for granted that any sense of sustainability will forever be founded on the conservation and triumph of a particular expression of human being, and thus all of our future imaginaries now operate through an unquestioned dedication to the industry of a particular form of human preservation.

That was the night where we began to part ways, I think. It was also the night that things crystallized for me, when I realized that perhaps there is no 'human enterprise' worth defending on a suffering planet, that perhaps there is no such a thing as a 'safe operating space' for humans to persevere after all. While I didn't have all the words back then, I do remember asking you: *what is it, exactly, that we are aiming to sustain?* And so, while I'm glad we have reconnected, I need to tell you that my answer remains the same. While I am sometimes envious of your ability to keep living a life of convenience and pleasure, of more importance to me now is working through collective ways of avoiding a political imagination captive to an either/or organization of reality: *either collapse or sustain*. Or, put another way, rather than focusing on actions that promise to sustain and extend the present (in all of its ecocidal glory) into the future, I have begun to question whether this present, with all of its desires and interests, is perhaps not worthy of sustaining.[28]

28 Claire Colebrook, 'A grandiose time of coexistence: Stratigraphy of the Anthropocene', *Deleuze Studies*, 10.4 (2016), 440–454, https://doi.org/10.3366/dls.2016.0238.

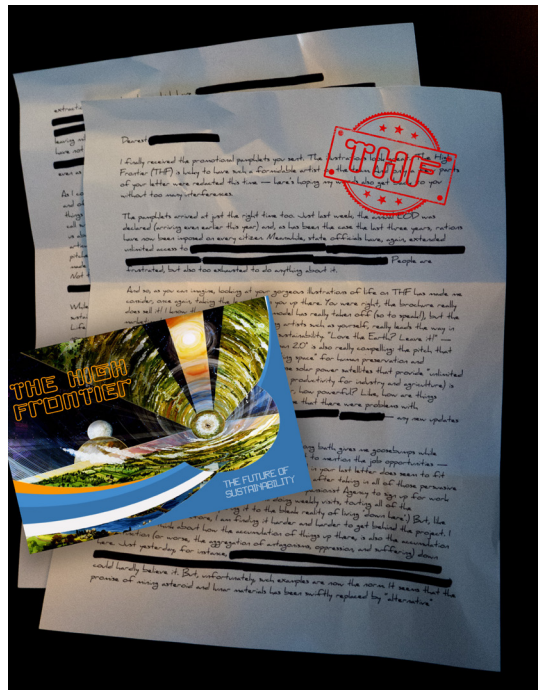

Fig. 10 Image by Jessie Beier (2019) with source material from *NASA Space Colony Art from the 1970s: Cylindrical Colonies* (public domain), creation by Rick Guidice (NASA Ames Research Center), one of the original contributing artists to G. K. O'Neill's *The High Frontier: Human Colonies in Space* (1976).

Aesthetic Attunements

Natalie Loveless

We are living in a time of climate catastrophe, ecological genocide and, now, pandemic. Species are dying at unprecedented rates; hurricanes, tornadoes, fires and floods occur with increasing intensity; the economy is crashing, and most are (at the time of writing) isolating in place—to one degree or another. This is a time during which we—those who labour in the fields of art practice, criticism, history and theory—may legitimately, and in new ways, be asking ourselves 'Why Art?' The responses gathered together in this forum, implicitly or explicitly, work to shift the terms of this question from 'why art?' to 'which art?' Or, from what 'art' (as a category of expressive, interventionist or critical cultural attention) can do *in general*, to *which forms* of artistic practice *reattune* and *recoordinate* us and *how*. In this way, they grapple with the distinction raised at the beginning of this forum, that of 'ecological form'.

Often, when I begin to talk about art that is *formed ecologically* I am asked whether I mean art with an activist or pedagogical approach to the environment and the human's place within it, or whether the distinction 'ecological form' refers to something like a work of art's carbon footprint or some other measure of ecological impact. My response is generally this: while I think that it is important—even crucial—that we pay attention to carbon use and environmental impact at the level of the conception, production and circulation of artwork, and that artwork that raises awareness about climate catastrophe is urgently needed at this historical juncture, both of these ways of thinking about ecological form, while necessary, are not, to my mind, sufficient. Not sufficient for art, and not sufficient for life.

By all means: recycle. Walk or take public transport instead of driving. Buy an electric car and get solar roof panels. Boycott institutions in bed with the fossil fuel industry. But as anyone who has started to research any one of these individual actions in any depth can attest to: before long we are down the rabbit hole of impossibility, unsure whether the energy used by the recycling plant or to produce the electric car fuel cell, in the final analysis, is actually ecologically sound or whether it

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simply defers or distracts from the problem by offering a short term and ultimately short sighted solution. This is not to say: don't research and make the best choices possible at any given moment, as needed. It *is* to say: don't mistake such actions as carrying any guarantee. We simply do not know and cannot know what it will take to pull ourselves back from the brink of climate collapse. When it comes to the impacts of climate change, it is not *if*, but *when*. And that *when* (and *where* and *for whom*) ongoingly exceeds our predictive capacities.

What the future holds we cannot guess, nor do we want to; but what we *can* and *must* do is move forward, one conference, conversation and artistic project at a time, looking to support multimodal ways of working in and with the arts and humanities, attuned to human and more-than-human social justice. As Beier, my co-organizer for the panel on which this forum is based, evocatively argues, we must resist the complacency of a technophilic guarantee: the seduction of thinking that the aim is to maintain economic growth within the logics of late-stage capitalism; the idea that the problem is simply *what* we are using ('dirty' as opposed to 'clean' energy) rather than, additionally, *how* we are using it. While it matters that we pay attention to our carbon footprints, and think about what it means for a scholar or artist to have used about half a ton of CO2 equivalent or more to fly from point A to point B to give a talk, or to consider the relative merits of the 55 or so tons expended for one of the Icelandic-Danish artist Olafur Eliasson's *Ice Watch* sculptures,[29] we must do so non-innocently. Tallying sustainability impacts and working to offset them without any attempt at degrowth is a mode of accounting that remains inside of the very system that got us into this mess in the first place.

Within the productivist and technophilic structures of our current economic system and worldview, art is understood as a cultural additive rather than a core value. The contributors to this forum challenge this perspective. "How might the world be shaped and organized differently?" is a question that matters urgently, and it is a question that art—particularly art attuned to social and ecological justice—asks. We need not only political, technological, and economic reorganization to help us move beyond our toxic ways of doing life

29 Information on Eliasson's 2018 installation is available here: https://icewatchlondon.com/.

under petro-colonial-capitalism, but social and cultural shifts—*shifts at the level of daily orientations and local practices*. Art, as a practice of aesthetic micropolitical re-attunement, encourages resilience and imaginative worlding, not by offering more facts but by finding ways, through aesthetic encounters and events, to persuade us to care, and to care *differently*. And while a creative, speculative, and multispecies model of care is far from the only thing needed in the context of climate justice and action, it is perhaps the most urgent.

We live in a world in which care practices are deeply undervalued, and, even when they *are* valued, too-often life is structured in such a way that there is (or seems to be) *no time* to really inhabit care as an ethics of being in-and-with-and-as the world. Care of things—attunement to things—that make no sense within a capitalist, consumption-driven, world view. We know the climate is changing. We know that the devastating effects that surround us will have consequences beyond our ken. More headlines and graphs aren't shifting—at a scale that matters—how we do human and more-than-human social and material life.

Given this, I stake my lot with art that works at the micro-political level of the here and now—art with both an aesthetic and an activist impulse. One of the quotes that I've been working with in this context is the following, by the feminist philosopher Donna Haraway: 'What is needed is action and thinking that does not fit within dominant capitalist cultures [… rather, we need] on the ground collectives capable of new practices of imagination, resistance, revolt, repair, and mourning and living and dying well'.[30] In developing such practices, she tells us a 'common livable world must be composed, bit by bit, or not at all'.[31]

This is key.

To take this quotation seriously is to argue for the need for new (artistic, pedagogical, institutional) strategies, strategies that force us to develop our artistic and academic research differently, responsively. Art that remakes relations. Work that asks us to render each other *capacious* and *capable* in our knowledge making-and-sharing practices; that asks us to negotiate the production of more livable and more just worlds, attentively, slowly… bit by bit.

30 Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), p. 51.

31 Ibid., p. 40.

In our given world, we romanticize the heroes. But real change doesn't happen at the level of the heroic, it happens at the level of the micro-political. It happens in the crevices. Yes, grand acts matter. They gather attention. They mobilize affect. They shift paradigms. But it is at the level of our everyday micro choices about how we move through the world that lasting change happens. Our temporal and material attunements form us. They shape us. And these shapes matter. To my mind, what art can contribute to the project of nurturing affective resilience and more-than-human social justice is this: local, situated, and care-filled attention to how *form makes worlds*.

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SECTION THREE: SUSTAINABLE CAMPUSES

12. The Weight of The Digital

Experiencing Infrastructure with InfraVU[1]

Ted Dawson

The following chapter by Ted Dawson explores the environmental entanglements of the digital humanities, considering the imbrication of digitally-driven attempts to confront environmental crisis with the contributions of digital technologies to that very crisis. The chapter centers on a case study of the InfraVU project undertaken in 2016–2017 at the Vanderbilt University Center for Digital Humanities, a project that sought to draw attention to the infrastructure supporting digital humanities (DH) at Vanderbilt. Dawson first considers the experience and concealment of infrastructure in contemporary life, and especially at the university. He then moves into a fuller description of the InfraVU project itself, showing how the development of the project exploited a productive tension between making and thinking which is central to so much DH work, and which can be understood as a specific inflection of the larger tension between understanding digital culture and digitally understanding culture. In addressing that

1 I am grateful to Madeleine Casad, Sophia Clark and Adam Merki, who, as members of the EcoDH working group convened at Vanderbilt in 2016–2017, contributed substantially to the ideas and projects discussed in this essay. I convened that group as the DH Center's first HASTAC scholar, and this work could not have been completed without the support of that organization. Ideas developed here have been presented to audiences at HASTAC 2017 in Orlando, at the 2018 Global Digital Humanities Symposium at Michigan State University and at the Maryland Institute for Technology in the Humanities at the University of Maryland, College Park, and I am indebted to helpful feedback from audience members at all of these venues, and especially to discussions with my co-presenters, Craig Dietrich, Amanda Starling Gould, libi rose striegl and Max Symuleski.

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tension, the InfraVU project demonstrates how digital humanists can use computational methods to think through environmental issues, while also reflecting critically on how that technology is itself implicated in environmental issues. The chapter concludes by foregrounding the role of the arts and humanities in ecocritical digital humanities (EcoDH).

Introduction: EcoDH

What is the environmental impact of the digital humanities (DH)? Let me approach this through a somewhat humbler question: what is the environmental impact of *a single DH center*? On entering the space, we recognize that the scarcely audible hum of computers indicates the flow of electricity, the generation of heat and the burning, in some far-off place, of fossil fuels. But how much do we really attend to the scope of the environmental entanglement of these technologies? And as we use these technologies to broaden humanistic thinking and find new pathways to understanding such intractable problems as anthropogenic climate change, how does our investigation itself become part of the problem we investigate?

This latter question, a central question of ecocritical digital humanities (EcoDH), could be understood as corollary to a central question of DH in general: how does inquiry into the culture of digital technologies inscribe itself into the use of those same technologies in cultural inquiry more broadly? Kathleen Fitzpatrick gave this one of its clearest formulations in a 2010 *Chronicle of Higher Education* piece, in which she labeled DH a 'nexus of fields within which scholars use computing technologies to investigate the kinds of questions that are traditional to the humanities', and to 'ask traditional kinds of humanities-oriented questions about computing technologies', thus outlining two tacks in DH which must obviously inform one another.[2] Though I do not expect in the following

2 Kathleen Fitzpatrick, 'Reporting from the Digital Humanities 2010 Conference', *The Chronicle of Higher Education Blogs: ProfHacker* (July 13, 2010), http://www.chronicle.com/blogs/profhacker/reporting-from-the-digital-humanities-2010-conference/25473.

to resolve the tension between these two aspects of DH—nor would I want to—I hope to make some small contribution to imagining more vividly what their imbrication looks like. The EcoDH framing of this question is helpful in this regard. Shifting from the question, 'How does understanding digital culture relate to digitally understanding culture' to the question, 'How does understanding the digital contribution to environmental crisis relate to digitally understanding environmental crisis' is both an attenuation and an expansion of the question. It narrows the focus to a specific sort of DH investigation, such as the one I will be describing below. Jennifer Gabrys offers an example of how such work frames the question: 'on the one hand, ubiquitous computing has become central to performing new environmental practices [...] Yet on the other hand [...] the projected rise in computational objects and applications is sure to generate new modalities and distributions of electronic waste'.[3] Such a dichotomy is clearly more manageable than the vast question of computers and culture. At the same time, though, the EcoDH framing links the question of the digital to the question of the geological, asking not just what it means to be human in a digital world, but what it means to be human in a time of human geological agency, the time some call the Anthropocene, in which the question becomes, per Stacy Alaimo, 'What can it mean to be human at this time when the human has become sedimented in the geology of the planet'.[4] By recognizing the expansion of human impact on the planet beginning in the late eighteenth century as a categorical shift in the relationship of human and planet, the Anthropocene explodes the idea of human culture, giving a sense of urgency to our investigations of the human/digital interface, as this becomes the human/digital/planetary interface.[5]

3 Jennifer Gabrys, 'Re-thingifying the Internet of things', in *Sustainable Media: Critical Approaches to Media and Environment*, ed. by Nicole Starosielski and Janet Walker (London: Routledge, 2016), pp. 180–195 (p. 181).

4 Stacy Alaimo, *Exposed: Environmental Politics and Pleasures in Posthuman Times* (Minneapolis: University of Minnesota Press, 2016), p. 1, https://doi.org/10.5749/minnesota/9780816621958.001.0001.

5 That the Anthropocene begins in the eighteenth century (indeed, that it has begun at all) is a matter of some controversy. I follow Dipesh Chakrabarty in opting for a beginning in the 1780s, a timing which coincides with measurable greenhouse gas increases in ice core samples, the invention of Watt's steam engine, and Kant's formulation of the 'Copernican revolution', which takes on a new weight in the face of dawning human geological agency.

I will begin by focusing on the narrow and specific, discussing a particular EcoDH project undertaken in 2016–2017 at the Vanderbilt University Center for Digital Humanities, a project that sought to draw attention to the infrastructure supporting DH at Vanderbilt. The project was dubbed InfraVU, a name meant to highlight the focus on infrastructure as well as our group's desire to get beneath the surface of Vanderbilt University, an institution which, like other universities, has a vested interest in concealing that infrastructure. I will thus first consider the experience and concealment of infrastructure in contemporary life, and especially at the university. I will then turn to a consideration of the InfraVU project itself, showing how the development of the project exploited a productive tension between making and thinking which is central to so much DH work, and which can be understood as a specific inflection of the larger tension between understanding digital culture and digitally understanding culture. I will finally address that tension, showing how InfraVU both uses digital technology to think about environmental issues, but also thinks critically about how that technology is itself implicated in environmental issues.

Concealing Infrastructure

We live in an age of marvels and a world of wonders. The Blue Man Group puts it well:

> Right now, there is a virtually invisible network which links together millions of people who would otherwise be completely isolated from each other. This exciting technology has grown to become an incredibly complex web of connections that is so large and difficult to track that it would be practically impossible to estimate its total size. And even though most of us live alone in urban isolation, this system represents one of the few ways all of our lives are intertwined. This system is: modern plumbing.[6]

This scatological riff on the Internet makes two important points. First, all-encompassing networks are not so new as we sometimes think;

6 Clips from this show are shown in the PBS documentary *Blue Man Group: Inside the Tube*; see *Blue Man Group: Inside the Tube*, dir. by Chris Wink and Candice Corelli (PBS, 2006). The scene quoted can be seen here: *Blue Man Group Modern Plumbing And PVC IV (HQ)*, 3:03, posted online by bluemangroupsurrey, *YouTube*, October 25, 2008, https://www.youtube.com/watch?v=KuQvgswttz0.

and second, there is a long history of burying the infrastructure that enables our modern existence, both in the literal sense, for water and sewage lines, like fiber-optic cables, are generally underground, but also in the abstract sense. Indeed, the comedy of this quotation arises from the simultaneous overwhelming presence in our minds of the Internet as metaphor for connection with the total obscurity of the actual infrastructure of connection.

While concealed infrastructure is a fundamental condition of our day, few institutions display this condition—which is to say, few institutions conceal their infrastructure—with more care and attention than the university. The campus tour given to prospective undergraduates and, more importantly, their parents, must be able to move smoothly across lawns, between academic buildings, and through libraries, dorms and dining facilities, without stumbling across the waste dumps, loading docks, HVAC units and computer clusters upon which these buildings and their occupants depend. And, as Nicole Starosielski points out in *The Undersea Network*, this is not a matter only of hidden pipes and cables, but of 'hidden labor, economics, culture, and politics'.[7] As much as we in the academy may be focused on bodies and embodiment, as much as we may study labor practices and advocate for improving them, the life of the mind as presented to our future students is all about the brains and computers of students and faculty, with pesky matters like plumbing, climate control and, indeed, computer networks, relegated to anonymous staff, hidden behind brick enclosures and buried under the ground.

Lisa Parks writes:

> While concealing infrastructure sites may be a viable aspect of urban planning (as has long been the case of sewer, electricity and water systems), one of its effects is to keep citizen/users naive about the systems that surround them and that they subsidize and use. Because of this, it is important to devise other ways of visualizing and developing literacy about infrastructures and the relations that take shape through and around them.[8]

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7 Nicole Starosielski, *The Undersea Network* (Durham: Duke University Press, 2015), p. 2, https://doi.org/10.1515/9780822376224.

8 Lisa Parks, 'Around the antenna tree: The politics of infrastructural visibility', *Flow Journal* (March 6, 2009), http://www.flowjournal.org/2009/03/around-the-antenna-tree-the-politics-of-infrastructural-visibilitylisa-parks-uc-santa-barbara/.

In 2016, the EcoDH working group at Vanderbilt's DH Center sought ways to 'visualize and develop literacy about infrastructures' that sustained our own work. We hoped to unearth some of the hidden aspects of DH at Vanderbilt, beginning with the infrastructure itself. Sitting in our climate controlled, brightly lit, and thoroughly screen-encrusted space in the Vanderbilt DH center, we wondered whether the material weight of digital work was really perceptible to users of the DH Center.

Much recent scholarship has categorized, measured and historicized the materiality of digital life, drawing attention to just the sort of material and human dimensions we were concerned with. Tung-Hui Hu, for example, in his *Prehistory of the Cloud* notes that 'the cloud is a resource-intensive, extractive technology that converts water and electricity into computational power, leaving a sizable amount of environmental damage that it then displaces from sight. [...] it also turns human labor into a resource' and 'covers up the Third World workers who invisibly moderate [...] websites and forums'.[9]

Allison Carruth has written similarly of the material dimensions belied by the 'light and airy image of the digital cloud'.[10] And just as Hu notes that 'the cloud has become so naturalized in everyday life that we tend to look right through it, seeing it uncritically, if we see it at all',[11] Carruth writes that 'the web is so ubiquitous for those cultures and communities that are "plugged in" that its infrastructure becomes imperceptible'.[12] She is not vague on the cause of this imperceptibility: 'The preponderance of ecological metaphors in how we speak about digital technology and networked computing masks, willfully in some cases, what is an energy-intensive and massively industrial infrastructure'.[13] In their introduction to *Media and the Ecological Crisis*, Richard Maxwell, Jon Randaulen and Nina Lager Vestberg argue similarly about not simply the everyday environmental metaphors that refer to media (beyond the cloud, Carruth names 'streaming content', 'server farms', 'the hive mind', and

9 Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge: The MIT Press, 2015), pp. xii, 146, https://doi.org/10.7551/mitpress/9780262029513.001.0001.

10 Allison Carruth, 'The digital cloud and the micropolitics of energy', *Public Culture*, 26.2 (2014), 339–364 (p. 339), https://doi.org/10.1215/08992363-2392093.

11 Hu (2015), p. xii.

12 Carruth (2014), 343.

13 Ibid., 341.

'mountains of data' as examples) but specifically about the metaphors of media studies itself, most importantly the term *media ecology*, which, by deploying the word *ecology* in an analogic sense to explain relations among media technologies, obscures the term's usual meaning. 'This is why the old media ecology needs to be recycled: its defining metaphor of media environments ironically fosters ongoing and harmful neglect of the media's environmental impact'.[14] They would surely agree with Carruth's assessment that 'the pull of metaphor directs one's attention away from the materiality of information'.[15]

Arguably, though, there is something redundant in the idea of metaphors directing attention away from materiality, for we never really noticed that materiality in the first place, a point Matthew Kirschenbaum had already made at the beginning of this century in identifying the 'tactile fallacy', the widespread belief that 'electronic objects are immaterial simply because we cannot touch them'.[16] These metaphors, then, troubling as they surely are, simply reinforce what appears as an intuitive understanding of digital culture as ephemeral. For InfraVU, counteracting the imperceptibility of the infrastructure supporting DH at Vanderbilt would mean directing attention towards the materiality of something whose immateriality we take for granted, and then reinforce with metaphors.

We had already attempted a few smaller interventions to encourage thinking about the materiality and energy consumption of digital work.

14 Richard Maxwell, Jon Randaulen and Nina Lager Vestberg, 'Introduction: Media ecology recycled', in *Media and the Ecological Crisis*, ed. by Richard Maxwell, et al. (London: Routledge, Taylor & Francis Group, 2015), pp. xi–xxii (p. xiii), https://doi.org/10.4324/9781315885650.

15 Carruth (2014), 339.

16 Kirschenbaum, who has used both the term 'tactile fallacy' and 'haptic fallacy' in referring to this phenomenon, goes on to call for scholars to 'begin cultivating a critical sensibility in which knowledge of material matters matters' (see Matthew Kirschenbaum, 'Editing the interface: Textual studies and first generation electronic objects', *Text*, 14 (2002), 15–51 (p. 43)). This should by no means suggest that a focus on "material matters" had not previously existed in media studies—indeed, a material focus dates back at least to the seminal work of Friedrich Kittler. But Kirschenbaum's call certainly reverberated, and the focus on the materiality has picked up throughout media studies fields, so that Nicole Starosielski and Janet Walker can write in 2015 that 'environmental media studies has taken its own materialist turn' (Nicole Starosielski and Janet Walker, 'Introduction: Sustainable media', in *Sustainable Media: Critical Approaches to Media and Environment*, ed. by Nicole Starosielski and Janet Walker (London: Routledge, 2016), pp. 1–19 (p. 12) https://doi.org/10.4324/9781315794877).

A simple activity involved having participants perform a traceroute to any familiar website, especially one they used in their work, and imagining the physicality of the list of routers returned in terms of their smashability—that is, considering the IP addresses displayed as places their digital journey could be ended with a hammer.[17] In another activity, intended to make the energy use of the computers in the DH Center more relatable, we recorded the electricity consumption of a single workstation over a week, and then used the numbers to extrapolate the mileage that could be driven in an electric car using the same amount of power as our computers.[18] But such exercises seemed woefully insufficient given the challenges outlined above. We wanted to do something bigger, something that would not only refer to the infrastructural entanglements of our work, but that would actually make the infrastructure visible. We began by considering the specific ways in which infrastructure is concealed at Vanderbilt University.

Experiencing Infrastructure (InfraVU)

The windows of the Vanderbilt DH Center, situated on the third floor of Buttrick Hall, look eastward over the verdant library lawn. In the morning, sunlight glitters in through magnolia leaves brushing the glass. Were the opposite side of the building visible, it would offer a rather different vista. Some two hundred feet to the west, sprawling across an area somewhat larger than the manicured lawn to the east, lies the university power station. But you can only see it from offices on the upper floors of the building. Students in classrooms on the lower floors, like pedestrians outside the building, cannot see the power station for the tasteful brick buildings situated in front of it, cheerfully obstructing the sight lines to the hulking industrial heart of the campus. Indeed, the arrangement of structures is such that the hungry scholar moving between Buttrick Hall and the adjacent dining building on the way to

17 I describe this activity in more detail in a blog post which compares the route between my then home and Vanderbilt University by bus (6 miles) and by Internet (400+ miles). So much for the efficiency of teleworking. See Ted Dawson, 'Sustainable DH, or: Smashing things with hammers', *HASTAC* (October 30, 2016), https://www.hastac.org/blogs/tedawson/2016/10/30/sustainable-dh-or-smashing-things-hammers.

18 Our preliminary conclusion was that the three computers then in the Center (which had just opened) used enough power per week to drive forty miles in a Nissan Leaf.

satisfy bodily needs would not even suspect the presence of the facilities they pass within 250 feet of, which secretly satisfy the sundry needs of the campus, channeling electricity, water, steam (used for hot water, heating and cooling) and, of course, data, to the buildings around them.

Needless to say, no unsightly power lines connect the station to the other buildings on campus. Instead, a network of traversable underground tunnels joins the power station to the various academic buildings. If we wanted to make the environmental implications of DH work at Vanderbilt perceptible, we thought a good starting point would be to make visible this infrastructure literally under the center. This would, of course, represent only the smallest portion of any sort of Vanderbilt DH 'footprint', as the infrastructure supporting the physical space of the DH center is slight compared to the infrastructure of the Internet and the decentralized data storage and processing that power so much of our work. But if the connection between a small office space and the machinery beneath it could be made, we supposed, this would serve as a microcosm for thinking about the larger issues. The incomprehensible material weight of the digital cloud investigated in the works of Carruth or Hu would make a deeper impression on shoulders that had already hefted the weight of the local infrastructure. Such language is of course figurative, though by the end of our work, we would begin to find ways to make it more concrete.

But we began not with the concrete but with the virtual, deciding to make a 360-degree video tour that would allow users to follow the path of water, steam, electricity and data from the inside of the power station to the DH center via the underground tunnels. We photographed a series of five videos. Four used a stationary camera, showing two sections of the plant interior, the interior of Buttrick Hall, and the interior of the DH Center. The fifth video was a two-minute journey through one of the steam tunnels from the plant to beneath Buttrick hall.[19] By inserting

19 We made several other videos, including a video of the disused coal burning furnaces and of the power station's control room. In the interest of creating a tour as transparently logical as possible, we did not include either of these videos in the virtual tour, as the areas depicted were not obvious pieces of the infrastructural connection between the power station and the DH center. It is worth considering the arguments that could have been made for these videos' inclusion, however. In the first case, coal burning was discontinued at Vanderbilt in 2015, and thus does not form a current part of the story we were telling, but including the interior shot of the furnaces would not only connect to the legacy of coal burning on campus,

this video between the two of the plant and the two in Buttrick, we had a series that rendered the vast majority of the infrastructural journey we wished to depict as virtual experiences that, by donning a headset, a viewer could enter.

Fig. 1 Still from the first 360-degree video, showing the plant interior. Note the icon at top left, which can be used to move the viewing angle. This shows the video as viewable on desktop. Photograph by Ted Dawson (May 16, 2017).

but also to the continuing use of coal in Vanderbilt's energy mix. While 23% of Vanderbilt's electricity is provided by natural gas burning at the plant, the other 77% comes from TVA, and as that mix comes roughly 24% from coal, about 18% of Vanderbilt's electricity still comes from coal burning (TVA, 'TVA at a Glance', https://www.tva.gov/About-TVA/TVA-at-a-Glance; Melanie Moran, 'Vanderbilt celebrates end of coal, smokestack teardown', *Vanderbilt News, Vanderbilt University* (April 13, 2015), https://news.vanderbilt.edu/2015/04/13/vanderbilt-celebrates-end-of-coal-smokestack-teardown/). Including what remains of the coal furnaces in our tour, then, would have worked to counteract the rapid dismantling of the plant's coal smokestack, which was gone a mere six months after the cessation of coal burning. In the case of the control room, not only would this have linked back to the human beings connected with the system, but it would have allowed us to include a marvelous anecdote of energy-consumption based surveillance, involving the spiking of steam usage during students' peak shower hours. That our individual human behaviors collectively manifest themselves as easily traceable energy usage patterns neatly encapsulates certain mechanisms of human geological agency.

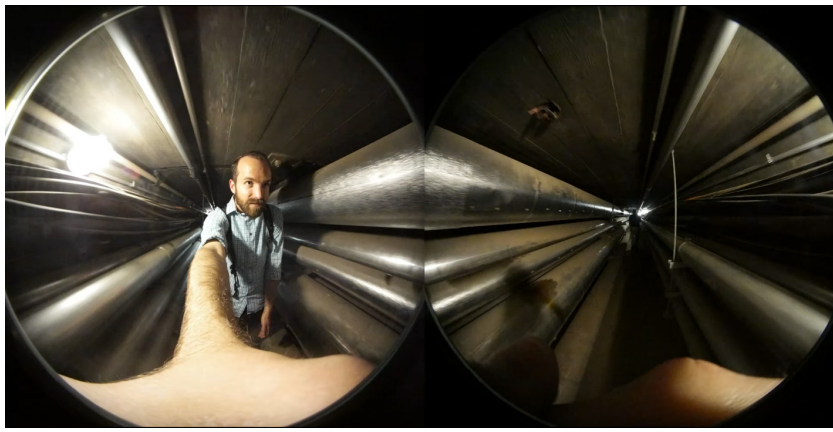

Fig. 2 The third video, traveling through the tunnels, before the two fish-eye images are stitched. On the left (behind the camera, holding it) is group member Adam Merki. On the right (in front of the camera in the distance) is Ronnie Pepper, our guide. Photograph by Ted Dawson (May 16, 2017).

The Infrastructure of InfraVU and Other Concerns

But before we had even finished stitching and editing the videos, we shifted again from tinkering to thinking about our tinkering.[20] Our concerns began with questions around immersion and embodiment. As we were testing our videos, one of our group members noted that the tunnel video induced nausea. That users might experience 'virtual reality sickness' while attempting to experience infrastructure with our videos was of course troubling in itself, but more troubling was the notion that this was more likely to happen to women than to men watching our videos. As observers of the higher prevalence of 'VR sickness' in women have asked: 'Is virtual reality sexist?'[21] Lisa Nakamura has glossed this problem as one of technology not accounting for human difference and the way 'women's bodies are more skeptical than men's', pointing out how many virtual experiences are coded—in two senses—as white male

20 Because 360-degree videos necessarily consist of several different camera images displayed together, the different views must be 'stitched' to remove redundant areas and overlap edges.

21 Gian Volpicelli, 'Posture could explain why women get more VR sickness than men', *New Scientist* (December 9, 2016), https://www.newscientist.com/article/2115648-posture-could-explain-why-women-get-more-vr-sickness-than-men.

experiences.[22] Riffing on Laura Mulvey, we might speak here of 'male embodiment'.[23]

That our project would be reproducing the histories of oppression built into the technologies it used connects to a range of systemic problems of the digital age that digital humanists have been confronting with both important theoretical contributions such as those of Nakamura or Safiya Noble, whose *Algorithms of Oppression* considers how 'digital decisions reinforce oppressive social relationships',[24] as well as in practices from the selection of keynote presenters at conferences, to the formation of organizations like African American History, Culture and Digital Humanities (AADHum) and the creation of digital projects like 'Torn Apart / Separados', with its elucidation of the networks of power that enrich themselves by excluding human beings from our national community.[25] My chief concern in the present essay, however, is a second problem that cut straight to the heart of our project, potentially undermining our very purpose.

While we sought to find ways to make visible the material entanglements of our seemingly lightweight lives, we were at the same time making tangible that very lightness. That is, the content of our videos was meant to be: 'look at all this stuff under your feet that enables digital experiences like this one', but the form of the experience, putting on a headset, possibly even a flimsy Google Cardboard, was reinforcing the sense of magic that the digital so easily evokes, the sense of being untethered from the material world. VR demands an enormous amount of computing power, and hence an enormous amount of electricity use and heat generation, but little of this is readily apparent to the end user, whose experience is literally lightweight and figuratively transcendent.[26] We were, in other words, participating in the occlusion

22 Lisa Nakamura, 'The racial empathy machine: Discourses of virtual reality in America after Trump', *Global DH Symposium* (Michigan State University, March 22, 2018).

23 For Mulvey's notion of the 'male gaze', see Mulvey, Laura, 'Visual pleasure and narrative cinema', *Screen*, 16.3 (1975), 6–18, https://doi.org/10.1093/screen/16.3.6.

24 Safiya Umoja Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism* (New York: New York University Press, 2018), p. 1, https://doi.org/10.2307/j.ctt1pwt9w5.

25 http://xpmethod.columbia.edu/torn-apart/volume/1/.

26 On a consumer-grade computer, stitching a three-minute video can take hours, a reminder of the processing work involved on the production end.

of VR's footprint while trying to draw attention to the occlusion of the DH center's footprint. Lisa Parks, writing about cellular antenna trees, notes that, 'as a cell tower disguised as a tree, the antenna tree draws attention to the materiality of infrastructure in the very process of trying to conceal it', and 'actually exposes more than it hides and in this sense can be thought of as a site for generating further public knowledge about the materiality of wireless and other network systems'. If, per Parks's argument, cell trees reveal as they attempt to conceal, were we doing just the opposite, and concealing what we tried to reveal? Were we creating a site for generating public knowledge about materiality, or were we creating a site for reinforcing the perception of immateriality, reinforcing the ways in which 'we are socialized to know so little about the infrastructures that surround us'?[27]

This problem is a specific instance of a larger issue that arises from seeking to use a technology to provoke criticism of that same technology. As Max Horkheimer and Theodor Adorno famously observed of the culture industry, could we not equally well say here that attempts to use the infrastructure of digital capitalism to call into question the infrastructure of digital capitalism do little more than 'confirm the validity of the system all the more zealously'?[28] Jodi Dean writes that:

> In communicative capitalism, reflexivity captures creativity, sociality, resistance, and critique enclosing them into mediated networks for the financial gain of a corporate and shareholding class. Within mass social and personal media networks, expressions of dissent enrich the few and divert the many. The media practices we enjoy, that enable us to express ourselves and connect with others, reassemble dissent into new forms of exploitation and control.[29]

Were we contributing to the project of 'big VR', and more generally, to the efforts of the 'corporate and shareholding class' to position VR and the resource-intensive networks and systems upon which it relies as enjoyable media practices, *virtual* reality with a purely representational connection to *real* reality?

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27 Parks (2009).

28 Max Horkheimer and Theodor W. Adorno, *Dialectic of Enlightenment: Philosophical Fragments*, ed. by Gunzelin Schmid Noerr (Stanford: Stanford University Press, 2002), p. 102.

29 Jodi Dean, 'Faces as commons', *Online Open* (December 31, 2016), https://onlineopen.org/faces-as-commons

Cate Sandilands has suggested that 'the contemporary, full-color, digitized proliferation of natures-as-commodities acts as a screen covering the exploitation of the natural world that is a central condition of capitalist production; this incorporation of the natural world into the bourgeois narrative of progress via green technologies and nature documentaries serves only to continue the barbarism of the present'.[30] Somewhere between green technologies and nature documentaries, of course, one could find our 360-degree videos, which thus become part of the 'bourgeois narrative of progress'.

Sandilands goes on to wonder what a Benjaminian arcades project of contemporary 'bourgeois nature' might look like. Just as Walter Benjamin drew together diverse texts to present dialectical images of his time, what if we attempted to constellate dialectical images of present-day texts of the environment? Sandilands asks us to imagine:

> what nature might appear [...] when arrested in a montage assembled from a 1972 Nova Scotia travel poster, a pulp western or two by a now-forgotten author, an old copy of *National Geographic* from the doctor's waiting room, last year's treatise on the 'right' kind of diet for optimal cardiovascular health (found right beside the dusty Stairmaster), *The Bell Curve* (garbage even before it was published), one of George W. Bush's televised speeches on oil exploration in the Arctic National Wildlife Refuge, and just about any policy document that speaks earnestly about the merits of sustainable 'development'.[31]

What nature might appear, we wondered, in the constellation of our videos with 360-degree videos of swimming with dolphins, VR first-person shooters set in post-apocalyptic landscapes, and Google's 'Tilt Brush', an application that immerses users in an empty black space and allows them to 'paint' the world into existence around themselves? Of course, Benjamin does offer a sort of hero of the arcades in the flâneur, and Sandilands wonders what this nineteenth-century figure might look like today: 'What modes of knowing [...] are generated in the *eco*-arcades that are the iconic/historic sites of late capitalism? [...] what kind of marginal-critical figure is enabled, not by the metonym/

30 Catriona Sandilands, 'Green things in the garbage: Ecocritical gleaning in Walter Benjamin's arcades', in *Ecocritical Theory: New European Approaches*, ed. by Axel Goodbody and Catherine E. Rigby (Charlottesville: University of Virginia Press, 2011), pp. 30–42 (p. 36).

31 Ibid., pp. 37–38.

site of nineteenth-century arcade/exhibition, but by that of twenty-first-century Facebook/ecotour?'[32] But she leaves this question open. As Benjamin observed of the original flâneur: 'the man of letters [...] goes to the marketplace as flâneur, supposedly to take a look at it, but in reality to find a buyer'.[33] And I hardly think handing to the flâneur a VR-headset changes this situation.

Conclusion: Bodies

There is, however, one last lesson from the Blue Man Group quotation: there is something fleshy and substantial in the Internet, namely ourselves. We are part of the system, even if as mere meat space flâneurs, wetware yet to be factored out of the hardware we have built.[34] The Internet is unthinkable without plumbing, not only because the physical infrastructure linking inputs and outputs of computers relies on the same formal principles, and sometimes follows the same paths, as the physical infrastructure linking the inputs and outputs of human bodies, but because human bodies, with all their attendant infrastructure, still constitute the Internet to a great extent.[35] This idea does not somehow free us from the aforementioned problems, but hopefully can help us attend to them. For as Alaimo writes: 'huge McMansions, giant trucks, and gas-guzzling SUVs'—and I would add *universities*—'serve to insulate their inhabitants from the world. Attention to the material transit across bodies and environments may render it more difficult to seek refuge within fantasies of transcendence or imperviousness'.[36]

With the focus on bodies in mind, we returned to tinkering. Even if our project cannot but take its place in the 'bourgeois narrative of progress', even if VR is nothing if not a 'fantasy of transcendence', could we find

32 Ibid., p. 38.

33 Walter Benjamin, *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism*, trans. by Harry Zohn (New York: Verso, 1973), p. 34.

34 Geoffrey Winthrop-Young has pointed out that 'wetware designates human insufficiency but also marks the embattled area that the computer must yet master in order to render humans obsolete' ('Hardware/software/wetware', in *Critical Terms for Media Studies*, ed. by W. J. T. Mitchell and Mark B. N. Hansen (Chicago: The University of Chicago Press, 2010), pp. 186–198 (p. 191)).

35 In 'Pipeline Ecologies', Starosielski describes how fiber optic cables in upstate New York follow pathways of both human waste and nourishment, including the distribution of milk.

36 Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010), p. 16.

ways it might help us attend to the 'material transits across bodies and environments?' How might we replace the lightweight digital experience with an experience that we feel in our bodies? Lisa Parks finishes her essay on antenna trees by invoking the artist, writing of the antenna-tree photography of Robert Voit that 'while manufacturers and carriers have devised ways to conceal cell towers, some artists have created works designed to draw our attention back to them'.[37] Inspired to think like artists, we imagined ways we might add heft to the experience of our 360-degree videos.

The next step for InfraVU will be what we are calling 'Google CastIron', which essentially will consist of attaching a skillet to either side of a Google Cardboard, so that the body experiencing our video tour will bear significant weight as it does, and the normally easy experience of turning to look about the virtual space will become one associated with significant physical discomfort. This will not by any means help supplement the impoverished sensorium of virtual reality; while the cast iron may supply some olfactory sensation of metal and grime, this will only coincidentally resemble the scent of the tunnels, and while holding the weighty metal will generate muscle heat, this will not come close to the stifling conditions we experienced while filming. We aim less to enhance the verisimilitude of the tunnel experience than to render perceptible the weight of the virtual experience itself. But cast iron will bear no direct correspondence to the material entanglements of the virtual experience, either. We had considered ways we might do this, for instance by attaching a headset to the floor, ceiling, and walls of a room with tension bands which would tighten in some correlation to the amount of electricity being consumed in the process of streaming the videos over the Internet and playing them on the headset. The preference for cast iron came not only because it would be far easier to implement and (we imagine) more memorably whimsical, but because attempting to tie the experience to a specific material weight would undercut the point that the material weight of our DH work ultimately escapes our calculation.[38]

37 Parks (2009).

38 We faced similar considerations with our 'computer mileage' experiment described above. While rendering energy used by computers in terms of electric vehicle mileage does tie digital work to more traditional measures of energy use and

Let me return finally to the question with which I began: What is the environmental impact of DH? Of course there is no possible answer to this question, any more than we can say what the environmental impact of the car is. To be sure, we can extrapolate numbers from tailpipe emissions, and so arrive at some numerical estimate of the environmental impact of *cars*, but we cannot even begin to figure the costs of the shifts in human ways of living tangled up with the emergence of the car—the shape of cities and the contours of the working day, just to name the obvious ones—and any understanding of what cars mean for our planet has to understand all of that as well. If there is an answer to this sort of question, it will not reveal itself to computational methods or big data crunching, but sooner to imaginative humanistic exploration of the sort that has been found in ecocritical work for decades already.[39] This is why the humanities are so critical in the Anthropocene. While many look to natural science and policy for solutions to global warming, it is in the humanities that we are most likely to find the kinds of work that challenge our assumptions about the world and our ways of living in it, and these are ultimately the things we must address if we are to avert catastrophe.

We are, in the end, not out to measure the footprint of DH so much as to shift the public discourse about the digital and the environment, to help us all remember that the difference between paper and digital is not one of dead trees versus digital ephemerality, but rather one of dead trees versus melting permafrost. We DH-ers will continue to do this as we always have, through intellectual and physical endeavors, by writing articles disseminated electronically and by holding seminars in which we use traceroute to imagine the infrastructure of electronic dissemination, by attending conferences and by measuring the 'mileage' of computers, by computing minimally and by affixing cast iron skillets to flimsy bits of cardboard.

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concomitant anthropogenic climate change, it also drastically underestimates the energy use involved, since much of the work performed 'on' the DH Center work stations in fact takes place in remote server farms and data centers, where its footprint is almost unknowable, though certainly always increasing.

39 Already in 1932, Aldo Leopold had written, "When I submit these thoughts to a printing press, I am helping to drain a marsh for cows to graze, and to exterminate the birds of Brazil. When I go birding in my Ford, I am devastating an oil field, and re-electing an imperialist to get me rubber" (Quoted in Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, Massachussets: Harvard University Press, 2011), p. 74, https://doi.org/10.4159/harvard.9780674061194).

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13. Asking Why

Cultivating Eco-Consciousness in Research Labs

Allison Paradise

Scientists question everything about the natural world. They work tirelessly in pursuit of understanding how and why the world behaves as it does. And yet, as a community, scientists rarely question their own behaviour in the lab. Equipment is often left on 24/7, protocols using hazardous chemicals remain unchanged for decades and freezers are filled with samples that haven't been used since the turn of the century. These behaviours become habits, passed down through the generations. The following chapter by Allison Paradise demonstrates how My Green Lab, a non-profit founded 'by scientists, for scientists' has helped to build a culture of sustainability by helping researchers see their behaviour in a new light. By encouraging people who work in labs to ask 'why', My Green Lab has been instrumental in changing the culture of scientific research. This approach has led to significant reductions in energy, water and waste in labs across North America. The laboratory sustainability movement in research has also inspired innovation in manufacturing, with laboratory product suppliers starting to design their products with sustainability in mind. This approach to sustainability—encouraging people to critically examine their behaviour and make conscious choices—is a model that could be replicated in any industry. As the work of My Green Lab demonstrates, if we want to enact lasting changes, we need to start by looking inward

 https://doi.org/10.11647/OBP.0213.20

and questioning our habits and behaviours. When we do this it can have a profound effect on ourselves and on our planet.

Introduction

The foundation of the non-profit My Green Lab was laid many years ago, when I was in high school, on the first day of my internship at a pharmaceutical company. Somehow, I was allowed to run an experiment on my own, and over the course of the day I used a lot of plastic, which ended up being piled on my bench because I couldn't find a recycling bin. I went up to the PI, who was in charge of the lab, and asked her where I could recycle all the plastic. She looked at me like I was crazy. We don't recycle here, she told me, all of that goes into the trash. Then it was my turn to look at her as if she was crazy. I couldn't understand why we couldn't recycle clean plastic. When I asked her why she simply told me the company policy was to incinerate all waste.

The conversation I had that day stayed with me as I continued to work in labs over the next decade. Every lab I worked in had its own way of doing things, and I was taught to follow their rules. As scientists, we are taught to think critically about everything—to question how things work and to push our understanding of the systems we study. Rarely do we turn that lens inward and question our own behaviour in the lab. Instead we accept certain principles as established and follow protocols because they are known to work. And while this allows us to focus our energy on the most pressing questions, the impact of following the rules in the lab can be significant. Labs discard an estimated twelve billion pounds of plastic annually, enough to cover an area twenty-three times the size of Manhattan, ankle-deep. They also use five to ten times more energy than office buildings, and four to ten times more water.

There are, in fact, many examples in our lives of things we do because of how we were raised, or what we were taught, that we rarely question. In the decade I spent as a neuroscientist, I adopted countless habits, routines and behaviours from my mentors and peers. Everything—from how I kept my notebook, to which chemicals I used, to how I operated the equipment in the lab—quickly became habits that I never

questioned. What we often don't realize is that these habits lead us to limit our choices, and often ourselves. Asking 'why?'—interrogating our own behaviour—allows us to uncover habits, routines and behaviours of which we were previously unaware. And once we are aware of them, we have the opportunity to choose something different. Choice is only possible when we are aware of our behaviour; everything else is automatic.

Knowing that the outsized consumption of laboratories is not a requirement of research, it is clear that to reduce the environmental impact of laboratories, we needed to break our habits. The non-profit organization My Green Lab was founded with the mission of creating a culture of sustainability through science. Our approach to our mission is unique. We work directly with scientists to interrogate their behaviour—to ask why and to uncover the assumptions underlying that behaviour. Then we work with them to explore different approaches and options that would best sustain themselves and their work. In other words, we make sustainability personal. This approach has led to significant reductions in energy, water and waste in labs around the world and has inspired innovation in manufacturing, with laboratory product suppliers starting to design their products with sustainability in mind.

Holistic Programming

To affect meaningful behaviour change in the lab, My Green Lab developed a number of programs that bring awareness to the environmental impacts of the laboratory and what can be done to minimize them. Together, My Green Lab's programs address environmental sustainability holistically, from products to behaviour, and from an individual scientist to an entire organization.

The broadest program, and one that encompasses elements of the other programs, is the Green Lab Certification program. This program recognizes scientists for the actions they are currently taking to reduce the environmental impact of their lab and provides recommendations for improvement.

My Green Lab has also developed two programs to affect changes in product design and purchasing decisions. The first is the Center for Energy Efficient Laboratories (CEEL), which is a collaboration

between My Green Lab, kW Engineering and Frontier Energy. The CEEL works closely with utility companies and the Environmental Protection Agency (EPA) to identify energy-efficient laboratory products, which utility companies can then incentivize by establishing rebate programs.

ACT is the other program that has been developed to reduce the environmental impact of purchasing laboratory products. ACT, which stands for accountability, consistency and transparency, is the world's first eco-label for laboratory products. The ACT label provides critical information about the manufacturing, use and end-of-life impact of a product and its packaging. ACT labels are meant to be used like nutrition labels to compare products on the basis of their impact, allowing scientists and procurement specialists to make safer, more informed choices.

These programs are designed to help people interrogate their behaviour and create a culture of sustainability. This article will go into more detail on the development, implementation and impact of these three programs. Each section will include information on the market's receptivity to the programs and how they have been shaped—and are continually shaped—by new technology.

Green Lab Certification

The recent emergence of a green movement focusing exclusively on laboratories has illuminated many opportunities for energy and water savings as well as waste reduction in labs. Championed by a coalition of scientists, facility managers, engineers, designers, sustainability directors and non-profits, the movement seeks to institutionalize sustainability in laboratories through the adoption of Green Lab programs. These programs have reached a wide variety of spaces, from university research and teaching labs, to biotech, manufacturing and hospital (clinical) labs.

My Green Lab is at the forefront of the Green Lab movement. My Green Lab developed the first-ever standard for laboratory sustainability best practices through the Green Lab Certification program.[1] Designed

1 https://www.mygreenlab.org/green-lab-certification.html

for individual labs, the certification program recognizes labs for existing safe, sustainable practices and encourages them to explore new ways to reduce their environmental impact.

Development

When My Green Lab was founded in 2013, there were fewer than ten campuses in the United States that had developed a set of recommendations for lab sustainability. The most comprehensive list was developed by Allen Doyle (formerly of the University of California, Davis) and Katie Maynard (University of California, Santa Barbara). Other universities, such as Duke, the University of Pennsylvania and Dartmouth, and companies, such as Genentech, had also developed their own sustainability standards for their labs.

To create a more universal standard for laboratory sustainability, My Green Lab gathered a group of scientists, sustainability professionals and safety officers from organizations with existing green lab programs to review existing best practices for laboratory sustainability. Led by My Green Lab, the group met bi-weekly for four months, questioning and discussing each recommendation, changing the wording as needed, and adding additional best practices whenever necessary. The result was a ~130 question assessment survey that covered eleven topics within the four main areas of energy, water, waste and chemistry. This assessment was intended to be used to evaluate existing practices in labs and to identify opportunities for more sustainable actions.

The new Green Lab Certification Assessment was beta-tested at the University of California, Los Angeles. Thirty labs participated in the pilot, providing feedback on the wording of the questions, the layout, and the overall impact of going through the process of completing the assessment. Their feedback was incorporated into the final Green Lab Certification Assessment, which became available on My Green Lab's website in June 2014. The Green Lab Certification Assessment has since undergone a series of updates and revisions to accommodate industry trends, new technology, and valuable feedback from scientists and industry experts. It is now ~180 questions and covers fourteen topics.

How the Program Works

In order for a lab to be certified, the lab or the organization first appoints someone to lead the program, also known as a Green Lab champion. The champion coordinates all sustainability related efforts in the lab by developing a roadmap for the lab. The champion assigns tasks to other lab members and hosts check-ins to track the lab's progress. Additionally, the champion is the point of contact to relay any roadblocks and/or successes to the organization during the implementation of the program. A meeting is then held with the lab to explain how the certification process works and the steps necessary to become a certified lab. At least half of the scientists in the lab must then complete the Green Lab Certification Assessment online, answering questions related to water, energy, waste, green chemistry, resource management and other key topics.

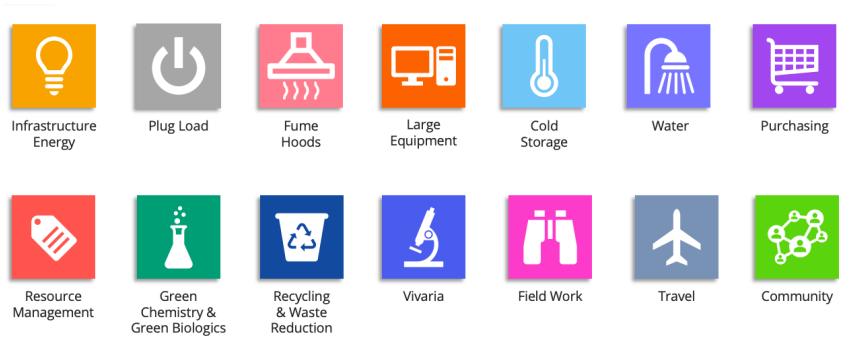

Fig. 1 Green Lab certification topics.

My Green Lab compiles the individual responses from the lab and scores the individual questions and topics to develop a baseline. The baseline identifies both green lab best practices already adopted by the lab, and opportunities for change. My Green Lab shares case studies and strategies for implementing best practices to give the lab a starting point in greening their lab.

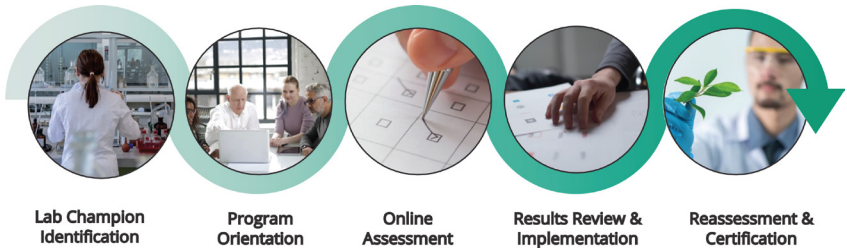

Fig. 2 Green Lab certification steps.

Once the assessments have been evaluated, a meeting is scheduled with the whole lab to present the results and discuss opportunities for improvement. The benefit of this approach is that everyone in the lab is able to see where they are already implementing best practices and where there is an opportunity for improvement based on the scores for each section. The results presentation can be very powerful for labs, particularly for labs that do not discuss these topics in lab meetings and have no guidelines for sustainable best practices. It is often inspiring for lab members to learn that their peers have switched to a greener solvent or have taken the time to turn off the lights every night or bring their paper recycling to the bin in the hallway. During these discussions we also encourage labs to ask themselves why they are doing things the way that they are doing them, and to consider choosing an alternative approach. In fact, many labs make decisions to change their standard operating procedures during this meeting.

After the results presentation, labs are given the opportunity to improve their score over a period of six to eight months. During this time labs may choose to change protocols, introduce signage or training, work their organization to understand current programs and capabilities. Whatever the lab decides to do, they become more aware of where environmental impacts exist in the lab and what they can do to minimize them.

When the lab is ready, they re-take the online assessment and My Green Lab again compiles the individual answers to create scores for the individual questions and topics. The topic scores are also accumulated into an overall assessment score that determines the certification level. By breaking the certification process into steps, the lab is encouraged to discuss impacts and make changes from the outset, which ensures

that the culture of the lab is changed through this process. Continuous improvement is built into the program as labs receive a new set of recommendations each time they take the assessment, and when those recommendations are implemented, the lab is eligible to be certified at a higher level.

Estimated savings from this outreach activity are calculated based on the implementation of the recommendations. For example, a lab that does not currently turn off a water bath overnight might be encouraged to turn it off. When this recommendation is implemented, the savings from turning off the water bath are attributed to the Green Lab program.

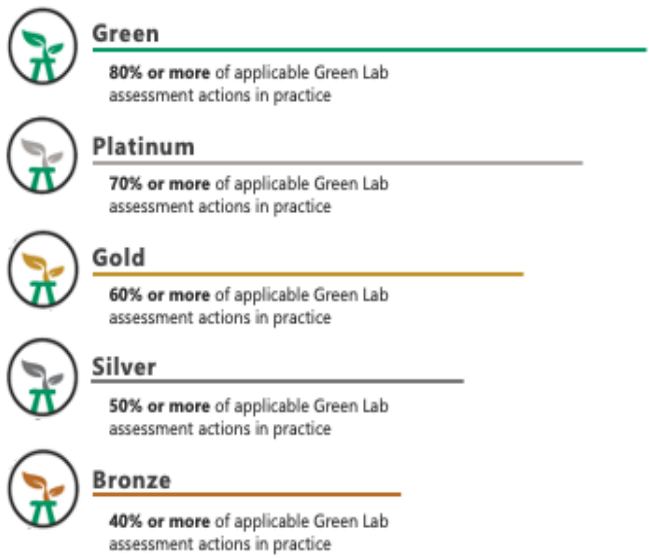

Fig. 3 Certification levels.

Program Reception

The response from scientists to the Green Lab Certification program has been overwhelmingly positive. Studies conducted by My Green Lab have shown that over 70% of scientists across the country see green lab initiatives such as energy reduction, water efficiency, and reduced hazardous chemicals as being 'very important' or 'important' to them; by contrast less than 5% of scientists said that these initiatives were 'not

important.' Recent articles published in prestigious scientific journals, including *Science* and *Nature*, also speak to the relevance of sustainability in the scientific community.[2]

Most labs that participate in the program have volunteered and have become Green Lab Certified by choice. Thus, labs are generally open and amenable to implementing the recommendations that are identified through their assessment. Typical recommendations that are embraced by labs include:

- Turn off equipment when not in use;
- Turn off lights at the end of the day;
- Defrost freezers regularly;
- Consolidate loads for autoclaves and dishwashers;
- Recycle plastic and gloves whenever possible.

Other recommendations are more difficult for labs to readily adopt. These include:

- Adjust set points on ultra-low temperature freezers to -70°C (from -80°C);
- Replace hazardous chemicals with more benign alternatives;
- Purchase right-size, energy-efficient, water-efficient and material-saving equipment;
- Turn off biosafety cabinets completely.

Comparing these lists, it becomes clear that the recommendations that are easiest to implement are the ones that mimic the actions people usually take at home, such as turning off lights and appliances, maintaining freezers, running full loads for dishwashers and recycling. The more difficult recommendations to implement are the ones that are

2 See, for instance, Zak, Joseph D., Wallace, Jenelle and Murthy, Venkatesh N., 'How neuroscience labs can limit their environmental impact', *Nature Reviews Neuroscience* 21 (2020), 347–348, https://doi.org/10.1038/s41583-020-0311-5; Madhusoodanan, Jyoti, 'What can you do to make your lab greener?', *Nature* 581 (2020), 228–229, https://doi.org/10.1038/d41586-020-01368-8; Rosen, Julia, 'Sustainability: A greener culture', *Nature* 546 (2017), 565–567, https://doi.org/10.1038/nj7659-565a; May, Mike, 'Adding efficiency to general lab equipment', *Sciencemag.org* (April 2016), https://www.sciencemag.org/features/2016/04/adding-efficiency-general-lab-equipment.

perceived as having an impact on research operations. For the points raised above, the concerns tend to be:

- Samples will not be preserved as well at -70°C;
- Benign chemical alternatives will not work as well in the experiment;
- Sustainable products will not perform as well as standard products;
- Biosafety cabinets must be kept on for sterility purposes.

Having conversations with scientists about concerns such as these is the most rewarding aspect of this program for all involved. These conversations get to the heart of examining the 'why' in people's behaviour. Why do scientists believe that samples are not preserved as well at -70°C? As of this writing there is no evidence that samples are unsafe or less stable at this temperature; it's simply a matter of 'that's how we do things' that has kept ultra-low temperature freezers set to -80°C. Even if a lab decides not to make a particular change, the discussion results in the lab making a choice about what is best for their research; they are no longer acting out of habit. Asking why does not always lead to a more environmentally sustainable outcome for each recommendation, but it does always lead to increased awareness and people making the choice that best sustains their work.

Receptivity to the recommended changes does not tend to follow age or position in the lab—graduate students are often as receptive as postdocs, and group leaders/principal investigators (PI) are as likely to champion the effort as their students. Staff who do not work in labs are also very receptive to the program. They see it as an opportunity to strengthen relationships between facilities management, safety officers, procurement and scientists. The Green Lab Certification program can also be used by management to identify organizational opportunities for sustainability. Organizations whose labs have been certified through this program often implement organization-wide changes based on the assessment results, such as eliminating single-pass cooling, installing low-flow aerators, providing rebates for energy-efficient equipment and supporting new recycling efforts.

Results

Six years later, My Green Lab's Green Lab Certification is recognized as the leading international standard for sustainable laboratories around the world. It is the most comprehensive, thoughtful, impactful program of its kind. The program has directly reached thousands of scientists in over four hundred laboratories, and it has indirectly touched tens of thousands of scientists whose operations have changed as a result of organizational changes that support reducing the environmental impact of labs, such as new recycling bins or rebates for energy-efficient equipment.

One of the unique benefits of the Green Lab Certification program is that the savings from the program can be quantified. Below are examples of realized and estimated savings in energy, water and waste.

Energy

Table 1 Estimated savings resulting from reduction of energy consumption of laboratory equipment by 10% at a large research university.

Equipment	**Estimated Units**	**Energy Consumption (MWh/year)**	**Potential Savings (MWh/year)**
-80°C Freezer	700	5,110	511
-20°C Freezer	890	2,950	295
Refrigerator	1,130	1,160	166
Fluorescence Microscope	450	120	12
Heating Block	700	160	16
Water Bath	630	200	20
Centrifuge	920	1,450	145
PCR Machine	530	430	43
Vacuum Pump	500	700	70
Shaker Table	290	650	65
Autoclave	200	3,300	330
Incubator	725	3,400	340
Tissue Culture Hood	410	2,040	204
Total		**22,170**	**2,217**

The table above illustrates the estimated savings that result from reducing energy consumption of laboratory equipment by 10% at a large research university. In most cases, this 10% reduction is achieved by turning off equipment when it is not in use or overnight. For pieces of equipment that must be left on 24/7, such as freezers and incubators, maintaining those units properly can lead to a 10% reduction in energy consumption.

Because each lab is unique, it is difficult to provide an estimated energy saving per lab. The typical energy savings associated with the recommendations in the Green Lab Certification program are below:

- Turning off equipment: >1 kWh/day (this assumes turning off two water baths overnight);
- Adjusting set points on ultra-low temperature freezers: 8 kWh/day/freezer;
- Closing fume hood sashes: 20 kWh/day/fume hood.

This results in a typical lab saving ~6,000 kWh/year, which is equivalent to removing one car from the road. There are an estimated 200,000 academic, biopharma, and clinical research labs in the United States. If every lab were to be Green Lab Certified, the energy savings would be equivalent to removing ~187,000 cars from the road or ~154,000 homes from the grid.

The Green Lab Certification program has directly saved an estimated two million kWh/year. The savings are reported 'per year' because the savings persist year-over-year. There have been additional realized savings in the form of implementing organizational changes, such as installing occupancy sensors on lights and reducing air change rates at night. Furthermore, this program has inspired Green Lab initiatives in dozens of other organizations, which have also realized energy savings as a result.

Water

Water savings in labs are often the result of three major changes:

- Aerator installation;
- Elimination of single-pass cooling;
- Installing water-saving devices on autoclaves.

Most lab faucets do not have low-flow aerators; standard faucets run at 4 gallons/minute (gpm). Low-flow aerators allow faucets to run at 1.5 gpm or less without reducing water pressure, resulting in a 70% reduction in water use. Large-scale aerator installation projects at universities have resulted in whole-building water savings from 100,000 to over 900,000 gallons/year.

Single-pass cooling can be found on many pieces of laboratory equipment and is a commonly-used technique in chemistry labs to cool distillation reactions. In these experiments, cold water is run from the faucet through a condenser and down the drain, i.e. the water is passed through the condenser only once before being discarded. Estimates have shown that a single lab, running the water at 2 gpm, consumes 1,900 gallons of water during a 16-hour reaction. Using this estimate, a typical lab will consume 5,000–9,000 gallons of water per week per reaction. Single-pass cooling can also lead to large-scale floods should the tubing become disconnected from the condenser overnight. Sharing this information with labs naturally leads to a conversation in which we ask why they have been using single-pass cooling and whether it truly is the best option for their work.

There are several good alternatives to single-pass cooling, including recirculating water baths, which may be homemade using a fish pump. There are also air-cooled condensers available that eliminate the need for water altogether. Whatever option the lab chooses, they will save thousands of gallons of water each week and eliminate the possibility of a flood.

Autoclaves (sterilizers) are also large consumers of water in North America. Older autoclaves have been shown to consume 700 gallons of water/day, mostly due to single-pass cooling. In the case of autoclaves, single-pass cooling is used to cool the effluent water from the sterilization cycle, which is too hot to go down the drain. The cold water runs 24/7 so that it can mix easily with the hot water when the hot water needs to be discharged. This process is clearly not an effective way of managing hot water effluent disposal. Organizations are encouraged to install water-saving devices on their autoclaves, which can result in reducing water consumption by as much as 70%. Labs are also encouraged to consider units with water-saving and energy-saving features when purchasing a new autoclave.

The Green Lab Certification program is estimated to save participating labs ~56,500 gallons of water per year. It is estimated that the program has directly reduced water consumption in labs by ~22 million gallons/year.

Waste

When labs first learn of the Green Lab Certification program, the first thing they ask about is how to reduce waste. Plastic, glass, gloves, EPS coolers and cardboard are all significant waste streams in labs, in addition to the hazardous and biohazardous waste that is regularly generated. Waste is highly visible to anyone working in a lab and reducing this can profoundly affect the lab's desire to engage with other aspects of an organization's sustainability program.

My Green Lab has not been able to quantify the amount of waste that has been reduced as a result of the Green Lab Certification program. Quantifying this would require extensive waste audits before and after the baseline assessment, which is difficult to do on a per-lab basis. In addition, there are different types of labs and the results of the waste audit will vary depending on the type of lab audited.

Nevertheless, the impact the certification program has had on waste reduction can be measured in other ways. It is estimated that an individual lab discards forty pounds of nitrile gloves per year. Many labs are unaware that there are opportunities to recycle gloves that are not considered hazardous waste and they do not think to question if there might be an alternative option to the standard procedure of throwing them in the trash. Labs become aware of glove recycling programs through the Green Lab Certification program, and as a result, most organizations that work with My Green Lab now recycle nitrile gloves. All Green Lab Certified labs have installed recycling bins and on average the amount of paper and cardboard that is being recycled as a result of the program has increased by 20%. Most certified labs also recycle and/or reuse EPS coolers whenever possible.

In addition to traditional waste streams, certified green labs also reduce their hazardous waste as they are directed towards tools that help them identify safer, more benign options. Labs that have participated in the program have reduced their use of ethidium bromide, a mutagenic

dye used to label DNA, by 26%. They are also increasingly choosing heptane over hexane (a chemical that becomes neurotoxic when metabolized) by 10%. Twenty percent of scientists in the Green Lab Certification program say that they are now choosing more benign chemicals over more hazardous chemicals as a result of the program.

Impact of New Technology on the Certification

Rapid advances in technology have impacted the Green Lab Certification program over the past six years. For example, when the assessment was first developed the group was not comfortable recommending that labs use solid-state illuminators over mercury or metal halide illuminators, which must be treated as hazardous waste due to their mercury content, for microscopy. That has since changed, as the benefits of solid-state illumination for scientific experiments as well as the environment are more widely recognized. Another significant change came when ENERGY STAR®-rated laboratory freezers became available in 2017. Prior to this, the assessment did not reference purchasing ENERGY STAR equipment, because none existed for laboratories; now the assessment asks scientists about choosing ENERGY STAR freezers when they purchase new units for the lab.

The Green Lab Certification program is regularly updated to reflect advances in technology, new information, and new best practices. Because of this, program participants are routinely challenged to question their behaviour and consider new ways of approaching their research.

Challenges

No program is without its challenges, and the Green Lab Certification program is no exception. The greatest challenge arises when labs have identified opportunities for improvement that an organization cannot support. This occurs frequently, as organizations are often new to supporting labs in sustainability. For example, a lab may receive a recommendation related to recycling. Yet the lab's ability to recycle depends on their organization's recycling ability, which is related to the contract the organization has with their waste hauler. If an organization

cannot find, or afford, a waste hauler to recycle material from the lab, this can lead to challenging conversations, especially when a lab feels strongly about implementing the recycling recommendation.

As another example, it may be recommended that a lab report faucet leaks. Faucet leaks can be a sensitive topic. Labs will often say that they have reported faucet leaks but that facilities management has not come to repair the leak in months. Conversations with facilities management often reveal how understaffed they are and how they do not have the capacity to respond to leaking faucets. As with the recycling example, this perceived lack of support can frustrate labs and an organization that is doing all it can to support their scientists with limited resources.

For some organizations, it can also be difficult to expand the Green Lab Certification program outside of labs that have a natural inclination to want to implement sustainable best practices. Program expansion may require incentives, which may take the form of equipment rebates, access to special funds, access to special recycling (such as glove recycling) and/or recognition. These require financial support and staff time to implement.

My Green Lab has been working with funding agencies to incorporate the Green Lab Certification Program into grant applications. This would eliminate the need for special incentives and make it much easier to expand the program to all labs.

Center for Energy Efficient Laboratories (CEEL)

Recognizing that behaviour change alone was not sufficient to truly create a culture of sustainability through science, My Green Lab co-founded the Center for Energy Efficient Laboratories (CEEL) to identify opportunities for energy reduction in laboratories. In order to develop targeted standards and programs to achieve increased energy efficiency, the CEEL developed a model that combines stakeholder involvement with objective evaluations of lab equipment energy consumption.

As shown in Figure 4, the CEEL works closely with utility companies, equipment vendors, and laboratory end-users to do market research, third-party testing of laboratory equipment, assist in the development of utility rebate and incentives, engage with stakeholders in the labs and support and consult with labs and procurement specialists in their sustainable procurement efforts.

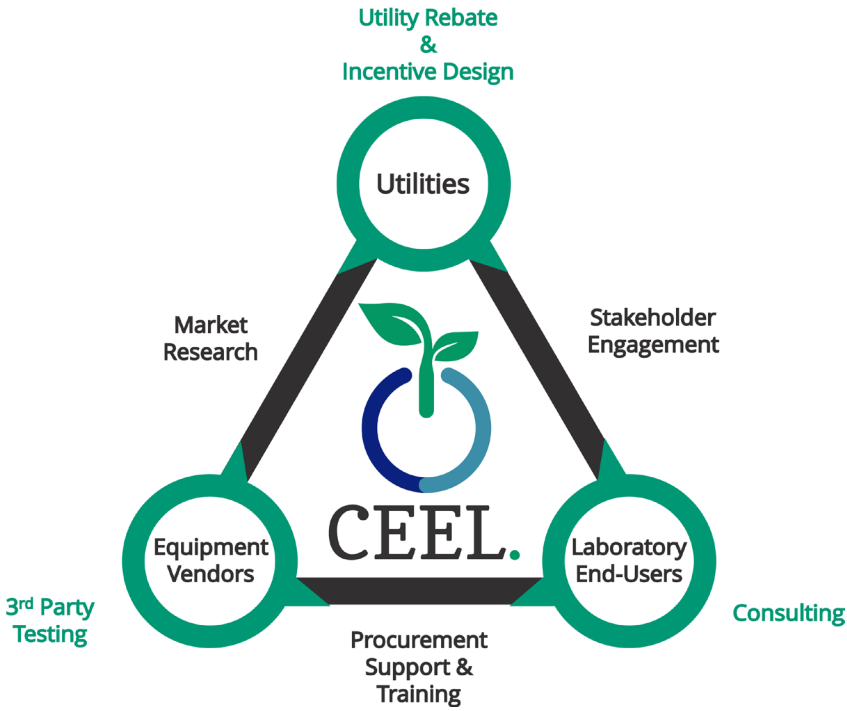

Fig. 4 The Center for Energy Efficient Laboratories (CEEL) brings together key stakeholders to drive energy efficiency in laboratories.

Development

The Center for Energy Efficient Laboratories (CEEL) is a collaboration between My Green Lab, kW Engineering and Frontier Energy. The CEEL was formed in 2014 with the goal of identifying energy-efficient laboratory equipment that may be eligible for utility incentive programs. Prior to the formation of the CEEL, laboratory equipment manufacturers were not working with utility companies, and utility companies did not have incentive programs for their laboratory customers. The CEEL team recognized that there was an enormous opportunity to reduce energy consumption in laboratories and that providing incentives and rebates to customers would quickly drive the market toward energy efficiency.

How the CEEL Program Works

The CEEL is currently supported by the California investor-owned utility companies (IOUs). The CEEL team works with manufacturers, sustainability professionals, scientists, and the utility companies to identify new projects. Projects are chosen on the basis of their potential to move the market toward energy efficiency.

Once a product has been chosen, Frontier Energy tests products from multiple manufacturers to determine the range of energy consumption for a particular product category. The data are given to the EPA and ENERGY STAR to assist with the development of standards for ENERGY STAR-rated laboratory equipment. They are also shared with the California utility companies, who determine whether there is enough information to develop an incentive program for the product category.

Program Reception

The CEEL work has been widely regarded as one of the most positive collaborations the California utility companies have been involved with in the past decade. The California Energy Commission (CEC) has recognized the CEEL and the supporting utility companies for their work. Outside of California, utility companies across the United States have used the findings in the CEEL reports to start similar incentive programs in their territories. Scientists have also praised the work of the CEEL as it has led to rebates on laboratory equipment (see Results).

Results

With the support of the California investor-owned utility companies, the CEEL has already taken a significant step toward addressing energy efficiency in laboratories by assessing and quantifying energy consumption due to plug loads. A 2015 study completed by the CEEL[3]

3 Allison Paradise, Jeff Beresini, Paul Delaney, and Kate Zeng, *Market Assessment of Energy Efficiency Opportunities in Labs* (March 12, 2015), https://www.etcc-ca.com/sites/default/files/reports/ceel_market_assessment_et14pge7591.pdf.

identified a minimum of 116 million square feet of laboratory space in California in just the academic, life science research, and hospital market sectors alone, and found that the market is growing at an average rate of approximately 5% per year. Extrapolated to the rest of the United States, laboratory space in the life sciences sector occupied ~1,200 million square feet in 2015. The study also discovered that plug loads from just thirteen pieces of commonly used laboratory equipment account for an average annual usage of 0.8–3.2 TWh/year in the state. Extrapolated to the rest of the United States, laboratory plug loads account for 80–320 TWh/year.

The CEEL study identified several pieces of equipment that present opportunities for energy savings in laboratories.

Table 2 Estimated energy consumption of common laboratory equipment in California.

California Lab Equipment Estimates	**Equipment Density (units/lab)**	**Approx. No. (thousand units)**	**Est. Energy Consumption (GWh/yr)**
-80 Freezer	2.9	58	228–648
-20 Freezer	3.7	74	126–363
Refrigerator	3.7	95	19–254
Fume Hood*	3.0	60	661–1322
Fluo Micro	1.7	34	6–12
Centrifuge	3.8	76	12–227
Water Bath	2.6	52	115–201
Heat Block	3.0	60	15
PCR Machine	2.2	44	35
Incubator	3.0	60	41–524
Shaker	1.2	24	53
Autoclave	0.8	16	26–527
Vac Pump	2.1	42	1–115
TC Hood	1.7	34	106–235
* HVAC electricity consumption due to fume hoods			

The chart above shows the estimated energy consumption of thirteen commonly used pieces of equipment in California's laboratories (reproduced from the 2015 study). Of these, only laboratory refrigeration has been studied to any depth, and within this category ultra-low temperature (ULT, -80°C) freezers have garnered the most attention. Therefore, following the 2015 study, the CEEL published a comprehensive report on ULT freezers.[4] This report was used as the basis for establishing ENERGY STAR standards for ULT freezers.

The ULT freezer report written by the CEEL changed the landscape of the life sciences industry. Prior to this work, only one manufacturer made freezers that were marketed as energy efficient. Now five major ULT freezer manufacturers make energy-efficient models that use low global warming potential refrigerants, and other manufacturers are following suit. A standard ULT freezer consumes 20 kWh/day, or as much energy as a single-family home. The energy-efficient models consume 50–70% less.

The California utility companies offer a $300 or $600 incentive for purchasing an ENERGY STAR-rated ULT freezer (the difference in rebate is based on the size of the freezer). Other utility companies, such as Eversource in Massachusetts, also offer ULT freezer rebates, and organizations themselves have begun to provide financial incentives to scientists willing to purchase energy-efficient freezers over standard models.

Prior to the CEEL's work on ULT freezers, energy-efficient laboratory equipment was not a topic of conversation. Now it is part of every major life science manufacturer's marketing materials. It is part of their design phase for equipment. And scientists are more aware than ever of the impact their purchases have on the energy consumption of their laboratory.

As scientists started to question why they were purchasing standard units instead of energy-efficient models, their purchasing decisions began to change. This change in purchasing meant that they were now more aware of how to save energy in their labs, which led to additional changes in behaviour, such as being more mindful of properly

4 Allison Paradise et al., *Ultra-Low Temperature Freezers: Opening the Door to Energy Savings in Laboratories* (August 31, 2016), https://www.etcc-ca.com/reports/ultra-low-temperature-freezers-opening-door-energy-savings-laboratories.

maintaining their new freezers and discarding old samples so as to avoid purchasing new units. This is a cycle that is typically inspired by My Green Lab's programs.

Impact of New Technology on the CEEL

The CEEL program is designed to be receptive and adaptive to new technologies; the team is always looking for new energy-efficient technologies to test and incentivize. The list of products that the CEEL will be evaluating over the next five years is extensive and includes many emerging technologies in the laboratory product space.

Challenges

The greatest challenge with the CEEL program is finding manufacturers who are willing to let the team test their equipment. Although the results are anonymized, manufacturers of non-energy-efficient equipment are nevertheless reluctant to provide equipment to test because they do not want to lose business on the basis of their energy performance. The CEEL attempts to overcome these challenges by establishing a coalition of manufacturers who are willing to work together toward the common goal of identifying energy-efficient equipment. Having manufacturers work together on CEEL projects has been a great way to move the industry forward.

ACT Label

The ACT label is the world's first eco-label for all laboratory products, i.e. consumables, chemicals and equipment. By emphasizing accountability, consistency and transparency (ACT) around manufacturing, energy and water use, packaging and end-of-life, ACT makes it easy to choose safe, sustainable products. ACT-labelled products are independently audited by SMS Collaborative, LLC (SM) (SMSC) and verified by My Green Lab.

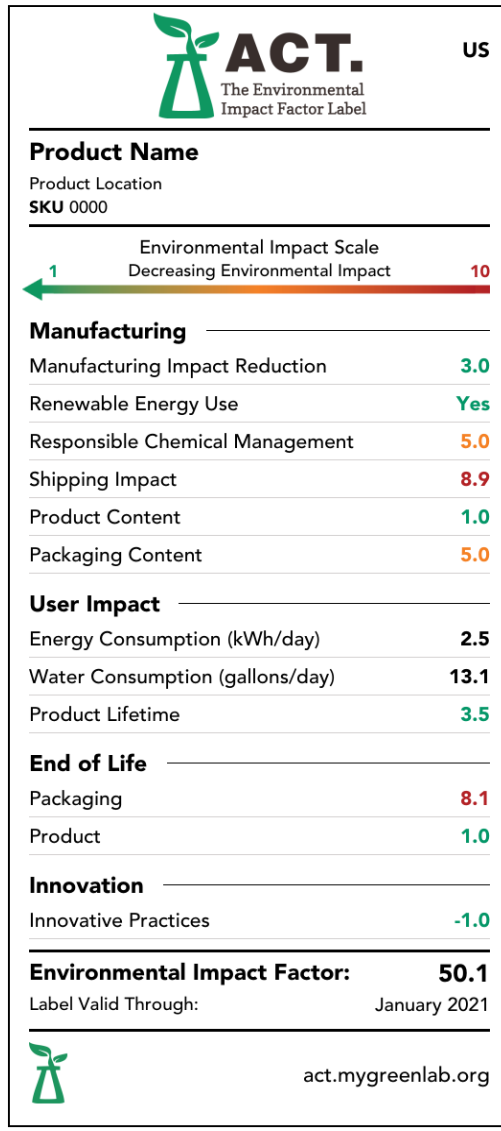

Fig. 5 ACT, the world's first eco-label for laboratory products.

Development

The ACT label was developed by My Green Lab in response to a growing need for transparency around the environmental impact of laboratory

products. In 2016, very few manufacturers considered sustainability when designing their products or packaging. And those that did made unverified environmental claims that were often ambiguous. After observing the success of the CEEL program, it became clear that the life sciences, industrial sciences, and healthcare industries needed environmental standards. However, there weren't enough data to develop those standards at the outset. For example, not enough was known about how conical tubes were manufactured to say brands X and Y make a sustainable product.

Therefore, the ACT label was conceived as an eco-nutrition label, intended to provide valuable information on the environmental impact of a product without making claims about whether it is sustainable. The criteria for the ACT label, also known as the Environmental Impact Factor (EIF) criteria, were developed with industry input. Scientists, sustainability directors, procurement specialists, and manufacturers provided valuable feedback on the EIF criteria, resulting in a comprehensive product labelling program for life science products. My Green Lab also worked closely with SMSC, an industry leader in developing third-party product certifications, to develop the EIF criteria.

Reading the ACT label is simple: the lower the score, the lower the impact on the environment; the greater the score, the greater the impact on the environment. Most categories are rated on a scale of 1–10; energy and water are reported as kWh/day and gallons/day (or liters/day), respectively. Like a nutrition label, which can be used on its own or to compare the nutritional values between products, the ACT label can stand on its own, providing a snapshot of the overall environmental impact of a product and its packaging, or it can be used to compare products on the basis of their environmental impact.

The ACT label program began as a pilot in May 2017 with twelve products. Feedback from this pilot study led to improvements in the label, which was formerly launched in October 2017. By January 1, 2018, over one hundred products had obtained an ACT label.

In late 2018, participants in the ACT label program made it clear that there was value in expanding the program beyond North America to the UK, Europe, China, and India. This feedback led My Green Lab to develop a UK and EU specific label in 2019.

How the Program Works

All products participating in the ACT program undergo an extensive desktop audit led by SMSC. The audit covers the key product attributes on the label, namely:

Manufacturing Impact Reduction: An evaluation of the manufacturing facilities to determine whether steps have been taken to reduce energy, water or waste in the manufacturing process.

Renewable Energy Use: An assessment of whether the product was manufactured using renewable energy.

Responsible Chemical Management: An assessment of the product's chemistry and the company's chemical management systems.

Shipping: An assessment of the impact of shipping the product from the manufacturing location to the distribution site.

Product Content & Packaging Content: An evaluation of sustainable content in either of the product or its packaging.

Energy and Water Consumption: A determination of the amount of energy and water consumed by the product when it is in use in a laboratory.

Product Lifetime: A determination of the product's usable lifetime and durability.

Product Disposal: An evaluation of the end-of-life options for the product. Each product component is assessed separately for products with multiple components (e.g., polypropylene cap and PET tube).

Packaging Disposal: An evaluation of the end-of-life options for product packaging. Each part of the packaging is assessed separately for packaging that contains multiple components (e.g., EPS cooler, cardboard box).

Innovative Practices: The innovation credit encourages manufacturers to achieve exceptional results in reducing their impact through innovative solutions that do not fall within the scope of any other Environmental Impact Factor. The resulting impacts can affect any

stage of the product or packaging life cycle - raw material acquisition, transportation/distribution, manufacturing, use phase, or end-of-life.

My Green Lab verifies the work of SMSC, and no labels are released until all parties—SMSC, My Green Lab and the product manufacturer—are in agreement. After the audit, manufacturers are shown opportunities to improve their scores. The process is similar to that of the Green Lab Certification—manufacturers are asked why they are using certain materials or manufacturing processes, and are encouraged to look for safer, more sustainable alternatives.

Due to the sensitive and proprietary nature of the material requested for the audit, all ACT assessments are performed under a mutual non-disclosure agreement.

The time required to undergo an ACT assessment varies based on the amount of information already available about the product. Most audits take two to six months, pending data availability. The ACT label is valid for two years, after which time products must be reassessed.

Once a product has obtained an ACT label, that label is made available online on the ACT website and also on the manufacturer's website. Products may also carry an ACT logo if the manufacturer so chooses.

The ACT label program perfectly fits in with the behaviour → products → behaviour cycle. The Green Lab Certification program encourages scientists to think more deeply about the products they purchase. It asks them to step back and ask why they are purchasing a particular product from a certain manufacturer. This reflection often leads scientists to seek more sustainable alternatives, often by requesting to see the ACT label or by requesting that a product obtain the ACT label. Being more mindful of their purchases leads to scientists more mindful of their overall environmental impact in the lab. In fact, there are often more opportunities for energy/water conservation and waste diversion as a result of making more deliberate purchasing choices.

Program Reception

The ACT label program has been well-received. Over forty top research universities and biotech companies around the world have already

taken steps to integrate the ACT label into their procurement systems. The International Institute for Sustainable Laboratories recognized several of these organizations as leaders in sustainable procurement in 2018 and 2019. In addition, manufacturers are increasingly recognizing the impact of disclosing the environmental impact of their product and are increasing their participation in the program. The ACT label also won a leadership award from the Sustainable Purchasing Leadership Council in 2018 in recognition of the label's potential to transform the life sciences industry.

Results

To date, there are over 500 ACT labelled products, with over 2,000 expected to be added in 2021. Although the full impact of the program has yet to be felt (owing to the fact that it is less than three years old), it has already had a substantial impact on the life sciences, industrial sciences and healthcare industries.

Every manufacturer that has undergone the process of obtaining an ACT label has made a change to their manufacturing, product, or packaging design. Manufacturers and suppliers are now taking steps to reduce the environmental impact of their products, and they are communicating these changes in an independently-verified way to their customers. Several manufacturers have begun take-back programs for their products as a result of the ACT label program; some have redesigned their products to be more energy-efficient; and others have found new vendors to supply sustainable packaging for their products. The ACT label program is transforming the life sciences industry.

The ACT label is also recognized as meeting the Living Building Challenge criteria, which means that any laboratory project that is aiming to be Living Building Challenge certified will need to purchase ACT-labelled products for their project. For the first time, laboratory buildings are being designed with regard to laboratory equipment, ensuring that the building will consume fewer resources and be a healthier space for scientists to work.

Impact of New Technology

As with the CEEL, new, sustainable technology is perfectly suited to the ACT program. My Green Lab actively looks for new laboratory products that have been designed with sustainability in mind to join the ACT program. By embracing new technology, the ACT program continues to make it clear to manufacturers, scientists, and procurement specialists that the laboratory products industry is moving toward sustainability.

Challenges

There is a fee associated with participating in the ACT program. This fee is less than any other product certification on the market; however, for an industry that is not accustomed to product certifications, it can be a challenge to include the ACT label in the budget. To assist companies in participating, My Green Lab has developed 'product family' pricing rather than 'per product' pricing.

Although there are quite a few ACT-labelled products, the list is by no means complete. This can be challenging when asking procurement specialists to include specifications for the ACT label in request for proposals (RFPs), as there simply aren't enough ACT-labelled products to do so yet. Moreover, because having an ACT label does not mean that the product is sustainable, procurement specialists can be reluctant to include the label in sustainable procurement guidelines.

The most effective way to overcome these challenges has been to find other ways to make it clear to suppliers that transparency is important. For example, some organizations have incorporated the ACT label into their e-procurement websites so that those products with an ACT label appear at the top of searches. The University of Virginia's most recent RFP requested that their suppliers actively pursue the ACT label.

Final Thoughts

With over 100 green labs programs at organizations worldwide and the transformative impact the ACT label has had on lab product manufacturing, My Green Lab is truly creating a culture of sustainability through science. Through our programs, we distil down all the potential opportunities for sustainability into broad ideas and concepts that are

designed to provoke scientists to ask 'why' for the habits that have the greatest impact in the lab. Once scientists start on this path, they carry it further with their own creativity and insight into their laboratory operations to build a culture of sustainability that is suited to their unique lab space.

My Green Lab's approach to sustainability—encouraging people to critically examine their behaviour and make conscious choices—is a model that could be replicated in any industry, and beyond the lab into our personal lives. All of us inherit habits and behaviours, and once we settle into life, we rarely take the time to question why we act the way that we do. If we want to change this world, we need to start by looking inward. As the work of My Green Lab has shown, when we do this, it can have a profound effect on ourselves and on our planet.

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14. Sustainability, Living Labs and Repair

Approaches to Climate Change Mitigation

Hart Cohen, Francesca Sidoti, Alison Gill, Abby Mellick Lopes, Maryella Hatfield and Jonathon Allen

The year 2020 started with a massive bushfire crisis in south eastern Australia, resulting in disruption to many communities, the loss of lives and businesses, an estimated loss of a billion animals and the dirtiest air on the planet in the cities of Sydney, Newcastle and Canberra. With record-high temperatures and a punishing drought lasting several years, the Australian bush was primed to explode into flames. With lightning strikes in national parks, the spontaneous eruptions of bushfire spread from the north coast to the south and inland towards the alpine regions of New South Wales and Victoria. With the very hot year of 2019 affecting other parts of the planet in 2020, the Antarctic Peninsula reached a record 65 degrees Fahrenheit. The chapter that follows reflects the new progressive politics of climate change that emerged in 2019 with large mass demonstrations taking place in Australia and around the world and examines the critical role of universities in the mitigation of climate catastrophe. The following interventions are variably focused on the concept of 'Living Labs' where thinking is developed within a problem-solving ethos. The three contributions here offer ways to think about sustainability

 https://doi.org/10.11647/OBP.0213.21

with specific reference to waste recovery, environmental awareness in urban settings and the contribution that a 'repair' mentality can make to a shared and re-cycled economy. With a clear-eyed recommendation that mitigation of climate change starts locally, the premise of the paper is that people can work with what is available as local solutions to specific problems. The impact of this approach can be essential to people who sense the impending catastrophe and who may have experienced the crisis directly through compromises in their health outcomes, the experience of trauma and the loss of property and livelihoods, though through no fault of their own. The links through the Western Sydney University campus, common ground to the authors to both its small bushland outpost and further to the local community it serves, suggest that the boundaries of the campus are permeable—and that *Living Labs* are both a means and metaphor for thinking about how the campus opens learning and knowledge creation about sustainability for its students, staff and community constituents.

Introduction

The following collaboratively-written chapter emerged out of our panel for the *Around the World* online conference on the theme of environmental sustainability. We would like to contextualize our contribution with reference to our country of residence, Australia, and our academic work on the campuses of Western Sydney University (WSU). The university is located on never ceded Aboriginal land. We therefore acknowledge the *Dharug* and *Gandangara* peoples as the traditional owners and custodians of the lands on which our particular WSU campus is sited. We respect their ongoing cultural and spiritual connections to this country.

Our chapter is motivated by the thinking and activities that coalesce around the specific theme of environmental sustainability. We see this theme as the most critical long-term contemporary concern of our shared world. The most recent IPCC report gives the planet half a generation to make wide-spread transitions across society, if we

have any hope of limiting global warming to 1.5 degrees above pre-industrial levels.[1] Universities have an important role in tackling these transitions as stewards of lifelong learning and incubators of innovation. Our university supports the case that the resilience of its constituent region will be achieved by responding to local environmental and societal challenges across all elements of its core business: curriculum, operations, research and engagement.

In broad terms, we can break down the climate change crisis into problems and practices related to:

1. The context of human-induced climate change and global warming and the concomitant need for transitions across society and culture.
2. The need for our university to focus on its own region and to contribute to sustainable practices related to both water and land in broadly promoting livability.
3. The need for our university to support the transition to circular and share economies by championing new skills and practices and applying them to specific contexts with defined goals and outcomes.

No potential approach to the mitigation of climate change should be ruled out. Thinking our way out of this dilemma requires both a renewed sense of moral clarity and a move to a more profound way of thinking about the planet. In psychological terms, this is thought of as equivalent to a therapeutic recovery (for example, from addiction), in theological terms as equivalent to a religious conversion and in evolutionary terms to the survival of both human and non-human species.

According to Charles Taylor,[2] the eighteenth-century Enlightenment deemed the natural world, everyday life and the life of the mind as the key sources of human identity and self-formation. With climate change, what passed earlier for the essentials in the formation of a modern identity are now considered under threat. This chapter thinks about how to recover these essential elements for a twenty-first-century

1 IPCC, *Global Warming at 1.5° Celsius: Summary for Policy Makers* (Geneva: IPCC, 2018), report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

2 Charles Taylor, *Sources of the Self: The Making of the Modern Identity* (Cambridge: Harvard University Press, 1989), https://doi.org/10.1177/004057369104800210.

Enlightenment by addressing the concerns and impacts of climate change.

With the focus on environmental sustainability, a key research priority for this university is to reflect on the contexts of the campuses themselves: their facilities, their uses, the sources of energy and how research that its staff undertakes can address these aspects of university life.

There are troubling signs that climate change is ramping up extreme impacts in Australia, one of the most marginal countries in the world with respect to cyclical extreme weather events such as drought and flood. We believe we can now distinguish between weather and climate in the Australian context given the recent evidence of the hottest years on record (eight of the last ten—see Fig. 1). In 2019, there has been an unprecedented rain event and flood in Townsville and north-western Queensland. The fish kills on the Murray Darling River system have resulted by the mismanagement of scarce water resources exacerbated by a regional drought lasting eight years.

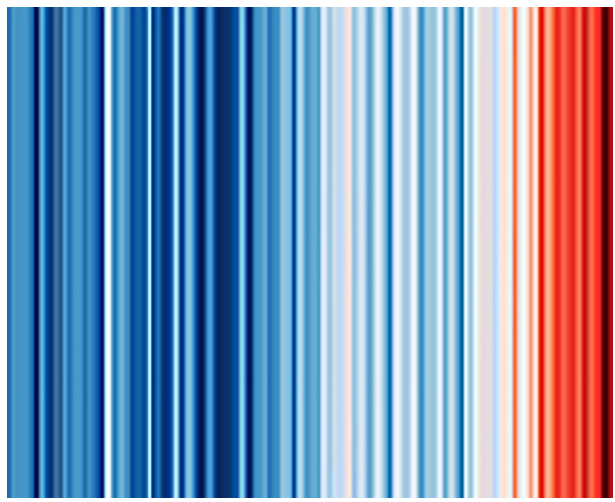

Fig 1. Prof Ed Hawkins warming stripes climate change visualizations of the world's average temperatures from 1850–2017.[3]

The fish kills are also a reminder of other threats to animal species through habitat destruction such as that experienced when fires raged

3 Ed Hawkins, 'Warming stripes' (May 22, 2018), http://www.climate-lab-book.ac.uk/2018/warming-stripes/.

in the high country of Australia. It is possible the demise of particular animal species as a consequence of more frequent fire events is tied to climate change. With these kinds of considerations, we have to think more deeply about the impact and effects of climate change. For example, in our area of the globe (southern hemisphere) the impact of climate change on Antarctica—particularly West Antarctica—is evidenced by ice melts into the sea. The effect of rising sea levels creates a crisis in our region with respect to habitability of low lying island nations and atolls in the Pacific. With a recently discovered 'cavern' below the land surface in Antarctica, the speed with which the ice melt is occurring appears to be accelerating.

The Australian bushfires of 2019–2020 were unprecedented in scope, scale, with costs in the loss of human life, livelihoods, dwellings, livestock and native animals. Centred largely on the east coast and parts of the inland, the bushfires burnt through an enormous amount of bushland—national parks, commonwealth estates and privately owned land. Now, the COVID-19 pandemic, coming on the heels of the fire catastrophe, has driven a deeper sense of crisis in the lives of those who had survived the fires but who were damaged emotionally and financially. We cannot but acknowledge the needs of those in the midst of this pandemic who, only weeks before the pandemic emerged, were struggling to find the resilience to recover from the worst bushfires known in Australia and indeed the world.

Despite Australia being precariously placed at the forefront of very serious climate challenges, it also has some excellent advantages. Australia has near-ideal conditions to enable access to non-fossil fuel sources for energy generation. The exponential take-up of rooftop solar as well as the development of solar farms on an industrial scale suggest an alternative scenario for energy generation. Given the inability of successive Australian governments to act on climate change, the stakes are high for politicians attempting to move toward stronger policy settings so that Australia might reduce its carbon footprint and deploy clean energy possibilities. Even with relatively small-scale undertakings such as the Carbon Pollution Reduction Scheme in which businesses can sell carbon credits, there is a long way to go towards neutralizing Australia's carbon footprint. Coupled with government incentives for both rooftop solar and solar farm investment and a recent court ruling

that defeated the proposal for a new coal-fired power station, there are signs that change may be underway. The explosion of school-age children around the world engaging in climate change demonstrations (including Australian schools) is also a welcome sight where the point about generational impact is clearly made.

Our chapter is driven by the particular projects that WSU academics on the A*round the World* panel have recently developed. In the context of the university, our panel explores some of the alternative ways that environmental sustainability can be actioned. The chapter is in three parts and each part is linked by both an interest in activism as a mode of addressing the climate change crisis and as a manner of offering practical approaches to engaging with these concerns.

Part 1 of the chapter is by Associate Professor Abby Mellick Lopes and Professor Jonathon Allen, setting the scene for how universities can contribute proactively to the societal transitions that need to take place. They argue that sustainability is agenda-setting for universities, and call for a different disposition in relation to how universities enact and facilitate knowledge creation. Abby and Jonathon spotlight three project examples that give shape to this new disposition, which have occurred over the last decade: *FuturesWest 2031, Transitioning to Sustainable Sanitation Futures and the Transdisciplinary Living Lab* (TDLL). These examples demonstrate the value of a future focus in learning and teaching, the importance of providing a space of experimentation where failure is seen as an essential part of learning enterprise, and the centrality of collaboration, which breaks down division between disciplines and the competitive relationship between universities.

Part 2 of the chapter is by Maryella Hatfield, who extends the Living Lab concept by focusing on the role of storytelling in communicating, ideating and inspiring sustainability. This includes documentation of some of the cross-disciplinary processes underway on campus among staff, students and external stakeholders. In a specific example, Maryella describes the impact of discovering bush land on our campus including a creek—a small tributary of the Parramatta River, a project that commenced with an investigation of this bushland and water with the involvement of media production students in a process of interviewing experts about the area. Uncovering these environments on campus

and then working on their role in the mix of initiatives to sustainability provides a great opportunity for context-led and problem-based learning experiences.

Part 3 of the chapter is by Dr Alison Gill, Associate Professor Abby Mellick Lopes and Ms Francesca Sidoti. Alison and Abby have been researching opportunities to repair everyday things that could be put on an alternative life path to an end in landfill, and to share design strategies of reuse, remake, maintenance and repair critical to sustainability, rather than promoting new objects. Recently it has become more urgent to reframe the role of repair as part of a community response to a waste crisis, as local councils struggle to cope with new responsibilities—material, socio-cultural, educational—in light of China's precipitous withdrawal from its role as the world's global recycler. Following an initial survey by Francesca of repair businesses and initiatives in the City of Parramatta, the community of interest to the university, the 'Re-pair' project turns to how the university could champion specific learning and cultural practices of sustainability with the potential to connect communities to more resilient futures with materials and reparative skills. This section of the article will outline a few key findings from the survey of local enterprises, and particularly the aspirations and challenges in transitioning from linear take-make-use-waste to closed loop and share economies.

These three projects are not mutually exclusive in either the thinking that drives them or the knowledge interests that guide them. The links through the university campus to both its small bushland outpost and further to the local community it serves suggest that the boundaries of the campus are permeable—and that *Living Labs* are both a means and metaphor for thinking about how the campus opens learning and knowledge creation about sustainability for its students, staff and community constituents.

A Decade of Design-led Sustainability Projects at Western Sydney

Abby Mellick Lopes and Jonathon Allen

The Living Lab concept—collaborative learning in a living, social setting—has its roots in the experiential, problem-focused approach to learning championed by John Dewey in the early years of the twentieth century.[4] His key claim of a continuity between learning and society has underpinned recent developments in Living Labs, engaged research, 'work-integrated learning' and the development of a research and teaching nexus. These developments attempt to roll back the abstraction of knowledge in academic institutions, to enhance the contemporary relevance of knowledge in applied contexts.

The critical and all-encompassing concerns of sustainability underscored by the Sustainable Development Goals (SDGs) and their associated 169 targets, to which Western Sydney University became a signatory in 2017,[5] bring a new urgency to these developments. However, rather than making education more socially relevant, there is now an unprecedented need for learning to be brought back to society, at multiple scales—local, societal and global. As Ezio Manzini, design theorist and champion of the social role of the design school in the transition to sustainability, remarks:

> The transition toward sustainability is a massive social learning process. The radical nature of the objective (learning to live better while leaving a light ecological footprint) requires vast experimentation, a vast capacity for listening and an immense degree of flexibility in order to change. Sustainability and the conservation and regeneration of environmental and social capital means breaking with the currently dominant models of living, production, and consumption, and experimenting with new ones. A social learning process on this vast scale must involve everybody.[6]

4 John Dewey, *Experience and Education, The Kappa Delta Pi Lecture Series* (New York: Touchstone, 1997).

5 Western Sydney University, 'Sustainable development goals 2030' (2017), https://www.westernsydney.edu.au/learning_futures/home/learning_transformations/re_developing_new_curriculum_courses/education_for_sustainability/sustainable_development_goals_2030

6 Ezio Manzini, 'Design context: Enabling solutions for sustainable urban everyday life', in *Enabling Solutions for Sustainable Living: A Workshop*, ed. by Ezio Manzini,

 https://doi.org/10.11647/OBP.0213.22

The role of the university in this social learning process is critical. The university is a repository of knowledge and memory, held both by people and in the durable records of knowledge created over time. The pursuit of new knowledge is a key concern of the university, which lends to it a unique, experimental disposition in the culture, and a capacity to facilitate the massive social learning process demanded by sustainability.

Leading design thinker Tony Fry has commented that as Australian universities took on a functional role in relation to the economy with the introduction of the Higher Education Contribution Scheme (HECS) in the late 1980s, learning was replaced by a culture of earning. We see evidence of this in the language of mainstream public discourse, where universities are primarily understood as service-providers to the labour market. The precarity evoked by the current COVID-19 crisis, has caused universities to double down on their efforts to market their offerings. However, contrary to negative, narrowly-formed economic views about the relevance of the university, the context of the crisis tells us that the university has never been more relevant. Universities must turn toward sustainability in their efforts to 'create the knowledge necessary to support a world that is livable for humanity'.[7]

In what follows, we provide some evidence for these claims of the relevance and importance of the role of the university by spotlighting three design-led sustainability projects conducted within Western Sydney University, and in partnership with other universities in the last decade. In selecting these few examples, we are in no way suggesting they are the only sustainability projects of note that have or are occurring at the university.[8] Instead, we highlight those projects that were particularly design-led, and that showcase an affinity between design and the social learning process advocated by Manzini amongst others.

The first project is *FuturesWest 2031*, a design-led initiative that aimed to generate a conversation about how Western Sydney could adapt to a

Stuart Walker and Barry Wylant (Calgary: University of Calgary Press, 2008), pp. 1–24 (p. 16), https://doi.org/10.2307/j.ctv6gqw0z.5.

7 Tony Fry, 'Confronting the Humanist Question', *The Australian Higher Education Supplement* (January 31, 2007), p. 26.

8 To get a sense of some of the many Living Lab projects that have occurred or are currently underway at Western Sydney, see https://www.westernsydney.edu.au/driving_sustainability/sustainable_futures/living_labs.

climate-changed future, which was held at the University of Western Sydney (now Western Sydney University) in the winter of 2009.[9] At this time, there was vital sustainability research going on at the university in various disciplines, however there wasn't the social license or cultural imperative that exists now, and the cross-university conversation was only in its early stages. We can recall there were still debates about the reality of human-induced climate change going on in the classroom and also on occasion in the staff room! *FuturesWest 2031* attempted to think about sustainability transitions for Western Sydney using an approach called 'design futuring',[10] which was also being championed in the design classroom via hybrid methods of future scenario planning.[11]

The project involved substantial baseline research on pressure points facing the region such as the future of food, urban mobility and population expansion. It used trends analysis and educated speculations about how these converging challenges might be met to develop scenarios of sustainable futures. This process was led by Dr Tony Fry in a 'hot house' workshop involving academics, students and local stakeholders. Graphic design was used to visually communicate emerging ideas in a community workshop promoting themes for ongoing conversation, examples of which are presented below in relation to two of the key themes explored at the event: the Western Sydney Food Bowl and Co-Housing.

FuturesWest 2031 was a catalyst for transdisciplinary conversations around sustainability, and had a strong influence on the project-based curriculum in design which continues to this day. In the above example, redundant car parks (on the presumption that by 2031, we've transitioned away from personal cars using internal combustion engines, to a greater dependence on public transport) are seen in three stages of their transition to urban agricultural and aquacultural food precincts—a zero-kilometer café appearing in the last image of the sequence.

9 Jonathon Allen, Abby Mellick Lopes and Tara Andrews, 'Futures west: A design research initiative promoting sustainable futures for Western Sydney', *Cumulus 38° South 2009 Conference* (Melbourne: Swinburne University of Technology/RMIT University, November 12–14, 2009).

10 Tony Fry, *Design Futuring: Sustainability, Ethics and New Practice* (New York: Berg, 2009), https://doi.org/10.2752/204191211x12980384100355.

11 Abby Mellick Lopes, Stephen Clune and Tara Andrews, 'Future scenario planning as a tool for sustainable design education and innovation', *Connected 2007: International Conference on Design Education* (University of New South Wales, Sydney, July 9–12, 2007), https://doi.org/10.1016/j.destud.2011.08.005.

Fig. 2 A future imagined: a car park becomes a site for local food production. Image credit: Jonathon Allen/ Paul Kouppas, *FuturesWest 2031*, 2009.

The role here of visualizing potential futures in the context of this project was twofold: firstly, to explore options that were hitherto unthought of, and secondly to provide seductive visions of the future in order to engage stakeholders and to generate, hopefully, provocative conversations with those stakeholders. An image is powerful in that it has the ability to focus discussion and ensure there is a consensus of understanding, whereas ideas and futures presented solely in written form are typically more open to interpretation. The image evokes the change as a 'concrete hypothesis': 'Not yet a reality, but that could be

made real if the necessary moves were made'.[12] Visualizing potential futures allows deeper, detailed discussion as, whilst stakeholders may have different opinions and priorities, they are at least focused on the same point at hand rather than upon their own, often differing, interpretive visions.

The Food Bowl theme recognized that while the region has an agricultural history, much viable agricultural land had been claimed by suburban sprawl and industry in recent decades. With growing concerns about food security and the decline of manufacturing and jobs in the West, an opportunity was framed to revisit this agricultural legacy and think about urban food in new ways for the region. This theme recognized the extensive expertise in water, soil and food sustainability at the university, and a promising cultural momentum around urban agriculture.

The co-housing theme addressed the momentum of poor housing development in Western Sydney, drawing attention to the car-dependency implicated by its diverse geography and inadequate public transport infrastructure, and built into the fabric of the buildings, as can be seen in the expansive space given over to the car in the image at left above. Building on the Food Bowl observations, the co-housing theme attempted to think through how Western Sydney might 'receive' a future population of migrants including climate refugees from nearby countries, facilitating greater density and a more climate-appropriate future everyday life.

In addition to raising questions about better climate-defensive and passive-thermal built forms, this theme brought into the conversation the importance of *social* innovations. For example, platforms, tools and 'starter packs' could support the take up practices such as food gardening. Equally, opportunities for new settlers to express and share culturally-specific knowledge and expertise, need to be created and expanded. Reciprocal and regenerative learning cycles are a critical aspect of the wider social learning process that *FuturesWest 2031* aspired to initiate. Rather than technical solutions or fixed realities, the visual scenarios we presented were meant to function in an innovative way as propositions and conversation starters. As it turned out, the conversation we were attempting to start with stakeholders was probably a little

12 Manzini (2008), p. 26.

Fig. 3 A future imagined: a 'McMansion' becomes a co-housing retrofit and hot tarmac is de-paved to make way for food gardens. Image credit: Jonathon Allen/ Paul Kouppas, *FuturesWest 2031*, 2009.[13]

ahead of its time. The event was, however, a significant learning exercise for everyone involved, and provided an experience of the university in the role of facilitator of social learning for sustainability, and as a hub for facilitating sustainability transitions.[14]

The second example was a research partnership led by the Institute for Sustainable Futures (ISF) at University of Technology, Sydney

13 The 'McMansion' is a reference to the fashion for excessively large dwellings that tend to parade codes of affluence whilst often being cheaply constructed and expensive to run.

14 Allen, Lopes and Andrews (2009).

(UTS) in collaboration with Western Sydney University (WSU), called *Transitioning to Sustainable Sanitation Futures*, and also known as The Funny Dunny Project[15] (2010–2011). This project established a transdisciplinary community of practice, involving academics from three universities, a water utility, industry and local government partners all working together to explore the problems and opportunities involved in implementing a novel system of sanitation across the two universities. This was very much conceived as a social learning initiative from the outset, creating a space to encounter and explore the many 'unknown unknowns' likely to emerge in the process.[16]

Taking the multi-level perspective promoted by transition management theory to understand changing socio-technical systems,[17] the global decline in the quality of mined phosphate rock used for food production[18] can be understood as a 'macro-level' or landscape event, outside the realm of direct human experience. The polluting and aging waterborne sanitation system in Sydney exists at the 'meso' (or regime) level,[19] to which everyday system 'actors' have some access. This project sought to create a 'micro' version of a complete 'closed loop' alternative system, make it operational and learn from what transpired from technical, social, legal and environmental perspectives. The system involved the installation of a number of urine-diverting toilets on campus at UTS for use by members of the campus community, the collection, storage and transportation of collected urine to Western Sydney, and its reuse as a partial substitute for phosphorus fertilizer in plant pot trials within the Agriculture Department at WSU, Hawkesbury.

15 'Dunny' is Australian slang for toilet.

16 Here we reference Donald Rumsfield's well-known observation about the 'knowns' that 'we don't know we don't know', which was made during a Pentagon news briefing to frame risk in relation to defending the US war in Iraq. Sustainability research and practice demands that we embrace risk in pursuit of a just and liveable world.

17 Frank. W Geels, 'Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case study', *Research Policy*, 31.8–9 (2002), 1257–1274, https://doi.org/10.1016/s0048-7333(02)00062-8.

18 Dana Cordell, Jan-Olof Drangerta and Stuart White, 'The story of phosphorus: Global food security and food for thought', *Global Environmental Change*, 19.2 (2007), 292–305.

19 Dena Fam et al., 'An historical analysis of Sydney's sewer systems to determine windows of opportunity for system change', *Design Philosophy Papers*, 7.3 (2009), 195–208.

One of the most unique aspects of this project was the way it positioned the importance of visual communication design in facilitating system operation.[20] Previous research had shown that a highly technical approach to the problem of recovering and reusing urine had excluded the experience of everyday toilet users, undermining the new system's chances, as the success of every new technology depends on its socialization. The Funny Dunny Project gave the user a central role, inviting, via visual communication tools created by students in the design programs of both university partners, a chance to participate in the learning process.

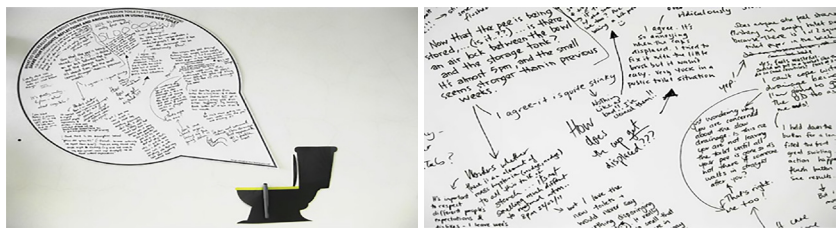

Fig. 4 A graffiti board designed to collect data for the Funny Dunny Project helped the researchers to track the socialization of the new 'closed loop' sanitation system. Designed by Yana Mokmargana (student of Visual Communications, WSU).

The Funny Dunny Project was conceived as a trial of a radical innovation at a 'niche' level, with the university acting as a critical research space to explore what was effectively a complex and future focused sociotechnical experiment. The 'niche' framing is interesting because it positioned the experiment ahead of what is actually happening in the culture at large—in what Frank Geels calls a space for radical innovations, where experiments are 'protected' and for which markets and preferences do not yet exist.[21] The project modelled system change by involving those with a vested interest in sanitation and a desire to explore the potential for change, but with the cautious conservatism that characterizes risk-averse industry 'actors'. It is critical to note here that the way the university setting acts to protect and nurture

20 Abby Mellick Lopes, Dena Fam and Jennifer Williams, 'Designing sustainable sanitation: involving design in innovative, transdisciplinary research', *Design Studies*, 33.3 (2012), 298–317, https://doi.org/10.1016/j.destud.2011.08.005.

21 Geels (2002).

innovation and enshrines the 'right to fail' as an important component of social learning.[22]

While this experiment created more research questions than it answered and there were many technical, regulatory and socio-cultural barriers preventing the immediate uptake of the new system, it certainly inspired the imagination of industry and government actors, and allowed important new conversations about phosphorus futures to germinate.[23]

Our final example builds upon the Funny Dunny Project and its cross-university collegiality, to further explore how design can facilitate social engagement and learning. The Transdisciplinary Living Lab (TDLL) model was developed in 2016–2017 as a collaboration between Design at UTS, Design at Western Sydney University and the Institute for Sustainable Futures at UTS. The TDLL emerged out of a design studio at UTS exploring the problem of food waste at local, societal and global scales.[24] A new food waste system had recently been installed at UTS, which was designed to eventually process 100% of the food waste generated on campus. This system had the capacity to transform most organic materials including grains, coffee grounds and meat into a 'soil conditioner' that could potentially be reused in local gardens and parks, via a process of low-temperature dehydration. Students in the Interdisciplinary Design program at UTS were tasked with researching the problem context of global food waste whilst also examining and reflecting on their own food practices, and proposing new concepts for how the university community could learn about the value of the system and take responsibility for what were sometimes new practices of separating organics from other waste streams in an institutional setting. Finally, students considered the impacts of their designs in relation to the SDGs and 'planetary boundaries',[25] and reflected on how the Living Lab had influenced their thinking about their future design careers.

22 Dena Fam et al., 'Transdisciplinary learning within tertiary institutions: A space to skin your knees', in *'Interdisciplinary and Transdisciplinary 'Failures' as Lessons Learned—A Cautionary Tale*, ed. by Dena Fam and Michael O'Rourke (London: Routledge, 2020), pp. 198–216, https://doi.org/10.4324/9780367207045-16.

23 The project was awarded an NSW Green Globe Award for Sustainable Innovation in 2012.

24 The lab process is explained in Alexandra Crosby, Dena Fam and Abby Mellick Lopes, 'Wealth from waste: A Transdisciplinary approach to design education', in *Cumulus Hong Kong 2016: Cumulus Working Papers 33/16: Open Design for E-verything*, ed. by Cecile Kung, Elita Lam and Yanki Lee (Hong Kong Design Institute, Hong Kong, November 21–24, 2016), pp. 51–55.

25 Johan Rockström, et al., 'Planetary boundaries: Exploring the safe operating space for humanity', *Ecology and Society*, 14.2 (2009), https://www.ecologyandsociety.

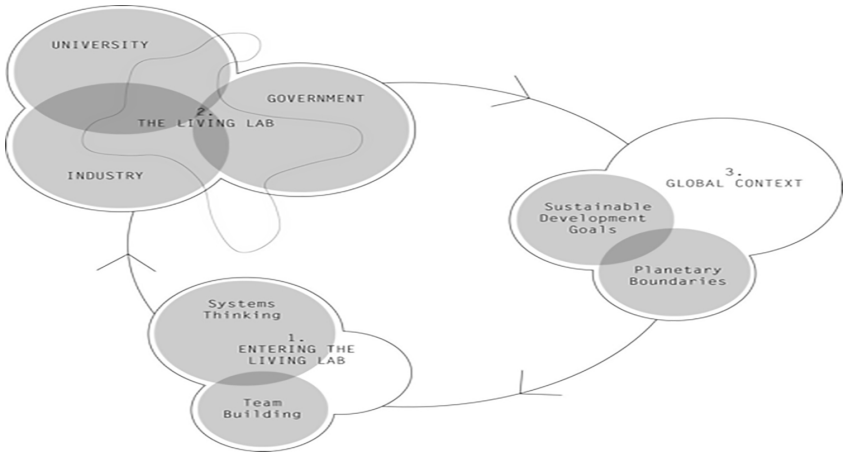

Fig. 5 Overview of key stages of skills development in the Transdisciplinary Living Lab model.[26]

The TDLL supports an approach to learning that starts with the familiarity of personal experiences and practices, what Fry terms 'digging where you stand',[27] to learning with and from others (essential to a transdisciplinary approach) to propose appropriate systemic intervention, and finally through to global impacts, introducing the concept of SDGs and planetary boundaries, within which our most mundane everyday practices are ultimately nested. This approach highlights that social learning must always be transformative of self and shareable with others.[28]

When Western Sydney became a signatory on the SDGs in 2017, sustainability lost any residual marginal or voluntary status and took centre stage. As the University Commitment Statement suggests, sustainability requires all core areas of the university—curriculum, operations, research and engagement—to be considered together:

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org/vol14/iss2/art32/ and https://doi.org/10.5751/es-03180-140232.

26 Alexandra Crosby, Dena Fam and Abby Mellick Lopes, 'Transdisciplinarity and the 'Living Lab Model': Food waste management as a site for collaborative learning', in *Transdisciplinary Theory, Practice and Education: The Art of Collaborative Research and Collective Learning*, ed. by Dena Fam, Linda Neuhauser and Paul Gibbs Fam (Switzerland: Springer International Publishing, 2018), pp. 117–131, https://doi.org/10.1007/978-3-319-93743-4_9.

27 Fry (2009), p. 224.

28 Mark Reed et al., 'What is social learning?', *Ecology and Society* 15.4 (2010), https://www.ecologyandsociety.org/vol15/iss4/resp1/ and https://doi.org/10.5751/es-03564-1504r01.

> Universities will have a vital role to play in addressing (these) critical global challenges and achieving the Sustainable Development Goals. Universities have a responsibility through their teaching to equip the next generation of leaders, innovators and thinkers to understand the global challenges facing the world and the role they can play in rising to meet these challenges. Through their research and training of research leaders, universities are at the forefront of finding sustainable social, economic, environmental and technical solutions to global problems. Finally through their own operations universities can pioneer innovation and can set an example to other sectors and businesses.[29]

Together, the three projects we've presented tell a story about the university's role in facilitating the broader societal project of transitioning to more sustainable cultures and economies. These projects demonstrate the importance of a future focus, of embracing an experimental approach that might entail failure and redirection as part of the learning process, and the importance of testing ideas with people, to produce more socially robust knowledge.[30] They also demonstrate a collaborative approach that transcends the competitive relationship between universities that is often exacerbated in a climate of funding cuts. Given the short time frame we have to make major transitions across many aspects of society if we are to limit global warming to 1.5 degrees celsius, it is important that we rapidly move toward the idea of a *knowledge commons*[31] for sustainability, to which we all contribute and can draw on in remaking society within our own small spheres of influence, care and responsibility. Finally, we believe these projects also tell a story about a transition taking place in the discipline of design, which has been instrumental in the rise of unsustainable consumption across the twentieth century, and therefore perhaps more than most, is the discipline that needs to remake itself.

29 Sustainable Development Solutions Network (SDSN), *University Commitment to the Sustainable Development Goals* (2019), http://ap-unsdsn.org/regional-initiatives/universities-sdgs/university-commitment/.

30 Julie Thompson Klein, 'Transdisciplinarity and sustainability: Patterns of definition', in *Transdisciplinary Research and Practice for Sustainability Outcomes*, ed. by Dena Fam, et al. (London: Routledge, 2017), pp. 28–42, https://doi.org/10.4324/9781315652184.

31 J. K. Gibson-Graham, Jenny Cameron and Stephen Healy, *Take Back the Economy: An Ethical Guide for Transforming Our Communities* (Minneapolis: University of Minnesota Press, 2013), https://doi.org/10.5749/minnesota/9780816676064.003.0002

Case Studies in Sustainability: The South Vineyard Creek Story

Maryella Hatfield

This project started as a collaboration to explore some of the ways in which sustainability principles were being applied on Western Sydney University Parramatta campus. A group of academic staff from the School of Humanities and Communication Arts (including Alison Gill, Abby Mellick Lopes and Kate Richards) thought that a key focus of the Living Lab initiative could be to consider the role of storytelling in communicating, ideating and inspiring sustainability. This would include documentation of some of the cross-disciplinary processes underway on campus and among staff, students and external stakeholders. We learned from our initial scoping of these projects, that many of the initiatives happening on campus were not well-known. So we wanted to start the process of documenting some of these initiatives.

I started doing some documentary interviews with a number of people involved in sustainability initiatives on campus. We have green star buildings and a range of energy initiatives that are very effective, but one little project (which we didn't realize was going to unfold in such an interesting way) resulted from the discovery of a small piece of bushland on our campus located on the Parramatta River—quite a lovely location. This tiny patch of bushland is part of South Vineyard Creek, a small tributary flowing into the Parramatta River. Although we had begun doing expert interviews with people knowledgeable about this location, we also started taking students down into the area, getting them involved in their own process of interviewing experts about the area.

You can see in this photo (see Fig. 6), on the left-hand side stands Dr Roger Attwater, our campus sustainability expert and manager. He looks after all the campuses and the sustainability initiatives on this campus as well, so that is why he is with us, being interviewed by the students and me, about the ecosystems of the river. In his explanation, Roger describes the riparian zone—the different plant and animal communities in the area, and the different flora and fauna species

 https://doi.org/10.11647/OBP.0213.23

determined by the characteristics of the zones they occupy. I'm on the right behind the camera, with a student to the right-hand side.

Fig. 6 Dr. Roger Attwater, Media Arts Production students and Maryella Hatfield (behind camera, second from right) in South Vineyard Creek. Photographer unknown (2018).

The surprising thing about this little patch of land is that it was discovered almost by accident. It was not known as a part of university land nor as part of local council land, but nevertheless became an area of study and exploration. Here in the middle of a very busy urban environment, there are multiple pressures from development on all sides and there were also plans for a light rail system to be built above and to one side of the area. There is already a railway embankment up to the side of this little patch of bushland, so suspicions were raised on the part of locals as to what was going to happen to this little area. Currently there are various scoping studies underway aiming to conserve the area as much as possible because these patches of bushland are actually quite rare in the city.

So, with all these different levels of research in relation to this environment, whether it's looking at the issue of climate change, the issue of *Cooling the Commons*, which Abby discusses in her research on how people in urban environments will cope with rising temperatures,

particularly in areas like Western Sydney,[32] we also considered a number of ways in which different disciplines can look at this example and learn from it. Our media and communication students for example (many of whom are not that knowledgeable at all about ecosystems or about even the value of natural systems) are becoming aware of these issues themselves simply by visiting the site and interviewing people about them. There is great value to be had for students in personally experiencing and developing research into the natural environment for themselves, first hand.

Fig. 7 Student Amy Xu shooting footage at South Vineyard Creek. Photograph by Maryella Hatfield, 2018.

We are also discovering interesting features of this area. For example, in the Parramatta River environs, the original indigenous name given by the Dharug people, the earliest inhabitants of this area, was Burramattagul, the meeting place of eels. We found that in this creek, eels are still thriving. While there are also turtles and tortoises, the eels have a particularly interesting life cycle related to the physical environment itself as known by Indigenous people of the region.

32 Abby Mellick Lopes, 'How People Can Best Make the Transition to Cool Future Cities', *The Conversation* (July 12, 2017), http://theconversation.com/how-people-can-best-make-the-transition-to-cool-future-cities-80683.

In addition to this, some of our students were about to start working on another project on sustainability. This was a New Colombo Plan initiative by the Australian Federal Government, led by colleagues Professor Juan Salazar and Dr Tanya Notley, documenting stories in Vanuatu in the South Pacific.[33] As it happened, in the process of talking to some of our experts, we found by sheer coincidence that the eels' life cycle takes them to the South Pacific on their breeding cycle. So this process of investigation revealed the global connectedness of ecosystems. It allowed students to then say, 'Oh that's a new angle, that's a new part of the story that we can explore and tell. Moreover, there are connections between local and global ecosystems which we can investigate further'.

So, these examples of the Living Lab foster exploration, investigation, documentation and storytelling, from many angles. For example, engineering students can visit the South Vineyard Creek area and consider it as a case study when looking at development processes. They can reflect on sustainability concerns and ask, 'Well, where do we put the light rail system? Wouldn't it be good if we can actually respect and conserve these ecosystems and allow things to go around?' Rather than thinking, 'We need to cut through and destroy no matter the cost to the environment'. These are some of the issues I think we are faced with in urban environments; 'How can we live in much more harmonious proximity to natural environments?'

This is likely an issue around the world, and not just local to us. Looking at these examples as case studies raises important questions, such as 'How can we learn, understand and proceed in a much more harmonious way in relation to the environment and allow there to be a much greater sense of balance and appreciation between various stakeholders'.

Resilient Cities and the Urban Environment

Out of such activities, further questions coalesce around the theme of resilient cities and the urban environment. When looking at all the big

33 Isabel Wagner, 'Student documentaries get close and personal with Vanuatu's climate change battle', News Centre, *Western Sydney University* (December 4, 2018), https://www.westernsydney.edu.au/newscentre/news_centre/more_news_stories/student_documentaries_get_close_and_personal_with_vanuatus_climate_change_battle.

issues together, whether it is climate change or urban development, they often seem an enormous cluster of problems. How do we respond to some of these really big challenges? How do we respond when we sometimes feel that the problems are insurmountable, in that, as 'wicked' problems, they are characterized by a high degree of complexity?

So, I come back here to a phrase that was raised at the Futures West event that Abby Mellick Lopes mentioned earlier in this chapter.[34] A *Future Scenario*[35] scholar, Tony Fry reiterates the idea of 'Dig Where You Stand'.[36] The principle is to look into your local situation and to see how you can bring the awareness from that micro situation, case study or moment of realization to the fore. Can you then see if you can apply what you learn on this smaller scale to a larger one? Even with a case study like the South Vineyard Creek story, many lessons can be explored and learned. There are many community members involved, local council people, Aboriginal people, members of the Dharug community and others, including members of a nation-wide group *Clean Up Australia*. One of the local groups connected with *Clean Up Australia*, are people who call themselves the River Keepers. Site leader Paula Coleman reported on their activities in March 2019.[37] In short, a whole community has grown out from this place and with the university as well.

Originally this project came about because we were considering a concept called the 'Sustainathon' where we were looking at inviting a broad range of people onto the campus to participate in an ideation process. This was based on discussions with Professor Chris Ryan from the University of Melbourne's Victorian Eco-Innovation Lab or VEIL.[38]

34 Allen, Lopes and Andrews (2009).

35 In the 'Methods of change 2: Designing in time' section of *Design Futuring* (2009), Tony Fry writes: 'Future scenario building not only requires a considerable amount of time and research but skill and practice. The basis of futuring scenario is not "what will be" or even "what might be" but "what potentialities beg interrogation"—this for possible precautionary design responses' (pp. 145–155), https://doi.org/10.2752/204191211x12980384100355.

36 Fry (2009), p. 224.

37 Paula Coleman, *Clean Up Australia Day, Vineyard Creek, Burramatta* (2019), https://www.cleanupaustraliaday.org.au/fundraisers/paulacoleman/Vineyard-Creek---Burramatta.

38 The Victorian Eco-Innovation Lab (VEIL) is a research-design-action group focused on innovation for more sustainable and resilient future cities. It is an interdisciplinary group whose work is engaged with and embedded in industry, government and communities. VEIL's work aims to shift thinking about both what is possible and what is needed imminently to create a more sustainable future. The group's projects

My initial contact with Professor Ryan arose from work surrounding my film *The Future Makers*, a documentary exploring possible futures based on environmental technologies and sustainability principles.[39] We had also discussed some of his ideas around the concept of 'eco-acupuncture', a way of considering how small examples can invigorate the larger entity exploring questions such as, 'What kind of ideal urban scenarios would we like to create?'.[40]

As part of a WSU Sustainability Research initiative,[41] we proposed to relate these ideas to our immediate situation and tell some of our local stories. Our aims are to document or capture our stories, and then to invite people to our campus, to explore and discuss some of the possibilities for Sydney and/or for Parramatta. In this way we hope to actually broaden this conversation around sustainability with more engagement in decision-making processes. There is currently much discussion about political culture; the idea that democracy is possibly in trouble because people feel left out of decision-making processes. Showing the ways in which people can engage meaningfully, can communicate and feel that they are being heard, and can then actually *see* that they're being heard, will doubtless feed into political culture more broadly.

Resilience and Lessons for the Future

We've been having a range of conversations with Dr. Roger Attwater as the Campus Sustainability Manager, with the Riverkeepers, and with

frequently use scenarios, modelling and visualizations of alternative futures to help communicate these ideas (see *Victorian Eco Innovation Lab* (*VEIL*), https://veil.msd.unimelb.edu.au).

39 *The Future Makers* tells the story of key Australians leading the way on the world stage in renewable energy. Some are designing a future based on models in nature. Others are creating a sustainable energy model for a 21st century economy (see Maryella Hatfield (dir.), *The Future Makers Film* (2008) http://thefuturemakers.com.au/about_the_future_makers_film.php).

40 Chris Ryan writes: 'Eco-Acupuncture focuses on multiple small interventions in an existing urban precinct that can shift the community's ideas of what is permissible, desirable and possible and provide transformation points for a new trajectory of development to a resilient low-carbon future' ('Eco-Acupuncture: Designing and facilitating pathways for urban transformation, for a resilient low-carbon future', *Journal of Cleaner Production*, 50 (2013), 189–199, https://doi.org/10.1016/j.jclepro.2012.11.029).

41 The WSU Sustainability Research initiative at Western Sydney University is led by Juan Salazar and Jeff Powell ('Research theme champions: Environment and sustainability' (Western Sydney University, 2018), https://www.westernsydney.edu.au/dvcresearch/dvc_research/research_theme_champions).

many others. In relation to resilience, one of the stories that remained with me was told by one of the Riverkeepers, Paula Coleman. In the photo below, she is shown describing a number of tree species in the surrounding area from the riverbed through the mangroves, all the way up the creek, that have been there for hundreds of years. She pointed in particular to the swamp mahogany trees that have clearly been growing for many decades and possibly centuries.

Fig. 8 Riverkeeper, Paula Coleman, at South Vineyard Creek. Photograph by Maryella Hatfield, 2018.

This is a powerful image of resilience. Having the existence of these trees being made visible and the ecosystem being revealed, right next to our campus, was part of this research process. Becoming aware of this ecology in this way is very meaningful. We are therefore witness to both the trees' resilience and the eels' resilience in the face of intense levels of urban development around them—the light rail and the industrial sites—encroaching on the areas adjacent to the riverbed on one side with the campus sitting on the other side.

Paula also suggested that there are a number of powerful owls that live in the creek environment. Who would have thought that would be possible in such a densely populated urban environment? We know that in the creek there are tortoises, small turtles, eels and lizards. There are

the mangrove areas all the way up to the eucalyptus communities and there are eastern water dragons (lizards) in the creek bed. So there may be many creatures living there that we are not yet aware of. The flora and fauna are powerful symbols of resilience and we have much to learn from these environments.

Research continues to reveal the powerful value of ecosystems in supporting life forms on earth, with examples such as the recent findings on the role of mangroves and wetlands in mitigating climate change.[42] Case studies such as these help students, academics and the community see how the broader principles apply through real examples in practice.

I think it's important that people have a sense of possibilities for the future, being able to see that we do have options and choices available to us, that decisions can be made in a more deliberative manner. Media, storytelling and documentation of these possibilities is a part of that process, and a theme that I explored in my film, *The Future Makers*.[43] Capturing stories of possible solutions and fresh ways of considering our relationship with the natural world gives us all a sense of agency and confidence in taking steps towards a future that is life-affirming in every sense.

Renowned biologist, E.O. Wilson describes the concept of 'biophilia' and the sense that humans have a natural affinity with all other life forms. Taking small scale experiences like this, applying them, and seeing how they relate to the greater whole can create powerful learning opportunities that may play out on many levels. He describes this principle eloquently here: 'I offer this as a formula of re-enchantment to invigorate poetry and myth: mysterious and little known organisms live within walking distance of where you sit. Splendor awaits in minute proportions'.[44]

We may well apply this formula to examples such as South Vineyard Creek. Using these ideas, along with concepts such as eco-acupuncture, allows for an approach that ties in the benefit of micro-storytelling about sustainability, or small examples about social and community learning.

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42 Kerrylee Rogers, Jeffrey Kelleway and Neil Saintilan, 'Rising seas allow coastal wetlands to store more carbon', *The Conversation* (March 6, 2019), https://theconversation.com/rising-seas-allow-coastal-wetlands-to-store-more-carbon-113020.

43 *The Future Makers Film* (2008).

44 Edward O. Wilson, *Biophilia* (Cambridge: Harvard University Press, 1984), p. 139.

As Ryan observes, a focus on 'multiple small interventions in an existing urban precinct [...] can shift the community's ideas of what is permissible, desirable and possible and provide transformation points for a new trajectory of development to a resilient low-carbon future'.[45] Inviting participants on all levels, from the community, academia, students, policymakers, developers, and engineers, to observe what takes place on a micro-scale may allow for consideration of issues on a much larger scale. It may be possible to see how efforts to address some of the wicked problems related to climate change, may benefit from practical observation and application of solutions, ideas and strategies emanating from the local and extending to the global.

Some of these wicked problems have come into even greater focus more recently, with the bushfires in Australia over the 2019–2020 period, followed dramatically by the COVID-19 pandemic. Both of these events are revealing, even more, the value and importance of keeping natural environments intact as much as possible, especially in urban environments. Many wildlife species are under extreme pressure and threat, and having habitats to escape to becomes a matter of survival. Many people undergoing isolation at home are realizing the value of green spaces near their homes for exercise, health and well-being. So, it may become even more crucial to appreciate and recognize the value of these habitats and micro-stories as sites for learning and passing on knowledge for future generations.

45 Ryan (2013), p. 189.

Re-pair: An Open Project for Cultures and Economies of Repair in Western Sydney

Alison Gill, Abby Mellick Lopes and Francesca Sidoti

A baseline study about repair policy, services and infrastructure was conducted in 2017 by Francesca Sidoti, supervised by Abby and Alison as design researchers, with a focus on the Local Government Area of Parramatta, New South Wales (NSW), Australia. The study set out to investigate the capacities of repair services to respond to the problems of waste and the unsustainable rates of divesting unwanted goods, and identify strategic opportunities for connecting community, education, not-for-profit and local government sectors in Western Sydney in social learning about repair.

The preliminary report[46] identified repair services and community organizations, including commercial, government, charities and not-for-profits, currently in operation in Parramatta, uncovering rich and complex interactions and cultures of repair with a clear relationship to the cultural demography of the city and the rise of digital service platforms. A number of barriers to and motivations for community engagement with repair services were found, and attention turned to the role Western Sydney University could play in leveraging local initiatives and connecting people, resources and expertise.

Abby and Alison have a long-standing interest in groups of practices central to the handleability of household objects and to constitutive, life-extending maintenance and repair, as we hope to re-orientate design's focus from developing new, more energy efficient objects to instead support sustain-*abilities* of use and care. 'Re-pair' is a critical-political design practice of re-direction and re-materialization that gives time to things.[47] It takes place at precarious moments when the life potentials of the things we carry can be imagined, weighed and put

46 Francesca Sidoti, *Cultures of Repair* (n.p., 2018) [preliminary report].

47 Tony Fry (2009); Alison Gill and Abby Mellick Lopes, 'On wearing: A critical framework for valuing design's already made', *Design and Culture*, 3.3 (2011), 307–327, https://doi.org/10.2752/175470811x13071166525234; Abby Mellick Lopes and Alison Gill, 'Reorienting sustainable design: Practice theory and aspirational conceptions of use', *J. Design Research*, 13.3 (2015), 248–264, https://doi.org/10.1504/jdr.2015.071456.

 https://doi.org/10.11647/OBP.0213.24

on an alternative path to that of landfill. With this strategic disposition, we recognize that redirecting stuff back into life involves skillful diagnosis and the unearthing of practical knowledges and tools that are in social decline; this includes strategies of design that articulate the old and the new—such as retrofit, retool, refurbish, reuse and remake—which have the potential to create new, more diverse socio-economic relationships. Re-pair disrupts rapid product turnover and the unsustainable consumption of individually-owned consumables, and creates an alternative imagination from the linear take-make-use-waste trajectory, modelling the circular and share economies to which parts of the community aspire.[48] The barriers to more widespread engagement include the demands of time and skills-acquisition to take-up what are currently marginal, specialist and expensive practices, with poor recovery systems, and have limited capacity to compete with the speed and convenience of retail for new consumables.

In the last decade, several Western Sydney councils including Parramatta City Council in 2007, Liverpool City Council in 2012 and Fairfield City Council in 2017, have adopted 'zero waste' strategies. While the concept of zero waste is idealistic, it does represent an aspiration for a radical reduction in the amount of waste going to landfill. During this time, the centrepiece of the Parramatta City Council's waste avoidance strategy and non-organic waste diversion has been recycling. However, China's National Sword policy regulated from 2018 the importation of twenty-four categories of foreign solid waste—to better protect their environment and public health—triggering a local Government crisis as Councils have lost the income from on-selling recyclate for offshore processing to recover the cost of collection. In addition to this disruption of the recycling system, charitable donation and illegal dumping of unwanted and unfit items are forms of divestment on the rise. The Western Sydney Regional Organisation of Councils estimated that illegal dumping costs the region slightly over $11 million in 2016.[49]

48 Patrick Schroeder, Kartika Anggraeni and Uwe Weber, 'The relevance of circular economy practices to the sustainable development goals', *Journal of Industrial Ecology*, 23.1 (2019), 77–95, https://doi.org/10.1111/jiec.12732.

49 Western Sydney Regional Organisation of Councils 2016, 'Project: Litter and illegal dumping baseline' (May 4, 2020), https://wsroc.com.au/projects/project-regional-waste/project-litter-and-illegal-dumping-baseline.

'Dumping' of clothing, textiles and household waste is a major concern for charitable organizations with Charitable Recycling Australia reporting that Australian charity and social enterprise retailers are forced to send over 80,000 tons of unusable donations to landfill every year, costing these retailers $18million in waste management costs and impacting staff morale and health.[50] These circumstances have created an opportunity to develop design's capacity to 'common'[51] and reframe repair as a much bigger part of a response to the crisis and the waste management picture. Not all the things divested from households can be repaired but more assessment time is needed for the many still working and reusable things sitting between the categories of 'new' and 'waste', that have the potential to be kept going with maintenance and attention. Not only can repair sustain and even improve the functional life of portable and fixed goods and services; it also offers opportunities to attune to what we call the 'cultural timing' of repair within everyday practices of ridding, to develop local labour and skills development, and fulfill social and creative needs. It could contribute to community engagement and wellbeing in a way that recycling never did. As Nazlı Gökçe Terzioglu, Clare Brass and Dan Lockton have found, repair is not just a matter of fixing things but 'a generative process that is motivated by complex emotional drivers and behavioural aspects. It gives a sense of accomplishment, teaches how things are made and informs their material qualities'.[52] This suggests that the role of repair extends beyond addressing waste management and environmental issues—it can serve as a platform for designing community engagement activities, creation of new skills and employment opportunities.

Our research study focused on a white/grey literature review of repair resources, policies and programs, plus the identification of repair businesses and services in Parramatta. Parramatta is a suburb twenty-four kilometres west of Sydney and home to approximately 245,000 people, and a focus of intense investment by public and private sectors, including

50 Charitable Recycling Australia, 'Advocacy', https://www.charitablerecycling.org.au/advocacy/.

51 Gibson-Graham, Cameron and Healy (2013).

52 Nazlı Gökçe Terzioglu, Clare Brass and Dan Lockton, 'Understanding user motivations and drawbacks related to product repair', *Sustainable Innovation 2015: 'State of the Art' Sustainable Innovation and Design* (University for the Creative Arts, Epsom, Surrey, November 9–10, 2015), p. 236.

the building, manufacturing and creative industries. Parramatta is undoubtedly important to the NSW and Australian economy, with Australian Bureau of Statistics estimating the city of Parramatta produces a gross regional product of $28.88 billion annually, representing 4.84% of the state's Gross State Product.[53] Parramatta is also increasingly diverse, with 50% of the resident population born overseas and 52% of the population speaking a language other than English at home.[54] The economic vitality of Parramatta, combined with the growing population and the shift from majority low density housing to medium and high density housing,[55] ensures that policy and practice must manage rates of consumption with a focus on waste avoidance and disposal, with the opportunity to consider materials sorting, reuse and repair.

Of the commercial repair services based in Parramatta (n = 122), 104 were formal (a business, often with a shopfront or established mobile organization) and the remaining 18 were identified as informal (people working informally, on the side or after hours). These informal commercial enterprises were industry specific and exclusively associated with clothing (7) or Electrical and Electronic Products EEPs (10), with the exception of one informal automotive business. While this survey can tell us the range of product areas and number of services in the Parramatta area, more research is necessary to get a clearer picture of the communities of repair practices, and the take-up and roles of repair in social life. Since the first phase that scoped existing services, we have been exploring ways to activate this research as a searchable database of these services and geo-mapping the repair activity. The mapping has revealed very interesting geographic and cultural clusters—like the significant network of informal Sari repair—and invited further questions about what conditions gave rise to the informal economies of repair that are underway—mobile or pop-up services, and the co-location of shared resources and services.

One of the most magnetic repair initiatives in recent years has been the emergence of repair cafés, with one established in Parramatta at

53 id.community, 'City of Parramatta: Economic profile', http://economy.id.com.au/parramatta.

54 id.community, 'City of Parramatta: Community profile', https://profile.id.com.au/parramatta/highlights-2016.

55 Ibid.

the Bower Reuse and Repair Centre. Started in Amsterdam in 2009 by Martine Postma, there are now estimated to be approximately 1,400 repair cafés worldwide.[56] The concept is relatively simple: a repair café is a space where people can bring their broken items and repair them with the assistance or guidance of a volunteer. Tools and materials are available as is the expertise of an assortment of repairers. The cafés aim is to provide skill development, a social space, and support political activism and advocacy around repair as an effective intervention against consumerism and waste.[57]

In Australia, there are sixteen repair cafés listed on the official Repair Café Foundation site.[58] In Sydney, this includes the Bower Reuse and Repair Centre, which has shopfronts in Marrickville and Parramatta, with a repair café on the last Saturday of each month at Parramatta, Banga workshop at Green Square and Zetland, and the Repair Café Sydney North, based in Chatswood. Expanding on the café concept, the Bower has an extensive program of events and workshops to encourage repair, and private online consultations with experts and group webinars were introduced in March 2020 as a digital community outreach program called RepairWorks Online during the COVID-19 shut-down. The Bower is careful to distinguish between paid repair services where items are left to be repaired, and skill development which is central to the Bower's community engagement and education program. Services include workshops on carpentry, upholstery, and furniture painting, repair services at an affordable price, access to workshop space, a collection and rehoming service for unwanted appliances and furniture. The Bower 'From House to Home' project, a partnership with other community groups, provides furniture for people in need—primarily asylum seekers and people who have experienced domestic violence—as they seek to set up a home.

Guido Verbist, manager of the Bower, outlined the key challenges for the charity around the community visibility of repair in the Parramatta Central Business District (CBD). In conversation, he mentioned that the 'Hunter Street location is in the business district, not the shopping

56 International Repair Cafe Foundation (2019), https://repaircafe.org.

57 *Sharing Cities: Activating the Urban Commons* (2018), https://www.sharingcities.net/.

58 International Repair Cafe Foundation, 'Want to start your own Repair Café? You can!' (2019), https://repaircafe.org/en/start/.

district. We find that we have fewer [walk-in] customers than in Marrickville, but those that come [to Hunter St] intend to come'. He speculates that it could simply be a matter of time to establish a stronger profile, as the initiatives have received strong support and promotion by Parramatta Council, however, he acknowledges the urgent need for an education framework about the multiple benefits of repair—i.e., repaired items can be better than the original—and a framework that separates repair from the idea of recycling as sorting and moving waste. Confirming our own and other research, Verbist sees the key barrier to embracing repair as the perception that 'buying new is best', and his strategy is to normalize secondhand and repaired goods by promoting the concept that 'buying secondhand is not second best'. Synthesizing our own and wider research, the following barriers to repair have been identified:

1. Finding a quality repair takes time and may be inconvenient, when the majority are time poor.[59]
2. The need to skill-up and find the tools and materials to DIY.[60]
3. Going against the grain of buying new, to love the pre-loved or worn object.[61]

Some of the motivations found for repair are:

1. Emotional attachment to an item.[62]
2. A familiarity with the product and/or an unwillingness to buy and then familiarise oneself with new products or technology.[63] We have recognized this accrued familiarity

59 Emma Dewberry et al., 'A Landscape of repair', *Sustainable Innovation 2016: 'Circular Economy' Innovation and Design* (University for the Creative Arts, Epsom, Surrey, November 7–8, 2016), pp. 76–85; Terzioglu, et al. (2015).

60 E. Kalantidou, 'Handled with care: Repair and share as waste management strategies and community sustaining practice', *PLATE Conference* (Nottingham Trent University, June 17–19, 2015), http://www.plateconference.org/pdf/plate_2015_proceedings.pdf; Daniela Rosner and Morgan Ames, 'Designing for repair?: Infrastructures and materialities of breakdown', *17th ACM Conference on Computer-Supported Cooperative Work & Social Computing* (Baltimore, MA, February 15–19, 2014).

61 Gill and Mellick Lopes (2011).

62 Terzioglu, Brass and Lockton (2015).

63 Dewberry (2016).

and learning by referring to the intrinsic value of the 'experienced product' in contrast to the new.[64]

3. As a means of empowerment, both in consuming and using items in an environmentally sustainable way and in developing the skills to truly 'own' an item.[65]

In order to re-prioritize 'experienced products' over new ones and fully 'own the already owned', consumer legislation, design and manufacturing must change. Verbist describes the impact that the push by consumers and small-business for 'right to repair' legislative reform in the European Union could have on manufacturing, and the aspirations for Australian legislation and a design-led circular economy: 'in the meantime manufacturers needed to move from "linear" to "circular" economies [...] Resources-to-waste products are the current model, but a circular economy is where you can time and time again use the parts [...] you can dismantle them and reuse them for new products. Some companies have started looking to that direction, but there's a lot more room for improvement'.[66] A groundswell of community and government pressure has the potential to push back and hold design and manufacturing to account, for producing too many screw-free, glued objects under warranties that lock out the user to tinkering and skills acquisition. There are many challenges ahead for design, and when there is a mandate to design items that can be more readily disassembled, fixed and updated, the part played by repair could grow.

Recent developments indicate that growing repair is not a pipe dream. The NSW Environmental Protection Authority have identified the roles of repair, refurbishment and remanufacturing in drafting a State circular economy policy in the discussion paper 'Too good to waste',[67] and there will be impetus for local government to discuss

64 Gill and Lopes (2011).

65 Rosner and Ames (2014).

66 Cited in: Jemima Burt, '"Right to repair" regulation necessary, say small businesses and environmentalists', *ABC News* (March 2, 2019), https://www.abc.net.au/news/2019-03-03/does-australia-need-a-right-to-repair/10864852.

67 'Too good to waste— a discussion paper on a circular economy approach for NSW', *Sydney: NSW Environment Protection Authority* (October, 2018), https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/recycling/18p1061-too-good-to-waste-circular-economy-discussion-paper.pdf?la=en&hash=4217537474E04FA7DD4A2D3191FFBD1A78433FD2.

these strategies in developing waste reduction and avoidance policy at Council level. A recent report prepared by Western Sydney University[68] recommends that our research on Parramatta's repair clusters indicates potential for Councils to leverage existing 'cultures of repair'; to model and embed circular economy principles in community engagement activities that not only recover waste materials but foster culturally diverse social, creative and economic opportunities.

68 Paul James et al., *Closing the Loop on Waste: Community Engagement, Cultural Diversity, and Shared Responsibilities in Waste Management in Canterbury-Bankstown* (Penrith, Australia: Western Sydney University, 2019), https://researchdirect.westernsydney.edu.au/islandora/object/uws:53180/datastream/PDF/view.

Coda

Hart Cohen

Having recently visited the western High Arctic, the sense of it as a 'barometer' of climate change is due to its vulnerability to environmental change.[69] This features in the context of the discourses of both research institutions and so-called 'non-state actors', and is linked to the Anthropocene. Rapidly melting sea ice, as well as other impacts of climate change, have been documented in a report on recently completed comprehensive studies.[70] The results have led to the emergence of multiple sources such as non-state actors, NGOs, and research organizations (e.g., Canadian High Arctic Research Station or CHARS) as significant influences in understanding and informing policy relating to the complex issues of climate change.

Fig. 9 Arctic Ocean from Cambridge Bay (Ikalutuuttiaq), Western High Arctic. Photograph by Hart Cohen, 2019.

69 Dorothea Wehrmann, 'The polar regions as "barometers" in the Anthropocene: Towards a new significance of non-state actors in international cooperation?', *The Polar Journal*, 6.2 (2016), 379–397, https://doi.org/10.1080/2154896x.2016.1241483.

70 Gary Stern and Ashley Gaden, eds., *From Science To Policy In The Western And Central Canadian Arctic: An Integrated Regional Impact Study* (*IRIS*) *Of Climate Change And Modernization* (Quebec City: ArcticNet, 2015), pp. 300–341, http://www.arcticnet.ulaval.ca/pdf/media/IRIS_FromScience_ArcticNet_lr.pdf.

 https://doi.org/10.11647/OBP.0213.25

In this context, by way of example, research organizations have included Inuit Elders as consultants to gauge the impact of climate change on their activities such as hunting and fishing, the impact on animal behaviour and specifically on environmental changes they have been able to observe in recent times. This supports the view[71] that the Anthropocene increases the likelihood for cooperation between non-state and state actors in the attempts to address climate change.

The logic of our contribution above bears out this view of the importance of non-state actors in assisting with this process of engagement with climate change. The examples of the engagement undertaken as part of the *Living Lab* suggest that students, academic staff and Aboriginal people—both stakeholders and rights-holders—have come to meet the complex and many varied challenges of climate change.

But the issues surrounding Anthropocene thinking and its intellectual horizons are anything but settled. Contemporary disputations include works by Dipesh Chakrabarty, who cites a historicist paradox in the anxieties that predict the end of humanity;[72] as well as Bruno Latour's attacks on scientific practice, now reversed in the era of the Anthropocene, where he articulates something resembling a 'Living Lab': 'I am working on something like laboratory life—a combination of lab and field work in an area called the "critical zone"—the study of the earth's skin'.[73] The ideas developed in relation to the South Vineyard Creek above suggest a strong affinity to the 'critical zone' approach. And finally, Donna Haraway argues that the Anthropocene is a 'boundary' not an 'epoch'. As she says, the Anthropocene throws into relief the Holocene, whose epoch allowed for 'cheap nature' or a massive draw on the planet's resources. Haraway thus calls for participatory people-based action 'with intense commitment and collaborative work and play with other Terrans, flourishing for rich multispecies assemblages that include people'.[74]

71 Wehrmann (2016).

72 Dipesh Chakraborty, 'The climate of history: Four theses', *Critical Inquiry* 35.2 (2009), 197–222, https://doi.org/10.1086/596640.

73 Jop de Vrieze, 'Bruno Latour, a veteran of the 'Science Wars', has a new mission', *Science* (October 10, 2017), https://www.sciencemag.org/news/2017/10/bruno-latour-veteran-science-wars-has-new-mission and https://doi.org/10.1126/science.aaq1805.

74 Donna Haraway, 'Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making kin', *Environmental Humanities*, 6 (2015), 159–165 (p. 160), https://doi.org/10.1215/22011919-3615934.

In a modest manner, we believe the projects found in this chapter emulate this call to commitment and action.

Fig. 10 Stop sign in Cambridge Bay (Ikalutuuttiaq). Photograph by Hart Cohen, 2019.

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15. An Intro to Econferences

Chelsea Miya, Geoffrey Rockwell and Oliver Rossier

Reading maketh a full [person], *conference a ready* [*person*], and writing an exact [person].

Francis Bacon, 'Of Studies', in *Essays* (1625)[1]

Flying is one of the most environmentally detrimental activities associated with our research practices. Until recently, even as colleges and universities took steps to green their campuses, conference-related air travel was on the rise. The COVID-19 pandemic forced academics (along with much of the world) back to the ground, but what will happen after travel restrictions are lifted? Will we slip back into old habits? Our reliance on flying is unsustainable, but research depends on open and timely communication of ideas, methods and results. How then can we adapt our conferencing practices to preserve their communicative value while reducing the need to fly so often? The following chapter introduces the econference medium and makes the argument for bringing academic conferences online, and maintaining these efforts after travel restrictions are lifted.

1 'Of Studies' (1597, enlarged 1625), *The Works of Francis Bacon*, Volume 1, https://en.wikisource.org/wiki/The_Works_of_Francis_Bacon,_Volume_1/Essays/Of_Studies (emphasis added).

 https://doi.org/10.11647/OBP.0213.26

In 2019, the 'green leaders' gathered at the World Economic Forum in Davos, Switzerland set an uncomfortable milestone. A record-breaking number of private jets—1,500 in all—landed in the city for the event.[2] The irony of burning massive amounts of fossil fuels to fly in speakers and attendees for a talk on global warming was not lost on observers, and points to not only a lack of self-awareness on the part of the organizers, but a wider problem within the research community. Flying is one of the most environmentally detrimental activities associated with our research practices.[3] Post-secondary institutions are increasingly prioritizing eco-friendly initiatives, as shown by the formation of organizations like the International Sustainable Campus Network in 2007, which at last count has 93 member institutes[4] and the University Climate Change Coalition in 2018.[5] But even as colleges and universities take steps to green their campuses, the amount of air travel that academics engage in continues to rise.[6] Our flying is unsustainable and yet research depends on open and timely communication of ideas, methods and results. How then can we adapt our conferencing practices to preserve their communicative value while reducing the need to fly so often? While there have been major transitions to using the Internet for teaching using online content management systems and publishing through e-journals, the academic conference has been slow to change. Small group meetings have gone virtual, thanks to phone conferencing and now video conferencing tools like Skype, Google Hangouts, LifeSize, and Zoom, but until recently we had not seen a similar transition in how larger conferences are hosted.[7]

2 Rebecca Ratcliffe, 'Record private jet flights into Davos as leaders arrive for climate talk,' *The Guardian* (January 22, 2019), https://www.theguardian.com/global-development/2019/jan/22/record-private-jet-flights-davos-leaders-climate-talk.

3 Malabika Pramanik, 'On the environmental impact of academic conferences', *The Wall Papers* (September 23, 2019), https://pwias.ubc.ca/wall-stories/the-environmental-impact-academic-conferences.

4 International Sustainable Campus Network (ISCN), https://international-sustainable-campus-network.org/.

5 University Climate Change Coalition (UC3), https://secondnature.org/initiative/uc3-coalition/.

6 Ken Hiltner, *A Nearly Carbon-Neutral Conference Model: White Paper/Practical Guide*, https://hiltner.english.ucsb.edu/index.php/ncnc-guide/.

7 See Lynne Anderson and Terry Anderson, *Online Conferences: Professional Development for a Networked Era* (Information Age Publishing, 2010); Lucy Gilson et al., 'Virtual teams research: 10 years, 10 themes, and 10 opportunities', *Journal*

However, in face of the double crisis of both climate change and the COVID-19 pandemic, researchers have been forced to reconsider our reliance on in-person gatherings. To understand the attraction of traditional academic conferences and the need for alternatives, we must first examine how they function and what they offer researchers.

Communities of Inquiry

One way to understand the importance of conferences to research is to think about how they help develop communities of inquiry (CoI). D. Randy Garrison, Terry Anderson and Walter Archer developed a CoI model as a framework for improving the integration of new communication media into distance education.[8] CoI research was conducted in conjunction with one of the first virtual, text-based conferences.[9] The model helped researchers conceptualize the levels of cognitive, social and teaching presence in a particular learning environment. CoI has become the most widely cited model for aspects of online education and teaching research.[10]

In order to adapt the CoI model to the conference environment, we can replace 'teacher' presence with 'leader' presence, as shown in Figure 1 below. Research leaders serve on conference organizing committees to select the content of conferences and set the climate for participants.

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of Management, 41.5 (2015), 1313–1337, https://doi.org/10.1177/0149206314559946; and Corinne Le Quéré et al., 'Towards a culture of low-carbon research for the 21st Century', Tyndall Centre for Climate Change Research, *Working Paper 161*, 2016, https://tyndall.ac.uk/sites/default/files/publications/twp161.pdf.

8 D. Randy Garrison, Terry Anderson and Walter Archer, 'The first decade of the community of inquiry framework: A retrospective', *The Internet and Higher Education*, 13.1–2 (2010), 5–9, https://doi.org/10.1016/j.iheduc.2009.10.003.

9 Ibid.

10 Terry Anderson, 'How communities of inquiry drive teaching and learning in the digital age', *North Contact* (September 2017), https://teachonline.ca/tools-trends/how-communities-inquiry-drive-teaching-and-learning-digital-age; Aras Bozkurt, et al., 'Trends in distance education research: A content analysis of journals 2009–2013', *The International Review of Research in Open and Distributed Learning*, 16.1 (2015), 343–344, https://doi.org/10.19173/irrodl.v16i1.1953.

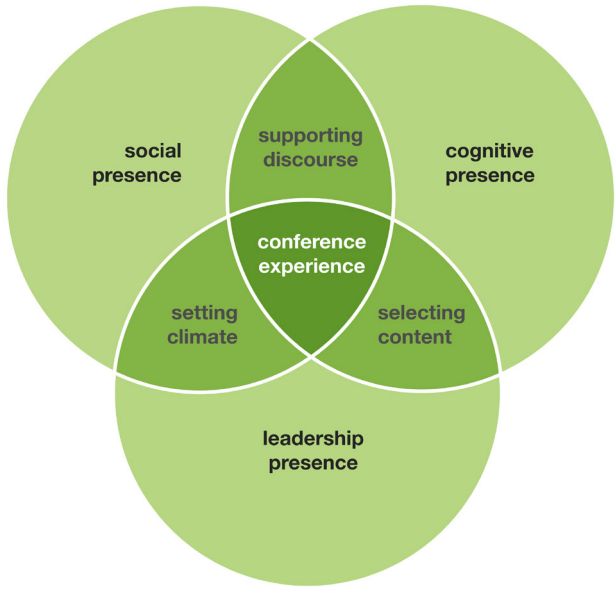

Fig. 1 Adapting CoI for conferences: proposed *conference* community of inquiry.[11]

Leadership presence in academic conferences contributes to the academic rigor and peer review aspects of the climate of these conferences.[12] Leadership presence in the conference experience can come from a wide range of sources. Core leadership presence in academic conferences may come from senior scholars, keynote speakers, administrative leadership, research innovators, and panel chairs. Other examples of academic conference leadership might come from organizing committees and conference coordinators. Theoretical models like CoI help frame future research into econferencing as an evolving modality of communicative interaction. The next section will explore key terminology related to econferencing, which has also been evolving with discourse related to this field.

11 Communities of Inquiry model adapted from Garrison, Anderson and Archer (2010).

12 See for example: Richard Katz, 'The Gathering Cloud: Is this the end of the middle', in *The Tower and the Cloud: Higher Education in the Age of Cloud Computing* (Educase, 2008), pp. 2–42; T. Storme, et al., 'Mobility and professional networks in academia: An exploration of the obligations of presence', *Mobilities*, 12.3 (2017), 405–424, https://doi.org/10.1080/17450101.2015.1116884.

Key Terminology

Econference

For the purposes of this chapter we will use the term *econference* to describe the act of conferencing via digital media. There are several other terms currently used: *web conference, online conference, virtual conference*. The problem with the phrase *web conference* is that it is also often used to describe one-to-one discussions online, or face-to-face (f2f) conferences which focus on issues of the World Wide Web.[13] Both *online conference* and *virtual conference* are plausible phrases, but are somewhat cumbersome when used as search terms and in metadata. It seems very possible that the term *econference* will evolve into common use at some point in the near future, similar to the evolution of terms like *e-books*, *email*, *e-transfer*, and *e-research*.[14] Finally, *econference* is more nuanced, as the "e" invokes the dual electronic and environmental dynamics of the medium. Our definition of econference is adapted from the one put forth by Anderson and Anderson to describe 'online conference' and reads as follows:

> An [*econference*] is a structured, time delineated... event that is organized and attended on the Internet by a distributed population of presenters and participants who interact synchronously and/or asynchronously by using online communication and collaboration tools.[15]

Hybrid Conference

A *hybrid conference* is a conference that uses a combination of online and face-to-face (f2f) communication and collaboration.[16] As will be

13 Katz (2008), p. 14.

14 Chris Armstrong, 'Books in a virtual world: The evolution of the e-book and its lexicon', *Journal of Librarianship and Information Science*, 40.3 (2008), 193–206, https://doi.org/10.1177/0961000608092554; Ask Oxford, *Frequently Asked Questions* (2008), https://web.archive.org/web/20080701194047/http://www.askoxford.com/asktheexperts/faq/aboutspelling/email?view=uk; Paul Genoni, Helen Merrick and Michele Willson, 'E-research and scholarly community in the humanities', in *E-Research: Transformation in Scholarly Practice*, ed. by Nicholas Jankowski (Routledge, 2009), pp. 91–108, https://doi.org/10.4324/9780203875049.

15 Anderson and Anderson (2010), p. 15.

16 Matt Bower, Mark J. Lee and Barney Dalgarno, 'Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality Environment', *British Journal of Educational Technology*, 48.2 (2017), 407–430, https://doi.org/10.1111/bjet.12435; Kirsten Broadfoot, Debashish Munshi

discussed in the Around the World (AtW) case study, the hybrid model may provide a key opportunity for conference organizers to strategically balance the core motivations of f2f social networking with the mitigation of environmental impact by using digital platforms to replace travel where possible.[17]

Motivations: Why do We Have Academic Conferences?

Universities and colleges are complex environments with a range of stakeholders who influence aspects of academic conferences. This includes how they are organized, conducted, and located, and whether the conferences happen at all. Key stakeholders include: academics, students, administrators, staff, organizations, politicians, and governments. Despite the importance of conferencing to academia, there is a general lack of research on the functions and modalities of academic conferences.[18]

While there are some major overlaps, the motivations for organizing and hosting conferences can be quite different for different stakeholders. Even academics themselves have different motivations at different stages of their careers.[19] Early career academics, like graduate students and pre-tenure professors, might need to build their research networks, to establish their place in the field by presenting and publishing, and to connect to leading researchers in their fields.[20] Many mid-career professors seek to broaden their research networks, build on their reputation in the field, and take leadership roles in journals and society conferences. University administrators might see conferences as venues for recruiting potential students and staff,

and Natalie Nelson-Marsh, 'COMMUNEcation: A rhizomatic tale of participatory technology, postcoloniality and professional community', *New Media & Society*, 12.5 (2010), 797–812, https://doi.org/10.1177/1461444809348880.

17 Bower, et al. (2017); Broadfoot, et al. (2010).

18 N. Jacobs and A. McFarlane, 'Conferences as learning communities: Some early lessons in using "back-channel" technologies at an academic conference—distributed intelligence or divided attention?', *Journal of Computer-Assisted Learning*, 21.5 (2005), 317–329, https://doi.org/10.1111/j.1365-2729.2005.00142.x.

19 Le Quéré (2016); Andrew Glover, Yolande Strengers and Tania Lewis, 'The unsustainability of academic aeromobility in australian universities', *Sustainability: Science, Practice and Policy*, 13.1 (2017), 1–12, https://doi.org/10.1080/15487733.2017.1388620; Storme, et al. (2017).

20 Storme, et al. (2017).

building capacity in current students and staff, fostering research collaborations, building prestige for the host institution, and generating conference tourism revenue.

Similarly, external stakeholders like business and political leaders, organizations and governments (civic, regional and national), might see conferences as venues for fostering research collaborations, building prestige for their jurisdiction, generating tourism revenue, and building capacity in current staff. Finally, there has been an important change on many campuses in Canada and across the Western World with the rise of profit-focused conference service departments.[21] In short, there are a range of key stakeholders influencing both the choice of whether or not to host conferences and the manner in which conferences are carried out on campuses.

On a political level, governments at all three levels, civic, regional, and national, can contribute financial and other resources to assist with academic conferences, particularly with large-scale conferences.[22] In Canada, national funding agencies like the Social Sciences and Humanities Research Council (SSHRC) prioritize knowledge mobilization activities like conferencing for collaboration building and research dissemination.[23]

On an organizational level, universities have three main mandates: teaching, research, and service.[24] Broadly speaking, conferences are primarily research dissemination vehicles, but also augment teaching and service. For example, conferences can augment teaching by allowing students to engage more deeply through personal presentations or conversations with top scholars from other locations. Academics who organize conferences are also often seen as serving the host universities by bringing a reputation boost. The importance of conferences at an organizational level is illustrated by the fact that even universities

21 See for example: UBC Conferences, http://ubcconferences.com; University of Toronto, 'Conference & Catering', http://www.food-beverage.utoronto.ca/conference-catering.

22 Joyce Pittman and Brian McLaughlin, 'Professional conferences, social capital and tourism: Is the alliance in jeopardy?', *Tourism and Hospitality*, 1.2 (2012), e109, https://doi.org/10.4172/2167-0269.1000e109.

23 SSHRC, Connection Program (2019), http://www.sshrc-crsh.gc.ca/funding-financement/umbrella_programs-programme_cadre/connection-connexion-eng.aspx.

24 Katz (2008).

facing financial challenges will often offer funding for academic staff to participate in conferences.[25]

Universities must also attend to financial and reputational issues related to conferences. Over the last several decades, with more financial pressure on core funding based on traditional teaching and research activities, universities in North America have turned more to auxiliary service activities like conference hosting to bolster financial resources.[26] Academic reputation is the largest single factor in the overall ranking metrics for universities.[27] Some researchers have described the key motivations for academics to attend conferences to be opportunities for social networking, keeping current in research areas, pressure to participate in an internationalized workforce, and building social capital.[28]

Looking at the core reasons why academics participate in conferences, it is evident that the focus is around presence.[29] On an individual level, conferences serve a diverse range of uses for academics because knowledge work 'involves communication among loosely structured networks and communities of people, and understanding it involves identifying the social practices and relationships that are operative in a particular context'.[30] International travel has become an important aspect of building and maintaining social capital for academics.[31]

A very pragmatic reason for academics to attend conferences is knowledge mobilization. Academics often find it challenging to keep up-to-date on the latest research developments.[32] Conferences can serve

25 Jacobs and McFarlane (2005).

26 M. Layton Turner, 'Boosting the bottom line', *University Business* (January 2, 2012), http://dev-new.universitybusiness.com:8080/article/boosting-bottom-line#main-content

27 QS World University Rankings, *QS World University Rankings Methodology*, https://www.topuniversities.com/qs-world-university-rankings/methodology.

28 Anderson and Anderson (2010); Broadfoot, et al. (2010); Helen E. Fox et al., 'Why do we fly? Ecologists' sins of emission', *Frontiers in Ecology and the Environment*, 7.6 (2009), 294–296, https://doi.org/10.1890/09.WB.019

29 Storme, et al. (2017).

30 J. C. Thomas, W. A. Kellogg and T. Erickson, 'The knowledge management puzzle: Human and social factors in knowledge management', *IBM Systems Journal*, 40.4 (2001), 863–884 (p. 868), https://doi.org/10.1147/sj.404.0863.

31 Glover, et al. (2017); Storme, et al. (2017).

32 Ben Levin, 'To know is not enough: research knowledge and its use', *Review of Education*, 1.1 (2013), 2–31, https://doi.org/10.1002/rev3.3001.

as spaces where relevant knowledge can be surveyed through shared presence in a scholarly community environment.

Not only are conferences a way to promote finished research, but also to develop and refine research-in-progress. They provide an opportunity to test out new ideas and solicit feedback. As such, finding ways to create lively discussions online, as shown in the Byrd and Rossier et al. case studies, is essential to running a successful econference.

Ultimately, the key motivations for academic conferences include the creation of spaces for social presence, cognitive presence, and access to leadership presence. Conferences are also important spaces where the agenda of research fields are negotiated. However, a key distinction between virtual and f2f conferences lies in how these spaces are structured and organized.

Traditional f2f gatherings are organized around the physical flows of people. When planning an in-person conference, one might, for instance attempt to balance the number of concurrent sessions versus keynote sessions; choose venues that have break out spaces for smaller discussions; consider the proximity to washrooms, food, and transit; strategize on where to set up wayfinding signage to help people navigate the conference space; and identify social spaces for networking.

By contrast, online events are not organized around the flow of people through a physical space, but rather the flow of ideas and dialogues through a virtual one. Econference organizers need to consider how to design this virtual space for the smooth engagement of cognitive and social presence. With this goal in mind, econference organizers might create a welcoming website, choose technology that is accessible on various platforms and devices, and creatively facilitate online discussion.

Having explored some aspects of why academics engage in conferences, the next section will look at how econferences have evolved over time.

Evolution of Econferences

Bangkok Project

The formation of the Internet set the stage for text-based conferences, which represent an important phase in the evolution of econferences. The first international econference was likely the 1992 Bangkok Project,

organized by Terry Anderson whose article 'Virtual Conferences Are Not The Same But Are They Good Enough?' also appears in this collection.[33] This conference was an extension of the XVI World Congress of the International Council for Distance Education (ICDE) and used carefully coordinated email relays to make a major f2f conference available to virtual participants.[34] This conference also serves as an early model for exploring dual presence, as there were contributors who both sent email messages and made in-person presentations. In this way the Bangkok Project also prototyped hybrid methods of engaging a distributed audience in the dialogue of a f2f conference. The Bangkok Project was held as an asynchronous set of interactive sessions over a longer period than most traditional conferences. The conference ran for three weeks, nearly as long as the Council of Nicaea, which lasted a month, and almost the same length as the Nearly Carbon Neutral Conference discussed below.

Nearly Carbon Neutral Conferences

The Nearly Carbon Neutral (NCN) econference concept was created by Ken Hiltner as a part of a response to a sustainability audit at UCSB, which found that nearly 30% (55,000,000 lbs.) of the CO2 footprint of its entire campus in 2014 came from air travel (UCSB Climate Action Plan, 2014). Hiltner and his colleagues used this stark finding as a motivation to explore alternative methods of conferences with a lighter environmental footprint. The NCN model, which was developed for the 2016 conference 'Climate Change: Views from the Humanities' and which is featured in Hiltner's Practical Guide, has three phases:

1. Speakers [pre]record their own talks.
2. Talks are viewed on the conference website.
3. Participants contribute to online Q&A sessions.[35]

33 Terry Anderson and Robin Mason, 'International computer conferencing for professional development: The Bangkok project', *American Journal of Distance Education*, 7.2 (1993), 5–18, https://doi.org/10.1080/08923649309526819.

34 Anderson and Anderson (2010).

35 Ken Hiltner, *A Nearly Carbon-Neutral Conference Model: White Paper/Practical Guide* (n.d.), http://hiltner.english.ucsb.edu/index.php/ncnc-guide/#intro.

The main goals of the NCN event organizers were 'to encourage the cross pollination of ideas across a broad range of disciplines' and 'help establish relationships and to build a community.'[36] In total, this econference featured 4 keynote speakers and 50 research presentations from 8 countries.[37] The online question and answer sessions are still available and provide insight into some of the successes and shortcomings of this format. Hiltner's opening remarks and corresponding discussion section have a particularly rich discussion of both the NCN application techniques and the philosophical underpinnings of the econference.[38]

Most significantly, the NCN econference model provides opportunities for several layers of cognitive and social presence among the presenters and participants by hosting both the presentations and the discussion online in three formats. In terms of cognitive presence, NCN presenters disseminate their research through video via Vimeo, voice via SoundCloud, and text via conference website comments.[39] Social presence was also augmented by some presenters' use of social media. The NCN econferences created access to research detailing climate change constraints and specific techniques for hosting similar econferences.[40]

NextGen Conferences: Unconferences, Hackathons and Beyond

The digital world continues to inspire new forms of gatherings, both on and offline. For instance, the 'unconference', which is less structured and more collaborative than a traditional conference, has become a mainstay of the digital humanities.[41] Unconferences bring together participants who are united by 'shared experience and expertise'. Often the participants, rather than the organizers, set the agenda, and the sessions can focus on exploring a topic or achieving an outcome, rather than on

36 Ken Hiltner, 'Opening Remarks', Climate Change: Views from the Humanities—A Nearly Carbon-Neutral Conference (UCSB, 2016), http://ehc.english.ucsb.edu/?p=13550.
37 Ibid.
38 Ibid.
39 Ibid.
40 Ibid.
41 See, for example: THAT Camp, 'About', https://thatcamp.org/about/.

set presentations.[42] Hackathons, likewise, invite participants to come together to tackle a specific problem, which can be, but is not necessarily, computational in nature.[43] There are many other variations of academic events including: poster sessions, exhibitions, performances, reading groups, workshops, and code-a-longs, to name a few. How might a poster session be optimized for online delivery? Could we host a poetry reading or teach a class in an online gaming environment? As academics experiment with bringing these formats online, the formats themselves will undoubtedly be transformed and reimagined.

The final section delves further into the affordances and constraints of econferences, in comparison to the traditional, f2f format.

Affordances and Constraints

Technological

The speed of travel and flow of information have been among the most important technological affordances supporting research conferences. Following World War II, improvements in aviation created many more opportunities for individuals to fly internationally, contributing to a rapid increase in larger international academic conferences. In particular, aviation has created opportunities for academics in wealthier countries with access to travel funds from research grants and institutional professional development funds. For individuals in other parts of the world the cost of travelling to distant conferences is often prohibitive, as the cost of airfare to a major conference in Europe or North America can be greater than the average annual income in developing countries.[44] The costs of conferences, which include not just travel but registration fees, also weigh more heavily on graduate students, many of whom live at or below the poverty line, and are consequently disproportionately affected by cuts to travel grants and bursaries. This has created a situation where researchers who have travel support, which usually means established academics in the Global North, have disproportionate international

42 Aidan Budd et al., 'Ten simple rules for organizing an unconference', *PLoS computational biology*, 11.1: e1003905 (2015), https://doi.org/10.1371/journal.pcbi.1003905.

43 Joshua Tauberer, *How to Run a Successful Hackathon*, https://hackathon.guide/.

44 Hiltner (2016).

visibility. The rich travel more and those without funding struggle to be heard.

Over the last fifty years, there has been an exponential growth in the technologies that accelerate the movement of information along with a simultaneous reduction in the financial cost of using those technologies.[45] With many currently forced to work remotely due to the COVID-19 pandemic, tech companies are rushing to fill the demand for video conferencing software and hardware. At the same time, the pandemic has laid bare the gaps in computing infrastructure. Despite the fact that communication technology has been rapidly advancing, there are significant populations in all parts of the world who have only limited access to computing devices and infrastructure.[46] Online delivery can exacerbate the digital divide and create barriers to participation for those without access to computing devices and to high-speed Wi-Fi. There continue to be important technological constraints and challenges for econferencing including maintaining acceptable levels of video and audio streaming quality.[47] There are, moreover, a variety of reasons why students and colleagues might feel uncomfortable broadcasting from home. Not all have access to a quiet, private workspace, for instance. As remote events grow in popularity, maintaining users' security and privacy presents an additional ongoing challenge to software companies and to the educational and research institutions that rely on them.

Accessibility

In addition to the technological considerations, there are also physical, social, and political constraints to conference participation. When it comes to traditional f2f conferences, an example of a physical barrier is a disability which makes travel and/or navigating the potentially crowded and cacophonous spaces of conference halls challenging. Social barriers to physically travelling to an event might include issues like family care.

45 Elizabeth Altman, Frank Nagle and Michael L. Tushman, 'Innovating without information constraints: Organizations, communities, and innovation when information costs approach zero', in *The Oxford Handbook of Creativity, Innovation, and Entrepreneurship*, ed. by Christina E. Shalley, Michael A. Hitt and Jing Zhou (Oxford: Oxford, 2014), pp. 353–378, https://doi.org/10.1093/oxfordhb/9780199927678.013.0031.

46 Ibid.

47 Bower, Lee and Delgarno (2017).

For example, parents of young children may not have the resources or support structures to allow them to simultaneously travel and provide care.

The COVID-19 pandemic dramatically changed how we interact. In the initial stages of the outbreak, more than a few clusters of infections were traced to conference events.[48] Since then, as a result of the necessity for physical distancing, countless gatherings have been either postponed or cancelled outright. In a post-pandemic world, academics will likely be more hesitant to travel abroad. Conference organizers will need to put safeguards in place to protect participants. Though the COVID-19 pandemic is unprecedented in its scale and impact, even in non-pandemic times there are myriad factors, from bad weather to family emergencies, that can force last-minute cancellations. Offering alternative modes of delivery in case of unforeseen events helps reassure participants by ensuring that organizers have a viable contingency plan.

Political constraints are, for example, situations where a conference is hosted in a country which restricts visas for visitors from other parts of the world. The travel ban enacted by then-President Donald Trump in 2017, which barred citizens from seven Muslim majority countries from entering the US, had a direct impact on the ability of scholars from those nations to participate in academic life. In response, thousands of academics signed petitions denouncing the ban.[49] Some conference organizers even took steps to relocate their events outside of the US.[50] Despite the backlash, the travel ban was not only upheld, but expanded, with restrictions placed on citizens from an additional six countries in February 2020;[51] and it was not until January 2021 that the ban was finally

48 Simon Little, 'B.C. dentist dies after attending dental conference with COVID-19 outbreak', *Global News* (March 23, 2020), https://globalnews.ca/news/6722164/dentist-dies-coronavirus-conference/; Farah Stockman and Kim Barker, 'How a premier U.S. drug company became a virus "super spreader"', *The New York Times* (April 12, 2020), https://www.nytimes.com/2020/04/12/us/coronavirus-biogen-boston-superspreader.html.

49 Michelle Ghoussoub, 'Canadian professors join academic boycott of U.S. in protest of Trump travel ban', *CBC News* (February 3, 2017), https://www.cbc.ca/news/canada/british-columbia/canadian-professors-join-academic-boycott-of-u-s-in-protest-of-trump-travel-ban-1.3966122.

50 James McLeod, 'Tech conferences moving north as trump policies turn off attendees', *Financial Post* (May 1, 2018), http://business.financialpost.com/technology/tech-conferences-moving-north-as-trump-policies-turn-off-attendees.

51 Nicole Narea, 'Trump's expanded travel ban just went into effect for 6 new countries', *Vox* (February 21, 2020), https://www.vox.

lifted by President Joe Biden. Nationalistic and xenophobic policies, such as those implemented by the former Trump administration, threaten the integrity of our research communities. In the current political climate, to rethink traditional conference gatherings and to seek out new ways of mobilizing and exchanging knowledge can be a form of productive resistance.

Hosting virtual or hybrid academic events can be a way to overcome the physical, social, and political barriers of f2f conferences and to build strong, vibrant research communities online. At the same time, online gatherings are not without their own challenges. One drawback to virtual gatherings is the risk of online surveillance and censorship. Governments can use a variety of means to restrict access to information online: from filtering specific content to blocking entire websites and platforms to complete Internet blackouts.[52] What is more, there is evidence that these tactics are becoming more widespread.[53] As reported by Human Rights Watch, in 2019 alone ten countries imposed partial or full Internet shutdowns.[54] As Internet censorship grows increasingly ubiquitous, the world wide web no longer functions as a singular 'world', but rather many separate worlds that are split along geopolitical lines. The 'fragmented web', as Kalev Leetaru terms it,[55] frustrates efforts to build transnational research communities. Government surveillance can also put participants in harm's way. Conference organizers need to consider these risks when deciding how open and publicly accessible the conference material should be. Will the conference content be publicly available or limited to registered participants? If the latter, how will access be mediated? Will the material be recorded and archived? If there is an online discussion, will commenters be anonymous or named?

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com/2020/1/31/21116736/trump-travel-ban-nigeria-immigrant; Nazita Lajevardi, Kassra AR Oskooii, and Loren Collingwood, 'Biden reverses Trump's 'Muslim ban.' Americans support the decision.', Washington Post (January 27, 2021), https://www.washingtonpost.com/politics/2021/01/27/biden-reversed-trumps-muslim-ban-americans-support-that-decision/.

52 Justin Clark et al., *The Shifting Landscape of Global Internet Censorship* (Berkman Klein Center for Internet & Society Research Publication, 2017), http://nrs.harvard.edu/urn-3:HUL.InstRepos:33084425.

53 Ibid.

54 Human Rights Watch, 'Shutting Down the Internet to Shut Up Critics', *World Report 2020*, https://www.hrw.org/world-report/2020/country-chapters/global-5.

55 Kalev Leetaru, 'Will increasing government censorship lead to a fragmented web?', *Forbes* (June 4, 2019), https://www.forbes.com/sites/kalevleetaru/2019/06/04/will-increasing-government-censorship-lead-to-a-fragmented-web/#56662a0f3de1.

These points deserve careful consideration, and furthermore conference protocols regarding privacy and security, once established, need to be clearly communicated to participants prior to the event.

Temporal

Time limits give an ephemeral immediacy to conferences. Conferences are designed to focus attention and have people examine something together for a limited period of time.[56] In the academic milieu, this distinguishes conferences from research groupings, online email lists, and other longer-term working collaborations. One advantage of traveling to a conference is that you can leave the busy work behind and focus on a topic away from distractions. The travel creates a time and space away that mark the conference as research. There are, however, trade-offs embedded in time constraints. For example, in order to attend a major conference, researchers may have to travel for a day or more to get there and as much to return. In the same way, when a group of academics are brought together to focus on a particular issue at a conference, they are by definition not focusing on other areas of their own research. Another constraint of traditional f2f conferences is that participants must return to their home institutions, therefore ending the conference dialogue. Online conferencing, by contrast, has an immediate affordance of allowing asynchronous dialogue relatively unconstrained by time and interwoven into other activities.[57]

Environmental

Mitigating climate change is one of the greatest challenges of the current era.[58] Air travel is a significant contributor to climate change

56 'Conference, n.', OED Online, Oxford University Press, September 2019, www.oed.com/view/Entry/38740; Anderson and Anderson (2010).

57 See for example: Anderson and Anderson (2010); Charlotte N. Gunawardena, 'A cross-cultural study of group process and development in online conferences', *Distance Education*, 22.1 (2006), 85–121, https://doi.org/10.1080/0158791010220106; Hiltner (2016).

58 United Nations, *Climate Change* (n.d.), http://www.un.org/en/sections/issues-depth/climate-change/index.html; Gwynne Dyer, *Climate Wars: The Fight for Survival as the World Overheats* (Oneworld Publications, 2010); Peter Kalmus, *Being the Change: Live Well and Spark a Climate Revolution* (New Society Publishers, 2017);

and one of the largest discretionary aspects of an individual's CO2 footprint.[59] At the University of Alberta, sustainability efforts are woven into the strategic mission.[60] In the broader context, Canada has taken a leadership role in establishing CO2 footprint formulas for the aviation industry in order to help mitigate some of the environmental impacts of flying.[61] As discussed above, academics can influence change at many levels of conference culture, as participants, attendees, keynote speakers, funders, and conference organizers.[62] In short, academics have both an opportunity and a responsibility to make personal and organizational choices that make sustainable conferencing more broadly available.[63]

At the same time, as pointed out by other authors in this book, information technology also has a carbon cost. Notably, energy emissions from computers were among the few sources of greenhouse gases that have not declined during the pandemic lockdown, but rather shot up.[64] As our appetite for data (and the energy that supplies it) continues to increase, we need to be wary of uncritically replacing one form of energy consumption with another. For that reason, the NCN conference model should be expanded to incorporate more rigorous reflection and interrogation of, not just our flying habits, but our computational habits.

Joseph Nevins, 'Academic jet-setting in a time of climate destabilization: ecological privilege and professional geographic travel', *The Professional Geographer*, 66.2 (2014), 298–310, https://doi.org/10.1080/00330124.2013.784954.

59 Vlad Coroama, Lorenz M. Hilty and Martin Birtel, 'Effects of Internet-based multiple-site conferences on greenhouse gas emissions', *Telematics and Informatics*, 29.4 (2012), 362–374, https://doi.org./10.1016/j.tele.2011.11.006; Hiltner (2016); Kalmus (2017); Niko Kommenda, 'How your flight emits as much CO2 as many people do in a year', *The Guardian* (July 19 2019), https://www.theguardian.com/environment/ng-interactive/2019/jul/19/carbon-calculator-how-taking-one-flight-emits-as-much-as-many-people-do-in-a-year.

60 University of Alberta, 'For the Public Good: Institutional Strategic Plan' (2016), https://www.ualberta.ca/strategic-plan, Objective 20.

61 Kathleen Harris, and Margo McDiarmid, 'Canada helps broker negotiations for UN pact on airline emissions', CBC (Sept. 9, 2016), https://www.cbc.ca/news/politics/aviation-carbon-emissions-agreement-icao-1.3753139.

62 Hiltner (2016); Kalmus (2017); Nevins (2014).

63 Coroama, et al. (2012); Glover, et al. (2017); Hiltner (2016); Kalmus (2017).

64 Michael Fuhrer and Errol Hunt, 'Bingeing Netflix under lockdown? Here's why streaming comes at a cost to the environment', *The Conversation* (August 6, 2020), https://theconversation.com/bingeing-netflix-under-lockdown-heres-why-streaming-comes-at-a-cost-to-the-environment-143190.

Conclusion

As shown, econferences can, in some ways, improve accessibility, lower cost, and significantly reduce carbon emissions. Even so, online gatherings are not without obstacles and come with a different set of considerations. Rather than attempt to replicate face-to-face interactions, the econference should be embraced as its own medium, one with unique affordances and constraints, and if econferences are to disrupt and not simply rebuild the status quo the research community needs to be rigorous in acknowledging and confronting these challenges head-on.

In the following articles, Terry Anderson, Nick Byrd and Oliver Rossier et al. share concrete examples of how to create and run econferences across a range of disciplines. These studies highlight the benefits and challenges of moving academic gatherings online, and it is the authors' hope that the academic community can learn from their findings to build capacity for future econferencing initiatives.

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16. Econferences Are Not the Same, but Are They Good Enough?

Terry Anderson

Terry Anderson helped pioneer econferencing with the email-based Bangkok Project event in 1992, which took place just one year after the World Wide Web went public. In the following chapter, he reflects back on the early challenges of the online conference medium and looks ahead to its future. How has the econference evolved from its origins to today? Will online gatherings always feel like a less satisfying version of their traditional, face-to-face counterpart or can they offer conference-goers something unique?

Beginning my PhD program in 1990 meant curtailing the perks I had enjoyed as a director of a distance education network in northern Ontario. There was no money for trips to exotic lands to participate in education research conferences. Thus, I was stuck—in pre-Internet times—in Canada, while my ex-colleagues enjoyed the learning, each other's company and the intercultural experience of other lands while attending international conferences. However, as the International Council of Distance Education Congress in Bangkok approached I began to wonder if I, and potentially hundreds of others, could participate in the conference—without actually travelling there. Thus was the inspiration for the world's first networked supported virtual or econference.

In the early 1990s we didn't think much about carbon footprints and time spent on airplanes, but we did worry about the high cost of travel

 https://doi.org/10.11647/OBP.0213.27

and hotels. And of course, the irony of distance educators, having to physically travel for their professional development while preaching the benefits of mediated learning, unnerved not just a few of us. So, how could we have meaningful and productive professional learning and networking while remaining in our homes?

To set the context, one must remember that in 1992 there was no Internet—or at least any Internet that ordinary citizens could access. However, email was becoming more popularly supported on networks such as BITNET, FidoNet, NetNorth, Usenet and eighteen other mail distribution lists that participated in this first econference. The learning design for the conference consisted of soliciting text talks/papers from six leading experts who would be attending the conference and distributed these 'first speaker inputs'. We invited participants to respond (using email) to the paper, to the first speakers and to the other participants. Each topic ran for two weeks of asynchronous discussion, with two topics running simultaneously. Listserv and other early email support services were used to distribute these emails. To expand access, we needed to bridge networks (remember no Internet), by using human 'porters'—'unsung heroes of the computer revolution', who manually cut and pasted text messages between various network distributors. In those days it was quite easy to solicit 'first speakers' as most had no idea what an econference was and many were willing to give it a try. Even though, as Canadian researcher Tony Bates noted, 'I feel like someone standing on the top of a mountain and shouting, without knowing if anyone is listening!'[1]

A participant survey of the Bangkok Project gleamed the following comments:

- 'For me this virtual conference means that I can attend—I would be un-able to get the funding to attend the 'real' conference'.
- 'It means that I have a permanent record of all dialogue, to which I can easily refer at a later date'.
- 'It means that I can choose when, during the day, I want to "attend" a session'.

1 Terry Anderson and Robin Mason, 'The Bangkok project: New tool for professional development', *American Journal of Distance Education*, 7.2 (1993), 5–18 (p. 11), https://doi.org/10.1080/08923649309526819.

- 'It means that I can listen to practitioners and experts in my field discussing the new developments that I am interested in and hope eventually to implement myself'.[2]

There have been hundreds of econferences held on the Net since 1992. Now, in addition to email, myriad technologies have been used to bring learning and networking to professionals around the world—including: live and recorded video, immersive environments, blogging, microblogging and others—all without the fiscal and environmental costs of physical attendance. However, in that same period there have been thousands of face-to-face (f2f) conferences held in almost every country of the world. These have created an industry of conference facilitators, conference facilities and dedicated conference hotels.[3]

Despite the attempts to make parallel experiences both on site and online, it is obvious to almost all attendees that an econference is 'not the same' and often not the first choice as attending in person.[4] But is it good enough? Does it meet certain needs that cannot be met face-to-face? Can online technologies facilitate meaningful learning experiences? And, of course, the driving question for distance educators, is, does it expand and make easier access to learning for everyone?

Others have noted the environmental cost of travel.[5] Not only airplane travel, but ground transportation to conference venues, cost of heating and servicing hotel and conference meeting rooms add to negative impact on our environment and our pocket books. In 2010, we attempted to quantify these savings using a case study of a medium-sized online conference. Using the participants home institutions to gauge the travel distance, we calculated what the carbon costs would have been if the event had been hosted in London, England, where the

2 Anderson and Mason (1993).

3 Karin Weber and Kaye Sung Chon, *Convention Tourism: International Research and Industry Perspectives* (Binghamton: Haworth Hospitality Press, 2002), https://doi.org/10.1016/s0261-5177(03)00087-6.

4 Veronica Outlaw and Kristi Garrett, 'Case study: Using HE-TPACK to improve virtual professional development opportunities', *Distance Learning Administration Conference* (Jekyll Island, Georgia, June 19–22, 2016), pp. 163–174, https://www.westga.edu/~distance/dla/pdf/2016-DL-PROCEEDINGS-updated.pdf.

5 Julian Crane and Brent Caldwell, 'Another inconvenient truth?', *BMJ: British Medical Journal*, 333.7581 (2006), 1256; Ian Roberts and Fiona Godlee, 'Reducing the carbon footprint of medical conferences', *BMJ: British Medical Journal*, 334.7589 (2007), 324–325, https://doi.org/10.1016/s0261-5177(03)00087-6.

organizers were based.[6] We found that the 194 conference delegates who would have otherwise travelled by airplane saved 2.21 tonnes CO2 of carbon emissions each, for a total of nearly 430 tonnes. To put this into perspective, the annual CO2 emissions per capita in Canada in 2018 was 15.32 tonnes, while by comparison the per capita CO2 emissions in India was 1.96 tonnes.[7] This means that a single conference flight can generate more carbon emissions than the average person in a developing country does in an entire year.[8] In addition to the environmental benefits, we also found that the financial savings for the participants was high. The cost to attend the econference was a mere $69 USD, a 3000% reduction in cost as compared to the f2f equivalent, with an average saving per person of $2,162 USD. Thus, there is no question that moving conferences online reduces the production of greenhouse gases and saves delegates thousands of dollars.

Perhaps because of these benefits, some online events have become enduring fixtures on the conference scene. Likely the longest running econference is the Teaching, Colleges & Communities (TCC) conference held since 1996 from Kapi'olani Community College. This conference attracts approximately 1,000 delegates and was one of the first to charge participants a registration fee. In a 2011 study, Curtis Ho, Bert Kimura and Rachel Boulay published data from five years of participant evaluations of the TCC conference. They report that the strong majority of participants felt a sense of community with other participants, appreciated the interaction opportunities and compared the conference favorably to f2f conferences they have attended.[9]

That said, most econferences are short-term or one-off events, that are only held for one or two years before they shut down or revert back

6 Lynn Anderson and Terry Anderson 'Online professional development conferences: An effective, economical and eco-friendly option', *Canadian Journal of Learning and Technology*, 35.2 (2010), https://www.cjlt.ca/index.php/cjlt/article/view/26390/19572, https://doi.org/10.21432/T29015.

7 Union of Concerned Scientists, 'Each country's share of CO2 emissions', *UCSUSA* (August 12, 2020), https://www.ucsusa.org/resources/each-countrys-share-co2-emissions.

8 Niko Kommenda, 'How your flight emits as much CO2 as many people do in a year', *The Guardian* (July 19, 2019), https://www.theguardian.com/environment/ng-interactive/2019/jul/19/carbon-calculator-how-taking-one-flight-emits-as-much-as-many-people-do-in-a-year.

9 Curtis P. Ho, Bert Kimura and Rachel Boulay, 'Retrospective analysis of a virtual worldwide conference for eLearning', *International Journal for Educational Media and Technology*, 5.1 (2011), 107–117, https://doi.org/10.1109/iceta.2018.8572065.

to the f2f mode. One of the challenges of econferences is to engender the type of informal and often spontaneous interactions that can and does occur at f2f conferences, most often before or after scheduled presentations. For many, these networking opportunities are as valuable as the formal sessions themselves. In an attempt to gain some of these informal benefits, Hannah Fraser et al. present a model for regional hubs at which delegates gather to attend both online and f2f sessions.[10] This can drastically reduce travel costs, with only a slight reduction in the diversity of potential contacts and of course also decreases the appeal of tourist, family or other personal benefits of expensive travel.

As the population's network literacy increases—through experience with social media, email, video conferencing and other mediums—so too does the potential for valued spontaneous and planned communications. Econferences have tried a variety of mediated techniques to engender this type of spontaneous networking that often include profiles, 'liking' and other techniques used on social networks and non-programmed virtual spaces that support real-time interaction. From our own experiences though, these have only been partially successful and we need innovative designs that attract participants to make themselves and their interests known to others in networking fashion.

Participation in conferences also builds technological competence among participants. Both f2f and online delegates to professional development conferences benefit from exposure and development of their own network literacy by exposure and opportunity to observe and participate in technologically mediated events. In both econferences and f2f conferences delegates are exposed to scheduling apps, profile pages and a variety of technology augmented presentations. In her 2005 dissertation thesis, Miri Shonfeld noted significant later use and competency gains from the exposure to technologies experienced during the conference.[11]

An econference is distinguished from ongoing, online communities of practice because it is time limited. Typically, an econference runs over two to three days. However, unlike its f2f comparator, participants

10 Hannah Fraser et al., 'The value of virtual conferencing for ecology and conservation', *Conservation Biology*, 31.3 (2017), 540–546, https://doi.org/10.1111/cobi.12837.

11 Miri Shonfeld, 'The impact of an online conference in education: A case study' (PhD thesis, Nova Southeastern University, 2005).

are unlikely to all be in the same time zone. Thus, organizers have experimented with twenty-four-hour conferences that 'Follow the Sun',[12] and, of course, the asynchronous components of most conferences allow participation around the clock.

Rather than merely attempting to mimic f2f conferences, organizers are experimenting with digital tools that promise to enhance communication beyond that supported f2f. One of the most obvious benefits is the digital record that remains, so that the econference (or sections of it) can be repurposed for future events either f2f or virtually hosted. Besides the recording of presentations, conference organizers have used threaded audio discussions allowing for asynchronous voice and video sharing.[13] The econference also supports the intervention of technologies such as translation, automatic transcription, visual and audio enhancement and other technologies that are emerging in the online world. More recently, we have seen conferences that are housed in virtual worlds providing opportunities for simultaneous experience of a variety of virtual environments and technologies designed to increase participants' telepresence.[14] Julie Santy, Mary Beadle and Yvonne Needham have noted the positive impact of conferences that bring together professionals from related, but often siloed knowledge bases and limited inter-professional interactions.[15] As these advantages grow, we may yet see a day when f2f seems a too ineffective way to communicate—in addition to being environmentally unsustainable.

In 2010, Lynn Anderson and I published a chronological taxonomy of virtual conferences beginning with the asynchronous, text-based

12 Angela Murphy and Shirley Reushle, 'Following the sun: Sustainable conferencing in a climate of change', *29th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (ASCILITE) (Wellington, NZ, November 25–28, 2012), http://www.ascilite.org/conferences/Wellington12/2012/images/custom/murphy%2c_angela_-_following.pdf; Sarah Stewart, Mary Sidebotham and Deborah Davis, 'The virtual international day of the midwife: Social networking for continuing professional development', *Nurse Education in Practice*, 12.5 (2012), 248–252, https://doi.org/10.1891/2156-5287.5.2.91.

13 Ho, Kimura and Boulay (2011).

14 William J. Ball, 'Political science: Academic virtual conferencing; The case of the teaching politics virtual conference', *Social Science Computer Review*, 18.2 (2000), 147–159; Thomas Erickson et al., 'Telepresence in virtual conferences: An empirical comparison of distance collaboration technologies', *CSCW 2010* (Savannah, Georgia, February 6–10, 2010), https://doi.org/10.23919/cisti49556.2020.9141049.

15 Julie Santy, Mary Beadle and Yvonne Needham, 'Using an online case conference to facilitate interprofessional learning', *Nurse Education in Practice*, 9.6 (2009), https://doi.org/10.1016/j.nepr.2008.11.004.

conferences such as the 1992 Bangkok Project.[16] We then documented the development of a second generation of conferences that added real time interaction via video and/or audio conferencing. Finally, we speculated on the development of a third generation based in immersive online worlds such as *Second Life*. By 2018, I realized that immersive worlds seem to have, like a fad, come and gone. It seems that the necessary technology challenges associated with these sophisticated technologies have not proven as useful to participants as we anticipated. However, small numbers of conferences based on all three generations continue to be produced.

Perhaps the largest econference to date was the 2016 HackSummit that attracted over 30,000 participants over four days to a conference hosted on Crowdcast streaming video platform enhanced with Twitter and other technologies.[17] This example demonstrates the potential for scalability of econferences that far exceeds that of f2f conferences. However, in practice, most econferences attract audiences measured in the hundreds—not tens of thousands!

Time Management and Continuous Partial Attention

One of the often-overlooked advantages of the econference is the ease with which a participant can control the amount of time and mental energy they give to the conference. Likely all of us have found ourselves sitting through conference sessions or on airplanes when our time and potential activities are totally controlled by others, regardless of our interest in being present at that time. We must wait until the session ends.

In an econference, I can exit any time I wish and return as easily. Of course, this license gives rise to abuse—and I just might not come back! The flexibility advantage is also a disadvantage as we observe the same phenomena in econferences as in Massive Open Online Courses (MOOCs), which are free and open to all and where significant numbers of registrants attend rarely and some not at all.[18] This convenience and

16 Anderson and Anderson, 'Online professional development conferences' (2010).

17 Sai Hossain, 'How to create a Crowdcast for 30,000 people', *Crowdcast blog* (August 9, 2016), http://blog.crowdcast.io/post/create-a-virtual-event-for-30000-people.

18 Doug Clow, 'MOOCs and the funnel of participation', *Third Conference on Learning Analytics & Knowledge* (*Lak 2013*) (Leuven, Belgium, April 8–12, 2013), pp. 185–189, https://doi.org/10.1145/2460296.2460332.

the related power to shift time through asynchronous technologies suits the self-directed, but sadly is often abused by the externally motivated.[19] However, this challenge is not unique to econferences and has challenged distance educators using any medium.

An interesting development in professional development conferences is the increasing use of online media by delegates while attending the conference (online or f2f). It is now possible for anyone to subscribe to the micro blogging feeds and social media reactions from delegates in addition to the audio/video from keynote or other speakers. Thus, we see pressure from both the online and the f2f delegates to harness the affordances of online technology to enhance their professional development. However, this simultaneous focus on multiple technologies and social contexts, has itself created problems and cautionary warnings from researchers.[20]

As noted earlier, the speakers in econferences often have challenges understanding the nature, the number and the reactions of their audience. Many systems provide means by which audience can share various emoticons expressing laughter, applause etc. However, these are typically used only by a minority of the attendees. What of the majority? It is likely that many participants are giving only partial attention to the conference while they are simultaneously engaged in other activities. Linda Stone labels this behavior 'continuous partial attention' (CPA). Stone differentiates CPA from multitasking in that the CPA goes beyond the efficiency of trying to accomplish more than one task at a time. CPA seeks to maintain connectivity at all times, thus making oneself open to opportunity, entertainment or whatever other potential benefits available within the (networked) environment.[21] CPA

19 Wen-Chung Liu and Chen-Ling Fang, 'The effect of different motivation factors on knowledge-sharing willingness and behavior', *Social Behavior and Personality: An International Journal*, 38.6 (2010), 753–758, https://doi.org/10.2224/sbp.2010.38.6.753.

20 Jennie Winter et al., 'Effective e-learning? Multi-tasking, distractions and boundary management by graduate students in an online environment', *ALT-J*, 18.1 (2010), 71–83, https://doi.org/10.1016/j.compedu.2011.08.029.

Eileen Wood et al., 'Examining the impact of off-task multi-tasking with technology on real-time classroom learning', *Computers & Education*, 58.1 (2012), 365–374, https://doi.org/10.1080/09687761003657598.

21 Linda Stone, 'Continuous partial attention', *Linda Stone* (November 30, 2009), https://lindastone.net/2009/11/30/beyond-simple-multi-tasking-continuous-partial-attention/

is just one of the manifestations of networked culture and economy in a networked era. Michael H. Goldhaber argues that 'the economy of attention not information is the natural economy of cyberspace'.[22] Organizers and presenters in econferences must then design interfaces and produce content that knowingly competes with the audience for their attention. Ironically, presenters in f2f conferences face a similar challenge as evidenced by the large percentages of their audience using their smartphones for a variety of tasks and entertainment while sitting in the physical presence of the presenters.

In 2008, George Siemens, Peter Tittenberger and I published an article arguing for the inclusion of a variety of technologies designed to increase interactivity amongst conference participants both online and f2f.[23] While driven by our interest and belief in the value of interactivity, I reflect now that many of the techniques we recommended (backchannel communication, live editing of conference proceedings, polling, games etc.) also had the negative association of potentially increasing CPA. This is not to say that these network-based additions/distractions are new to the present time. I can recall sitting through many a church sermon and leaving not recalling a single idea that the preacher had shared!

So, where are we now? Econferences continue to be hosted by a variety of academic, NGO and commercial industry groups. Indeed, a small industry has arisen of online companies that provide logistical and organizational support for these conferences.[24] But f2f conferences continue and (at least outside of pandemic times) are many times more popular than their online cousins. Convention tourism is a large and booming industry,[25] though its recovery from COVID-19 is far from certain. Obviously, econferences offer large economic and ecological advantages over their f2f alternatives. These advantages are likely to increase as the ecological and financial costs of travel increase. However,

22 Michael H. Goldhaber, 'The attention economy and the net', *First Monday*, 2.4 (1997), https://doi.org/10.5210/fm.v2i4.519.

23 George Siemens, Peter Tittenberger and Terry Anderson, 'Conference connections: Rewiring the circuit', *EDUCAUSE Review*, 43.2 (2008), 14–28, https://auspace.athabascau.ca/bitstream/handle/2149/3525/ERM0820.pdf?sequence=1&isAllowed=y.

24 See for example, Communiqué Conferencing's virtual trade show platform: Communiqué Conferencing, *Virtual Trade Show Software Platform* (2019), https://www.virtualtradeshowhosting.com.

25 Weber and Chon (2002).

as Everett Rogers[26] and other researchers of technological adoption processes have observed: relative advantage is important and necessary but not often in itself sufficient to induce adoption of new technologies or practices. In *Diffusion of Innovations*, Rogers identifies four key factors that impact the speed of adoption, but none of these appear able to adequately explain the resistance to econferences. The first factor he points to is *compatibility*, yet, given the ubiquitous use of audio and video from smart phones or desktops, compatibility seems hardly an issue in econference adoption. Next is *trialability*, and again it is relatively easy (as I demonstrated even in 1992) to organize an econference. Then comes *complexity*, and once more our exposure to these technologies has meant a continuous increase in network literacy, especially among potential attendees at academic conferences and increased ease of use of online technologies. Finally, *observability*, but this should not be a problem as it relatively easy to drop in and visit an operating econference. So, what holds adoption up?

Critics of Rogers's adoption theories, especially in regard to technological innovations, have charged that the theory underestimates the complex social environment in which adoption takes place. For example Kalle Lyytinen and Jan Damsgaard argue that innovation 'researchers should be careful in analyzing the impact of the nature and meaning of the technology, the role of institutional policies and regimes, the impact of the industrial policies and strategies, and the importance of the installed base and learning inertia'.[27] Besides applying all of these barriers to the context of econferences, we see perhaps an even larger benefit of f2f conferences that will never be matched virtually. These are the personal benefits that accompany f2f conferences.

I illustrate that with a final story from my own experience. As a graduate student, I undertook a small study among medical doctors working in small communities in Northern Ontario. My intent was to determine the demand and the barriers to the compulsory professional development for medical doctors that could be delivered at a distance.

26 Everett Rogers, *Diffusion of Innovations* (New York: Free Press, 2003).

27 Kalle Lyytinen and Jan Damsgaard, 'What's wrong with the diffusion of innovation theory?', *Working Conference on Diffusing Software Product and Process Innovations* (Banff, Canada, April 7–9, 2001), p. 14, https://doi.org/10.1007/978-0-387-35404-0_11.

When I queried these doctors about the disadvantages associated with attending professional development activities in large urban centres that are located in some cases thousands of kilometers from their homes, I heard a variety of concerns. Doctors would have to leave their families and their practices, arrange for substitutes, travel by car to airports, stay in strange hotel rooms, listen to potentially boring talks and eat restaurant food for days. When I asked about the contrasting advantages, I heard that the doctors looked forward to getting away from their family and patients, travelling to far away cities, staying in hotel rooms, eating fine restaurant food and listening to inspiring talks. These same characteristics are both positive and negative: the same reasons both encourage and discourage adoption of econferences.

Conferences have become an established and often subsidized means for participants to travel, to extend their visit with tourist activities, to bring family members along on a holiday, and to enjoy social networking activities with persons of kindred interest. Econferences are limited in their support of any of these characteristics. Thus, until established social, employment and taxation practices are changed—for example, tax write offs and employer subsidy of f2f conference attendance—we will continue to see econferences play a secondary role to their f2f cousins. But just as these obstacles to econference adoption are large, they are fragile, and increases in all of Rogers's characteristics in support of econference adoption ensure that econferences will continue to be hosted and attended. We can also expect improvements in the technologies used to support econferences, increase networked literacy amongst both participants and presenters, as well as increasing pressure to restrain professional development costs, both financial and ecological.

To conclude, we should remember that, as Voltaire said in 1770, 'best is the enemy of the good'.[28] Online conferences are not the same as their f2f counterparts. However, econferences are good enough to ensure quality learning, professional development and network exposure, and can achieve this at far less environmental and financial cost—which makes them worth pursuing.

28 Quoted in Susan Ratcliffe, *Concise Oxford Dictionary of Quotations* (Oxford University Press, 2011) p. 389, https://doi.org/10.1108/09504121211193948.

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Wood, Eileen, et al., 'Examining the impact of off-task multi-tasking with technology on real-time classroom learning', *Computers & Education*, 58.1 (2012), 365–374, https://doi.org/10.1016/j.compedu.2011.08.029

17. Online Conferences

Some History, Methods and Benefits

Nick Byrd[1]

Academics have probably been organizing conferences since at least the time of Plato.[2] More recently, academics have brought some of their conferences online.[3] However, the adoption of online conferences is limited. One might wonder if scholars prefer traditional conferences for their ability to provide goods that online conferences cannot. While this may be true, online conferences outshine traditional conferences in various ways, and at a significantly lower cost. By considering the costs and benefits of both conference models, we may find reasons to prefer online to traditional conferences in some circumstances. This chapter shares the methods, quantitative results and qualitative results of the Minds Online conferences of 2015, 2016 and 2017. The evidence suggests that the online conference model can help scholars better understand their profession, share the workload of conference

1 This project was improved by Cameron Buckner, Richard Brown, Pete Mandik, Thomas Nadelhoffer, Eddy Nahmias, Madeleine Ransom, Bruce Rushing, John Schwenkler, Justin Weinberg and Markos Valaris.

2 Jonathan Barnes, 'Academy', in *Routledge Encyclopedia of Philosophy* (London: Routledge, 2016), https://doi.org/10.4324/9780415249126-A001-1.

3 See, for example, Richard Brown, *The First Online Consciousness Conference* (2009), https://consciousnessonline.wordpress.com/program/; Cameron Buckner et al., 'Minds online 2017—program', *Minds Online* (2017), https://mindsonline.philosophyofbrains.com/minds-online-2017-program/; Fabrizio Calzavarini and Marco Viola, 'Neural mechanisms online conference', *Neural Mechanisms* (September 4, 2018), https://neuralmechanismsonline.wordpress.com/webconference-2018/; Thomas Nadelhoffer, *First Online Philosophy Conference* (*OPC 1*) (2006), https://philosophycommons.typepad.com/opc1/.

 https://doi.org/10.11647/OBP.0213.28

organizing, increase representation for underrepresented groups, increase accessibility to attendees, decrease monetary costs for everyone involved, sustain conference activity during states of emergency and reduce their carbon footprint. So, the advantages of traditional conferences might be outweighed by their higher costs after all.

Philosophers have not been shy about doing philosophy online. The commercial online service DIALOG was created around 1972.[4] Before the end of the decade, philosophers were using DIALOG for bibliographic indexing.[5] Later, the distributed discussion system Usenet, was established.[6] And, by 1983, philosophers and other academics were discussing philosophy on Usenet.[7] With the advent of email, online philosophy discourse continued via listservs like the PHILOS-L.[8] In the 1990's philosophers brought philosophy to static webpages. So many philosophy webpages were created that by 1993, a website was created to catalogue philosophy webpages.[9] Soon enough, philosophy had online encyclopedias,[10] online journal articles,[11] online article reviews,[12]

4 Susanne Bjørneer and Stephanie Ardito, 'Online before the Internet: Early pioneers tell their stories', *Information Today*, 11.6 (2003), https://infotoday.com/searcher/jun03/ardito_bjorner.shtml.

5 Philosophy Documentation Center, 'History', *Philosopher's Index* (1979), https://philindex.org/about-us/history/

6 Michael Hauben and Ronda Hauben, *Netizens, On the History and Impact of Usenet and the Internet* (Los Alamitos: Wiley, 1997).

7 S. Vestal, 'Have you a good paradox?', *net.Philosophy Newsgroup Discussion Thread* (April 29, 1983), https://ia800404.us.archive.org/zipview.php?zip=/13/items/usenet-net/net.philosophy.mbox.zip

8 Stephen Clark, *Making Use of PHILOS-L* (1989), https://listserv.liv.ac.uk/cgi-bin/wa?A2=ind8908&L=PHILOS-L&P=1323.

9 Dey Alexander, *Philosophy in Cyberspace: A Guide to Philosophy-Related Resources on the Internet* (Bowling Green: Philosophy Documentation Center, 1995).

10 See, for example, Liesbeth De Mol, 'Turing machines', *The Stanford Encyclopedia of Philosophy* (1995/2018), ed. by Edward N. Zalta, https://plato.stanford.edu/entries/turing-machine/; Edward N. Zalta, 'Gottlob Frege', *The Stanford Encyclopedia of Philosophy* (1995/2019), ed. by Edward N. Zalta, https://plato.stanford.edu/archives/sum2018/entries/frege/.

11 See, for example, Norman Swartz, 'Can existence and nomicity devolve from axiological principles', *Electronic Journal of Analytic Philosophy* (*EJAP*) (August, 1993), https://ejap.louisiana.edu/EJAP/1993.august/swartz.abs.html.

12 See, for example, Paul Weithman, 'Review of "Distributive justice and the complex structure of ownership"', Brown Electronic Article Review Service (BEARS), ed. by James Dreier and David Estlund (March 1, 1995), https:// web.archive.org/web/19970606094747/http://www.brown.edu/Departments/Philosophy/bears/homepage.html.

Table 1 The early history of online philosophy.

Year	Description	URL
1979	Philosopher's Index (via DIALOG)	philindex.org
1983	Usenet	alt.philosophy and net.philosophy (ia800404.us.archive.org/view_archive.php?archive=/13/items/usenet-net/net.philosophy.mbox.zip&file=&ext=)
1986	HUManities BULletin Board	humbul.ac.uk (users.ox.ac.uk/~mikef/rts/future/slide4.html)
1989	Philos-L	listserv.liv.ac.uk/cgi-bin/wa?A2=ind8908&L=PHILOS-L&P=1323
1993	A Guide to Philosophy in Cyberspace	web.archive.org/web/19990209072931/http://www-personal.monash.edu.au/%7Edey/phil/
1993	Electronic Journal of Analytic Philosophy	ejap.louisiana.edu
1994	David Chalmers (personal website)	web.archive.org/web/19970720201749/http://ling.ucsc.edu/~chalmers/index.html
1994	University of Chicago Philosophy Project	web.archive.org/web/19971210103000/http://csmaclab-www.uchicago.edu/philosophyproject/philos.html
1995	Stanford Encyclopedia of Philosophy	plato.stanford.edu
1995	Internet Encyclopedia of Philosophy	iep.utm.edu/home/about/
1995	Brown Electronic Article Review Service	web.archive.org/web/19970606094747/http://www.brown.edu/Departments/Philosophy/bears/homepage.html
1996	Brown Electronic Article Review Symposia	(ibid.)
1997	The Philosophers' Magazine	philosophersmag.com
1997	EpistemeLinks	web.archive.org/web/19981202141433/http://www.epistemelinks.com/

online magazines,[13] online profiles,[14] and massive open online courses.[15] A list of these and other examples of the earliest online philosophy can be found in Table 1 The early history of online philosophy.—links that are broken have been supplied using the Wayback Machine.[16]

Online Philosophy Conferences

At some point, philosophers were organizing online reading groups,[17] online symposia,[18] and online conferences such as the Online Philosophy Conference,[19] the Online Consciousness Conference,[20] the Minds Online conference,[21] the Neural Mechanisms Webconference,[22] and the Uncovering Philosophical Biases In Scientific Controversies digital conference.[23] To give an idea of the reach of online philosophy conferences, the page views for each conference are reported in Table 2.

13 See, for example, Jeremy Stangroom, 'Enter an experimental philosophical universe', The Philosophers' Magazine (July 1, 1997), p. 58, https://doi.org/10.5840/tpm1997119.

14 See, for example, David Chalmers, David Chalmers' Home Page (1994), https://web.archive.org/web/19970720201749/ling.ucsc.edu/~chalmers/index.html

15 Leonard J. Waks, *The Evolution and Evaluation of Massive Open Online Courses: MOOCs in Motion* (New York: Palgrave Macmillan, 2016), https://doi.org/10.1057/978-1-349-85204-8.

16 Internet Archive, *Wayback Machine*, http://web.archive.org/.

17 J. Cohen, *The University of Chicago Philosophy Project* (1993/2018), https://web.archive.org/web/19971210103000/http://csmaclab-www.uchicago.edu/philosophyproject/philos.html.

18 James Dreier and David Estlund, *Brown Electronic Article Symposia* (1996/2002), https://brown.edu/Departments/Philosophy/bears/homepage.html.

19 Thomas Nadelhoffer, *Second Online Philosophy Conference* (*OPC 2*) (2007), https://philosophycommons.typepad.com/opc2/.

20 Richard Brown, *Online Consciousness Conference* (2009–2013), https://consciousnessonline.wordpress.com/program/.

21 Cameron Buckner, Nick Byrd and John Schwenkler, 'Minds online 2017—program', *Minds Online* (2015), https://mindsonline.philosophyofbrains.com/2015program/; Cameron Buckner, Nick Byrd and John Schwenkler, 'Minds online 2016—program', *Minds Online* (2016), https://mindsonline.philosophyofbrains.com/minds-online-2016-program/; Cameron Buckner, et al. (2017).

22 Fabrizio Calzavarini and Marco Viola, 'Web and hybrid conferences', *Neural Mechanisms* (2018), https://neuralmechanisms.org/webconferences.html.

23 Rani Lill Anjum and Elana Rocca, Uncovering Philosophical Biases In Scientific Controversies (2020). https://interdisciplinarityandexpertdisagreement.wordpress.com/blog/program/.

Table 2 Online philosophy conferences and views

Conference	Views
Online Philosophy Conference (2006)	>30,000
Online Philosophy Conference (2007)	>14,000
Online Consciousness Conference (2009)	≅11,000
Online Consciousness Conference (2010)	≅14,000
Online Consciousness Conference (2011)	≅ 20,000
Online Consciousness Conference (2012)	>16,000
Online Consciousness Conference (2013)	≅ 25,000
Minds Online Conference (2015)	12,795
Minds Online Conference (2016)	10,745
Minds Online Conference (2017)	9,998
Neural Mechanisms Webconference (2018)	≅ 500
Uncovering Philosophical Biases In Scientific Controversies (2020)	1,265

Alas, all but one of these online conferences have ceased. While participants found these conferences highly rewarding, the organizers found the workload of annual conference organizing to be unsustainable.[24] So one might wonder how to replicate the online conference so as to share the burden of serving the profession. Further, one might wonder why scholars should take on this particular burden in the first place. What do we actually know about online conferences and how they compare to traditional conferences? This chapter addresses some of these inquires by explaining the methods of one of the longest-running online philosophy conferences, sharing its quantitative and qualitative results, and highlighting the relative advantages of the online conference model.

Design and Evaluation Considerations

Conferences can serve a wide range of needs, from pre-publication peer-review to dialogue about the academy's climate. Given this wide range of

24 Cameron Buckner, Nick Byrd and John Schwenkler, 'The future of online conferences in philosophy', *Daily Nous* (October 15, 2015), https://dailynous.com/2015/10/15/the-future-of-onlineconferences-in-philosophy/.

needs, conference design and evaluation involves many considerations. This chapter will focus on a few elements that are relevant to designing and evaluating conferences: data, workload, inclusivity, emergency resilience and sustainability.

Data. Conferences are a source of valuable data about the profession, such as demographic information, trending topics, linguistic patterns, etc. Online conferences are entirely digital. So online conferences provide ready-made quantitative and qualitative data for analysis. Therefore, the contents and experiences of online conferences are more easily analyzed.

Of course, gathering and sharing data from traditional brick and mortar conferences can be just as valuable to the profession. Indeed, various claims about the profession and its climate can be answered by more rigorously analyzing data from both online and traditional conferences. Alas, these data are rarely public or digital and therefore inaccessible for such analysis. This chapter presents quantitative and qualitative data about one of the longest-running online philosophy conferences in hopes that such data gathering and sharing will become the norm.

Workload. At first glance, online conferences seem to involve less workload. They are less encumbered by the need to plan travel, accommodation, meals, childcare, physical accessibility, and the like. And everything occurs online. So conference responsibilities can be fulfilled anywhere that offers Internet access. These features of online conferences can make online conference organizing easier. However, not all online conference models are so location independent—e.g., online conferences that record a live panel discussion from one location. Further, not all traditional conferences are so technology-dependent—e.g., conferences in which presenters read from printed copies of their papers. So while the workload of each online conference might be lower, on average, than its traditional counterpart, there will surely be exceptions to this average difference between individual online conferences and more traditional conferences.

There are also longitudinal differences in workload between online and traditional conferences. Traditional conference organizing responsibilities are often handed off from year to year so that the workload is more distributed amongst its members. However, online

conference organizing requires somewhat specialized experience or skill (e.g., with content management systems like WordPress, web development more generally, etc.) that traditional conference organizing might not. So insofar as this experience and skill is less common among academics, the workload of online conference organizing cannot be as widely distributed as the workload of traditional conference organizing—at least, not until more members of the profession become familiar with online content creation and management. This is, in part, why the present chapter attempts to make its methods transparent. The hope is that publishing this information will reveal how easily online conferences can be replicated.

Emergency Resilience. Many conferences can be disrupted by natural disasters, disease outbreak and other unexpected emergencies. Worse, traditional conferences expose attendees to local emergencies, toxins or communicable diseases. Of course, online communities can continue to function in the wake of local, national or global states of emergency.[25] As a result, online conferences may be valuable alternatives to traditional conferences when emergencies are occurring or else predictable.

Inclusivity. Philosophy has been called 'demographically challenged'.[26] For instance, academic philosophy still contains a large gender gap[27] and a larger racial gap.[28] Some propose that closing these gaps not only improves representation, but improves philosophy's epistemic conditions[29] and perhaps counterconditions undesirable

25 Xiangyang Guan and Cynthia Chen, 'Using social media data to understand and assess disasters', *Natural Hazards*, 74.2 (2014), 837–850, https://doi.org/10.1007/s11069-014-1217-1; Jooho Kim and Hogun Park, 'A framework for understanding online group behaviors during a catastrophic event', *International Journal of Information Management*, 51.102051 (2020), https://doi.org/10.1016/j.ijinfomgt.2019.102051.

26 Linda Martin Alcoff, 'Philosophy's civil wars', *Proceedings and Addresses of the American Philosophical Association*, 87 (2013), 16–43.

27 American Philosophical Association, *Demographic Statistics on the APA Membership, FY2016 to FY2018* (2018), https://apaonline.org/page/demographics; Molly Paxton, Carrie Figdor and Valerie Tiberius, 'Quantifying the gender gap: An empirical study of the underrepresentation of women in philosophy', *Hypatia*, 27.4 (2012), 949–957, https://doi.org/10.1111/j.1527-2001.2012.01306.x; Saara Särmä, '"Congrats, you have an all-male panel!"', *International Feminist Journal of Politics*, 18.3 (2016), 470–476, https://doi.org/10.1080/14616742.2016.1189671; Jennifer Saul, 'Scepticism and implicit bias', *Disputatio*, 5.37 (2013), 243–263.

28 Tina Botts et al., 'What is the state of Blacks in philosophy?', *Critical Philosophy of Race*, 2.2 (2014), 224–242, https://doi.org/10.5325/critphilrace.2.2.0224.

29 A. E. Kings, 'Philosophy's diversity problem', *Metaphilosophy*, 50.3 (2019), 212–230, https://doi.org/10.1111/meta.12358.

stereotypes.[30] Fortunately, online conferences can be less constrained by location, scheduling, childcare, and other variables, eliminating barriers that might prevent already underrepresented scholars from participating in more traditional conferences. Data in the present chapter provides some support for this optimism about the inclusivity of online conferences.

Sustainability. Scholars are realizing the need for more sustainable conference practices.[31] Online conferences can significantly reduce carbon output by eliminating the need for carbon-intensive air travel and other forms of transportation. And with the advent of renewable-powered data centers,[32] online conferences might even be able to become carbon neutral. So if scholars want to reduce their profession's carbon footprint, then they should seek to adopt the online conference format. This chapter offers one set of such methods.[33]

The Minds Online Conference

Method

The Minds Online conferences were organized in 2015, 2016 and 2017 by Cameron Buckner, Nick Byrd, John Schwenkler and Bruce Rushing and in association with The Brains Blog.[34]

Call for Papers (CFP). Each year's call for papers was posted at the beginning of the calendar year to PhilEvents.org. The CFP would include a description of the conference, a list of the keynote presenters, a list of suggested paper topics and submission instructions. In addition to being advertised to PhilEvents users, the call for papers was advertised

30 Nick Byrd, 'What we can (and can't) infer about implicit bias from debiasing experiments', *Synthese* (2019), 1–29, https://doi.org/10.1007/s11229-019-02128-6.

31 See, for example, David S. Reay, 'Virtual solution to carbon cost of conferences', *Nature*, 424.251 (2003), https://doi.org/10.1038/424251a.

32 See, for example, Gary Anthes, 'Web host sees bright future with 100% solar-powered data center', *Computerworld* (November 5, 2007), https://computerworld.com/article/2539563/web-host-sees-bright-future-with-100--solar-powered-data-center.html.

33 See also Trevor Chow-Fraser, Chelsea Miya and Oliver Rossier, *Moving Ideas without Moving People: How to Econference at the University of Alberta* (2018), https://aroundtheworld.ualberta.ca/wp-content/uploads/2018/05/E-Conferencing-Toolkit.pdf.

34 The conference proceedings can be found at https://mindsonline.philosophyofbrains.com.

on The Brains Blog,[35] on email listservs such as Philos-L, and on social media platforms such as Facebook and Twitter (via The Brains Blog page and the organizers' personal profiles). The deadline for papers was in March (see Table 3).

Table 3 Timeline for annual Minds Online Conference organizing.

January or February	Call for papers posted, advertised
March	Deadline for conference submissions, reviewers solicited
April	Deadline for responding to authors, invited commenters solicited
May	Deadline for commenters to confirm, for authors to send revisions
August	Deadline for comments to send comments to authors, organizers
September	First conference session begins (see Table 4).

The Minds Online conference required submissions to adhere to the following guidelines:

- limited to approximately 3,500–7,500 words;
- prepared for anonymous review;
- described with several keywords;
- accompanied with an abstract of no more than 500 words;
- submitted as .doc, .pdf, or .rtf file.

Authors submitted their name, contact information, current position, email address, keywords, an anonymized copy of their paper and a cover page to The Brains Blog[36] via an online form.[37]

35 Gualtiero Piccinini, *Brains: A Dialogue on Philosophy of Mind and Related Matters* (December 25, 2005), https://web.archive.org/web/20070723084710/philosophyofbrains.com/2005/12.aspx.

36 John Schwenkler, 'Minds online submissions', *The Brains Blog* (November 16, 2014), https://philosophyofbrains.com/minds-online-submissions.

37 *JotForm*, https://jotform.com/.

Review. In 2015, review was double-blind. In 2016 and 2017 review was triple-blind—only one author was asked to review their own paper and the author notified the organizers of their error so that they could find another reviewer. Reviewers were solicited by the organizers via the conference's Gmail address. Reviewers indicated their name, the title of the submission they reviewed, whether or not they would be willing to comment on the submission if accepted, their rating of the submission on a scale ranging from 1 (Unacceptable) to 5 (Excellent), their (optional) comments for the author and their (optional) comments for the organizers. Reviews were submitted via Google Forms.[38]

Invited Commenters. Invited commenters were recommended by authors and reviewers. Organizers invited commenters via the conference's Gmail address. The deadline to submit invited comments to authors and organizers was August (see Table 3).

Scheduling. Each conference included three to four sessions. Each session lasted one week (see Table 4 Timeline for each Minds Online Conference session.). It included a keynote presentation, three to four contributed presentations and two to four invited commenters for each contributed session. Paper presentations and invited comments were published the weekend before the Monday of their session. Public comments were enabled on Monday. The goal of this posting schedule was to allow for pre-reading and, subsequently, more careful and reflective public comments. Keynote presentations were also posted on the Monday of the session, when public commenting began.

Table 4 Timeline for each Minds Online Conference session.

Saturday	Publish, announce N^{th} session's contributed presentations with invited comments.
Monday	Publish keynote presentation. Enable and announce public commenting.
Friday	Announce final day to comment on N^{th} session. End public commenting at end of day.
Saturday	Publish, announce $[N+1]^{th}$ session contributed presentations with invited comments.

38 Google, *Google Forms*, docs.google.com/forms/.

Presentation. Presentations included a short video, created by the author(s). Organizers encouraged videos to be short (e.g., 'about 5 minutes'), simple and to provide only an overview of the paper. Nonetheless, the length, style and depth of videos varied widely. Videos were shared with organizers via cloud storage services and then uploaded to the Minds Online conference YouTube channel by organizers.[39] Once uploaded, videos were embedded at the top of their corresponding paper presentation. So each presentation included—in the following order—the presenter's video, the presentation title, the author's name and affiliation (with a link to their personal website), the presenter's paper (in html, but with a link to a printer-friendly PDF version at the beginning), and links to invited comments, as pictured in Figure 1.

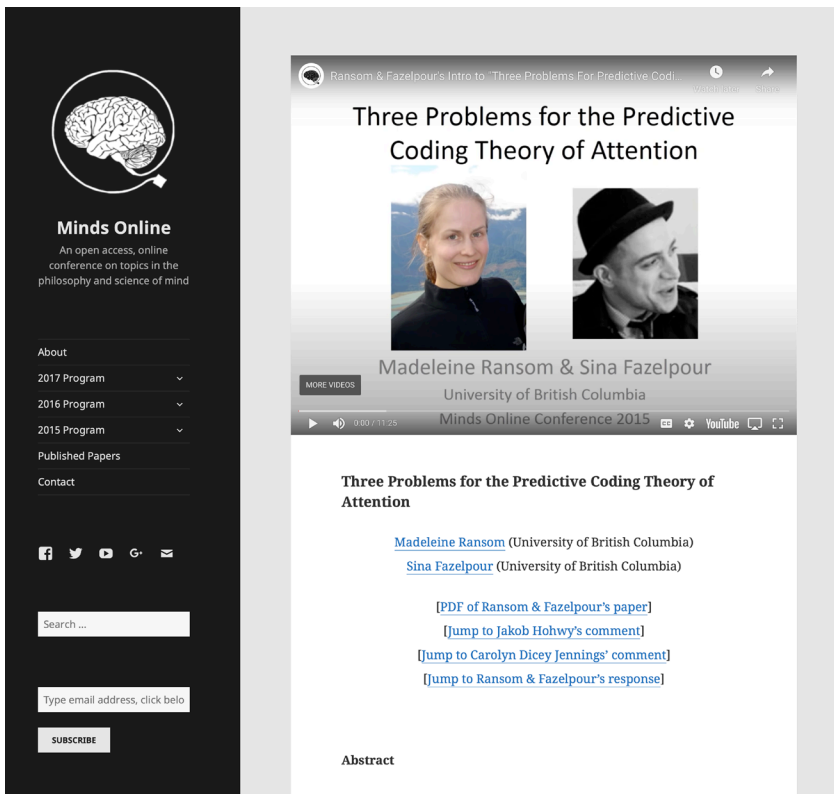

Fig. 1. Example of Minds Online Conference post.

39 'Brains Blog', *YouTube* (August 26, 2015), https://youtube.com/channel/UC6mcwUhGe39zScWd2cxm_dQ.

Comments. Like many conferences, one of the purposes of the Minds Online conference was to give scholars access to pre-publication feedback on their papers. So appended to every conference presentation were invited comments from a few relevant experts. This (a) ensured that every presentation had an audience of scholars in its field and (b) identified specific avenues of discussion for the five-day open comment periods for each presentation. Invited comments were appended to and published at the same time as their corresponding paper. Invited comments were also pinned to the top of the comments section—i.e., invited comments always appeared before public comments.

It was decided *a priori* to abstain from creating a comment policy or moderating comments until a need for moderation and corresponding policy arose. In three years of conferencing, there was no need for comment moderation. Posting comments required commenters to type their name and email address into the comment form—email addresses were visible only to the organizers managing the website via the password-protected WordPress content management system.

Website Management. The conference was hosted on a subdomain of philosophyofbrains.com. The hosting company created the subdomain and installed the open-source WordPress content management system on it.[40] The appearance of the website was adapted from the Twenty Fifteen theme.[41] Presentations were created by copying text from .doc or .rtf files and pasting it into new posts. (NB: at the time, figures and images could not be copied and pasted. Instead, they were uploaded and inserted into posts one-at-a-time.) Each presentation's blog post was time-stamped so that they appeared on the blog page in the same order as the program. Each year's conference program was published in 'page' format. Each program contained links to each presentation. Each session of each year's conference had its own category so that users could view each session as one webpage. The conference logo was found in a public domain image library.

Pre-Print Concerns. A small minority of scholars expressed concern about having their paper posted online for the Minds Online conference. The worry was that posting the paper for the conference could make it ineligible for publication in academic journals. These worries were

40 *WordPress*, https://wordpress.org/.

41 WordPress, 'Twenty Fifteen', *WordPress* (August 11, 2020), https://wordpress.org/themes/twentyfifteen

assuaged when organizers of the conference relayed their experience of publishing papers whose earlier drafts had circulated at traditional and online conferences. The worries were further assuaged by the fact that many papers shared during the online conference were published in respected journals afterward.[42]

Results

Some aspects of the online conferences can be analyzed quantitatively, such as online conference visitors, page views, presentations, comments and social media shares. The following data come from Wordpress.com and publicly available data about the Minds Online conferences of 2015, 2016 and 2017.

Descriptive Statistics. Data about conference participation, inclusivity, and video were gathered from WordPress, from presenters, and from YouTube. These data are reported below.

Participation. Participation data was obtained using the 'Stats' feature in WordPress. The number of visitors, page views, submissions, comments, and social media shares for each year are reported in Table 5 Traffic statistics for each year of the Minds Online Conference. By design, the 2017 Minds Online conference included only three sessions and lasted only three weeks compared to four sessions over four weeks in 2015 and 2016. Data for these years show a slight decline in more superficial forms of participation such as page views per year, but slight increases in more substantial forms of participation such as visitors per week and comments per presentation.

Inclusivity. The gender distribution of Minds Online presenters and geographic composition of participants for each year of the Minds Online conference is reported in Table 6. This representation of women was at least as high as the 25.1% of postsecondary philosophy instructors in the United States that were women at the time.[43] In 2015, double-blind peer review selected a higher rate of women than men. Triple-blind review selected a higher rate of women than men in 2016, but not in 2017. Additionally, in every year of the Minds Online conference the

42 Minds Online, 'Published papers', *Minds Online* (2018), https://mindsonline.philosophyofbrains.com/published-papers/.

43 American Philosophical Association (2018).

Table 5 Traffic statistics for each year of the Minds Online Conference.

	2015	**2016**	**2017**
Mean Visitors/Week	3,199	2,786	3,333
Total Visitors	5,173	4,234	3,615
Total Page Views	12,795	10,745	9,998
Mean Comments/ Presentation	30	48	38
Mean Shares/Presentation	41.22	Unknown	Unknown

largest share of page views came from outside the USA. These data might suggest that the conference was at least as inclusive as the average philosophy conference in the United States. Without publicly accessible conference data, this hypothesis is difficult to test.

Video Content. Most presenters created videos to accompany their papers, as recommended by the organizers. Video durations ranged from 61 seconds to 26 minutes, 48 seconds. As this is being written, individual Minds Online videos have been watched between 57 and 2301 times.

Inferential Statistics. Participation varied over the course of each conference. One might wonder how session order (e.g., beginning, middle or end of the conference), presentation type (i.e., keynote vs contributed), or presenter gender accounted for variance in conference participation (i.e., page views or comments). Multiple regression analysis revealed that participation, measured by views, varied significantly by session order and gender, but not presentation type. Specifically, participation decreased from the beginning to the end of each conference, on average, but page views were significantly higher for presentations by women, on average (see Figure 2 and Figure 3)—despite fewer women presenters. Standardized correlation coefficients, effect sizes and p-values are reported in Table 6 Participation by presentation type, session order and presenter gender.

Table 6 Participation by presentation type, session order and presenter gender.

	Standardized Coefficient	***F* (1,45)**	***P***
Session Order (Week 1—Week 4)	-.47	13.12	.001
Presentation Type (Keynote vs Cont.)	-.04	0.01	.752
Gender (Men = 1, Women =2)	.28	4.66	.038
Year (2015, 2016, 2017)	-.18	2.1	.153

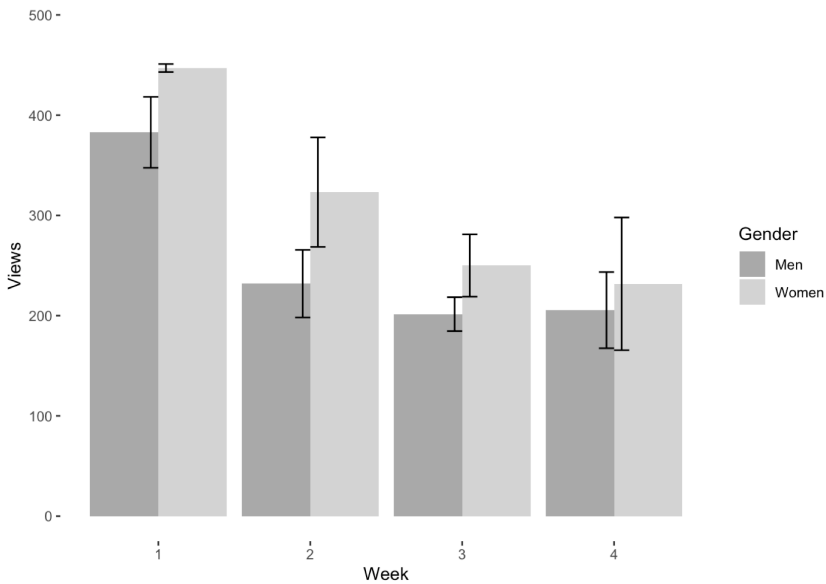

Fig. 2 Average page views for presentations per week by gender with standard error bars.

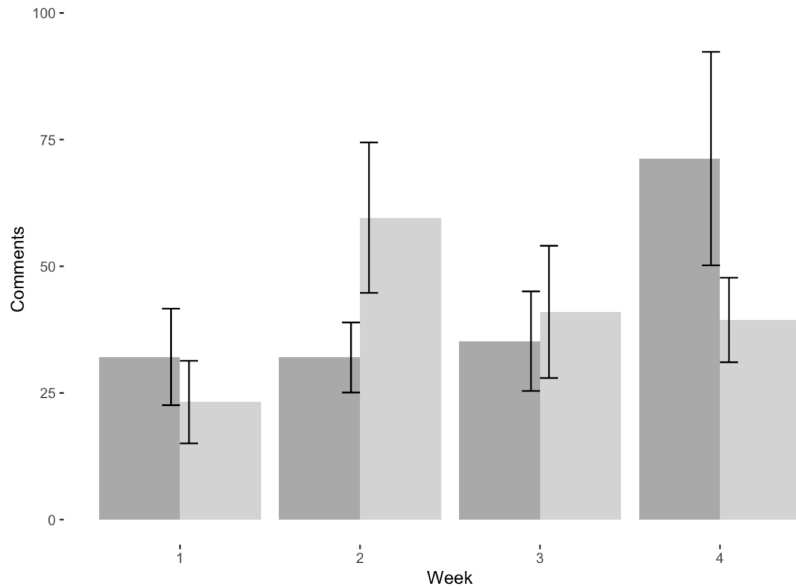

Fig. 3. Average comments on presentations per week by gender with standard error bars.

Multiple regression also revealed that the average number of comments per presentation increased marginally by week ($\beta = .27$, $F(1,45) = 3.6$, $p = 0.064$), but did not vary significantly by presentation type, gender, or year ($ps > 0.23$). Nonetheless, there were noticeable differences in comments received by men and women from year to year (see Fig. 4 Average comments on men's and women's presentations per year.).

Qualitative Analysis. Minds Online participants and presenters were given the option to complete a post-conference survey. When asked about their overall experience, 5% selected 'negative', 17% selected 'neutral' and 78% selected 'positive'. Also, when prompted with 'Feel free to tell us anything that might help us improve the Minds Online conference', responders reported outstandingly positive experiences. For example, 'I had an overall great experience' and 'I think the conference is overall fantastic and I consider it the gold standard for how to do an online conference'. More specifically, Minds Online participants and presenters mentioned valuing the online conferences' accessibility, pace, video content and commentary. However, some participants expressed concerns about the duration and volume of the conference.

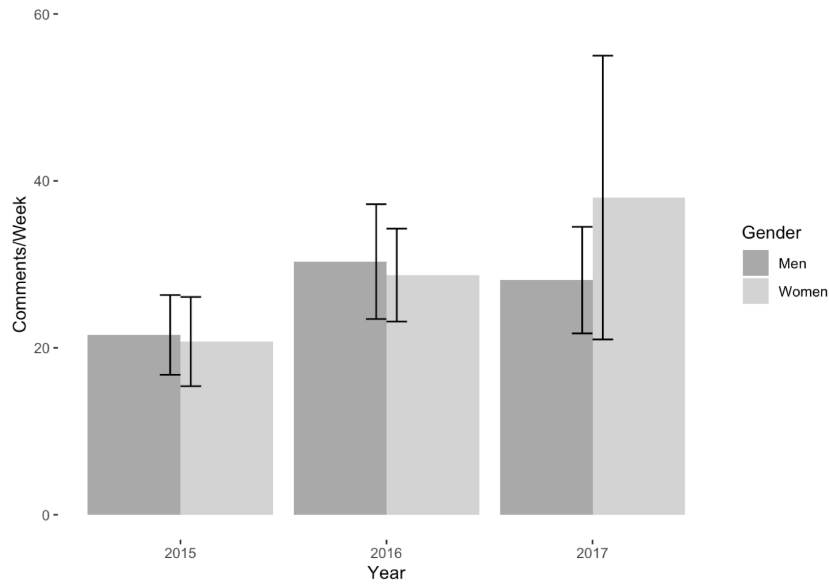

Fig. 4 Average comments on men's and women's presentations per year.

Accessibility. Some presenters and participants who were new to online conferences seemed to be won over by the accessibility. One presenter went as far as to say, 'I loved the Minds Online format: there was no need to travel […]' and another presenter adds, 'Participation was easy'.

Pace. Like previous online philosophy conferences,[44] the Minds Online conference lasted several weeks. Allowing a few days for people to comment created opportunities for more careful and extended discussion. And dividing the conference into separate weeks seemed to be appreciated. 'I really appreciated the pacing of the discussion. [I]n traditional conferences, just attending the talks you want to attend can be extremely exhausting. For this reason, I think not posting all papers in one go was the right decision', reported a presenter. Despite valuing more time and sessions, participants also valued periodic deadlines—e.g., the final day to comment on a session. One participant reported, 'Knowing that I had a deadline if I wanted to comment really helped me focus as an audience member. It also helped make it feel more like

44 See, for example, Nadelhoffer (2006); Brown (2009).

a "real" conference. The amount of time allotted, and overall pace was good'.

Video. Most Minds Online presenters created the recommended video introduction to their paper. Some participants reported appreciating the videos, but also reported a preference for short introductory videos rather than longer, more comprehensive videos. A participant reported, 'I like having the videos there. It's nice especially when I get to see and hear the author; it humanizes the whole process. I find myself not watching the entire video, though, and rely on the actual papers to get the philosophical content'. Another participant seconded this point. '[I] f one is going to just make one video then [a] short abstract one is best. Most people get the argument from the paper but [the video] makes it feel more like you are engaging with a person [because] you can at least track their tone and inflection a little'.

Comments. Invited comments were submitted to presenters at least a week before the presentation, giving presenters ample time to formulate careful responses. Many presenters seemed to appreciate this. 'I really enjoyed the opportunity to have such great invited comments', reported a presenter.

Public commenting was open for five days for each paper—after papers had been available for pre-reading over the weekend. The descriptive statistics revealed that many participants commented, suggesting that commenting was easy and rewarding. Both presenters and participants seem to confirm this. One presenter reports,

> [We] received really helpful commentary from commentators who likely would have declined to comment on our paper at a traditional conference due to travel and timing issues. [O]ur paper received more exposure than it would have had at a traditional conference. [M]y co-author and I had lots of people comment to us about the paper (outside of the conference comments) or mention that someone else had posted a link to it somewhere or was discussing it on twitter or another blog. [...] I found the back and forth with our commentators to be immensely helpful and productive. This is one of the biggest benefits of the online format in my opinion.

Other presenters reported, 'I thought the Minds Online Conference had an impressive lineup of talks and commenters and many of the discussions went really well', and 'I found the quality of the comments wonderful'. Participants also praised the commentary. For example, 'I

[got] a lot out of just "lurking" and observing the various exchanges (even if I couldn't find time to articulate a comment)'.

Volume. One consistent line of constructive feedback from presenters and participants concerned volume. Papers and commentaries seemed too numerous or too long for many survey responders' schedules. As one participant reported, '[I]t was very hard to find the time to participate in as many sessions as I wanted to, compared to a normal conference [because I had to] weigh [conference participation] against all my other responsibilities'. Another participant reported a similar sentiment, 'My only complaint is that I felt overwhelmed by the volume of excellent material. I wanted to read and comment on several papers, but simply couldn't keep up with more than one or two'. Some presenters had similar concerns, 'I do think there were too many talks, such that most of them did not seem to garner enough attention'. Other survey responders were more concerned about the length of presentations and commentaries. For instance, someone wrote, 'The papers were too long to facilitate online discussion. [...] The comments were also very long for the Internet format'.

Costs. The total monetary cost of hosting Minds Online conference is about $15 per month. That is the cost of hosting philosophyofbrains.com, including the cost of the conference's subdomain mindsonline.philosophyofbrains.com. Co-organizers volunteered their time. The call for papers was advertised on PhilEvents.org at no cost. Peer-reviewers volunteered their time. The conference program was advertised at no cost by Facebook, Twitter and Reddit users. Keynote and contributed presenters volunteered their time. Invited commenters volunteered their time. The conference's videos are hosted on YouTube at no monetary cost. And, of course, there were no costs associated with travel, lodging, childcare or food.

The labour costs for the Minds Online conference were low compared to a more traditional conference. However, as many other online philosophy conference organizers report,[45] the labour required to organize an online

45 Richard Brown, 'Consciousness online—10 years later', *OneMoreBrown* (May 14, 2018), https://onemorebrown.com/2018/05/14/consciousness-online-10-years-later/; Thomas Nadelhoffer, 'Comment on "The future of online conferences in philosophy"', *Daily Nous* (October 17, 2015), https://dailynous.com/2015/10/15/the-future-of-onlineconferences-in-philosophy/#comment-74841.

conference was not insignificant. Other online conference organizers report, 'It was also an awful lot of work putting [the online conference] together. […] First, as a junior philosopher, I had a number of other things that had to take precedence—namely, research and teaching. [So] it seemed like I was stretched thin enough as things were'. Another online conference organizer reports, 'I [organized the online] conferences while teaching a 5/4 load [four to five courses per semester]. As the years went by and the committee work and professional commitments grew, I became overwhelmed [even though] I really did enjoy [and benefit from] organizing it'. Indeed, part of the reason that the Minds Online conference was put on hold after the 2017 conference was that its organizers were too busy with other, more career-advancing work. This is largely due to the highly competitive nature of hiring and promotion in academia and the relatively low institutional rewards for professional service such as conference organizing. These conditions leave early career philosophers with little incentive to serve their colleagues by organizing conferences—online or otherwise.

Discussion

The data suggest that the Minds Online conference produced the kind of participation, inclusivity and impact to which many conference organizers aspire. Presenters and participants alike clearly reported being appreciative of the online conference format in general and the Minds Online conferences in particular. Of course, the data also reveal some opportunities to improve online conferences—e.g., by adjusting duration and volume. Online conference organizers could provide important professional improvements by incorporating these insights into future online conferences and publishing their results for comparison.

General Discussion

The Minds Online conference results suggest that online conferences can improve scholars' conferencing practices and experiences. It has produced useful data about the academy, shared the workload of conference organizing, maintained or improved representation for

underrepresented groups, and reduced the academy's carbon footprint. Moreover, the cost of obtaining all of these benefits was strikingly lower than the cost of a traditional conference. This raises questions about the advantages of the online conference model vs. more traditional conference models.

Advantages of Online Conferencing

The Minds Online Conference revealed that the online conference format has many advantages. These advantages include presentation quality, commentary quality, pace, cost, convenience and safety.

Presentation quality. One clear advantage is the quality of the presentations. Naturally, this quality is largely determined by the quality of the submission pool and selection process. While both online and traditional conferences can employ rigorous selection processes, the online conference does not disincentivize submissions based on geographic distance, travel funding, teaching load, physical ability or childcare needs. So the online conference allows not only more submissions, but more high-quality submissions that tend not to be submitted to or presented at traditional conferences. Of course, submission quantity can also be aided by associating an online conference with a large, existing online community such as The Brains Blog contributors and readers.[46]

Commentary quality. One reason that the online conference format allows for better commentary might be that there are fewer spatial and temporal constraints—e.g., for booking space, scheduling concurrent sessions, etc. Another reason that online conferences can offer improved commentary is that there are fewer constraints on who can be invited to comment. For example, invitations need not be limited only to those who can manage to travel to a particular location at a particular time. Moreover, commentaries can be far more detailed and developed than a verbal comment or question at a traditional conference. So online conferences can offer all of their presenters a quality of commentary that traditional conferences can offer to only a few of their presenters.

46 Piccinini (2005).

Pace. The traditional conference's constraints leave little time for people to respond to presentations and thereby select for confidence and quick wit. Of course, it is not obvious that confidence and quick wit correlate with the kind of clarity and rigor that scholars hope for in conference feedback. The results of the Minds Online conferences suggest that allowing more time for reading and commenting allows not only for improvements in comment quantity, but also improvements in comment quality.

Cost. The monetary and time costs of online conferences are lower for organizers, presenters, and participants. The main savings come from not having to plan or purchase venue space, transportation, accommodation, or food. However, there might also be additional time and cost savings for online conference-goers who participate from home—e.g., savings from not having to commute, find childcare, purchase professional clothing, clean professional clothing, etc.

Convenience and Safety. Finally, online conference organizers, presenters and participants enjoy more autonomy and less inconvenience, stress and risk than their traditional conference counterparts. For example, online conference-goers are not at the mercy of transportation systems, non-optimally accessible venues, limited childcare or non-inclusive meal options. They can be anywhere with an Internet connection, dressed however they want, eating whatever they need, attending to all sorts of other needs at work and at home. These benefits are obvious. Less obvious are the expected events in which these benefits become handy. During multiple years of the Minds Online conference, many organizers and participants evacuated to hotels or relative's homes while hurricanes Harvey, Irma and Michael were wreaking havoc in their backyard. However, everyone was able to fulfill their conference duties. One might wonder how online conferences might be more resilient than traditional conferences in the face of other kinds of emergencies such as virus outbreaks.[47] Overall, the flexibility of online conferences in the face of unexpected emergency is simply not possible for traditional conferences.

47 Anthony McAuley, 'Two upcoming New Orleans conferences canceled amid coronavirus fears', *The New Orleans Advocate* (March 4, 2020), https://nola.com/news/business/article_c865e6e8-5d7c-11ea-ad9d-f71dc925f69e.html.

Advantages of Traditional Conferencing

Of course, the traditional conference model has benefits that the online conference model lacks. It is worth acknowledging these advantages and considering how—if at all—online conferences can achieve similarly advantageous outcomes.

Professional Serendipity. Some of the most fortuitous moments in careers occur when scholars unexpectedly cross paths while at a traditional, in-person conference. These interactions simply cannot occur—or cannot occur in the same way—online. Perhaps more importantly, traditional conferences afford opportunities for people to exchange valuable information that is not usually discussed publicly—e.g., delicate topics or the climate of particular departments. Online conferences might be able to improve professional serendipity by including a 'virtual meet and greet' in the program[48] or by creating opportunities for participants to chat privately—e.g., letting presenters opt to share their email address with participants.

Social Efficiency. Socializing via written word, video and other online mediums is significantly more effortful and time-consuming than face-to-face conversation. Further, the probability of confusion, misunderstanding, and offense might be higher in online conversation where many social cues are easily lost. Worse, these disadvantages of the online conference model could compound as the volume of a conference increases. One way for online conferences to compete with traditional conferences' social efficiency would be to employ technology that mimics face-to-face interaction—e.g., video conferencing.[49] Online conferences might also reduce their outsized social workloads and risks by limiting the volume of their presentations and commentaries.[50]

Conclusion

Online conferences have provided open access conference presentations and commentary to thousands of participants all over the world for

48 Madeline Ransom, 'Comment on "The future of online conferences in philosophy', *Daily Nous* (October 20, 2015), https://dailynous.com/2015/10/15/the-future-of-onlineconferences-in-philosophy/#comment-75263.

49 See Calzavarini and Viola (2018).

50 Ibid.

over a decade—and at a small fraction of the cost of their traditional conference counterparts. Like previous online philosophy conferences, Minds Online participants viewed their experience favorably.[51] Further, the Minds Online conference managed to—among other achievements—represent some underrepresented groups at least as well as they were represented in the profession at the time. Of course, there are still many opportunities to improve the methods and results of online conferences with new innovations as well as past innovations.[52] For example, online conference organizers might attract more submissions by offering presenters the option of publishing in a special issue of a respected journal after revising their paper according to the commentary received during the conference. Further innovation and research should investigate these opportunities to improve online conferences.

There are also opportunities to improve conferences more generally. While the benefits of online conferences and traditional conferences are fundamentally different, there may be ways to design both traditional and online conferences to get the best of both models. For those interested in organizing online conferences, the present chapter provides some historical context, replicable methods and empirical data about the results. Those interested in continuing with the traditional conference model may still improve traditional conferences by adopting online conferences' innovations in reviewing, commenting, scheduling and more. Of course, which methods are most likely to achieve desirable outcomes is an empirical question. So the path to improving conferences—online or otherwise—involves more conference organizing, more data collection, more analysis and more publications thereof. However, motivating scholars to provide this service to their profession might require incentives and support from professional institutions that have yet to be widely adopted in academia.[53]

51 Buckner, Byrd and Schwenkler (2015).

52 Fabrizio Calzavarini and Marco Viola, eds., *Neural Mechanisms: New Challenges in Philosophy of Neuroscience* (New York: Springer, 2020).

53 Brown (2018).

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18. 'Greening' Academic Gatherings

A Case for Econferences

Oliver Rossier, Chelsea Miya and Geoffrey Rockwell

Traditional academic conferences that require participants to physically travel between locations have a large environmental footprint. That is why a growing number of researchers believe it is imperative to seek out more sustainable alternatives.[1] The following case study looks at the Around the World virtual conferences organized at the University of Alberta as an example of how to host sustainable research gatherings without the carbon cost of flying. The success of this online event, with its diverse range of topics and presentation formats (live, pre-recorded,

1 See, for example, Umair Irfan, 'Air travel is a huge contributor to climate change. A new global movement wants you to be ashamed to fly', *Vox* (November 30, 2019), https://www.vox.com/the-highlight/2019/7/25/8881364/greta-thunberg-climate-change-flying-airline; Caroline Levine et al., 'Reducing the carbon footprint of academic travel', *Inside Higher Ed* (April 18, 2019), https://www.insidehighered.com/views/2019/04/18/12-scholars-share-ideas-reducing-carbon-emissions-academic-travel-opinion; Xavier Anglaret, Chris Wymant and Kévin Jean, 'Researchers, set an example: Fly less', *the Conversation* (February 13, 2019), https://theconversation.com/researchers-set-an-example-fly-less-111046; David Myton, 'The academic conference: flying into a storm of carbon emissions', *Campus Morning Mail* (July 25, 2019), https://campusmorningmail.com.au/news/the-academic-conference-flying-into-an-environmental-storm-of-carbon-emissions/; Malabika Pramanik, 'On the environmental impact of academic conferences', *The Wall Papers* (June 5, 2019), https://pwias.ubc.ca/wall-stories/the-environmental-impact-academic-conferences; *No Fly Climate-Sci*, https://noflyclimatesci.org/; *We Stay on the Ground*, https://westayontheground.blogspot.com/p/about.html.

 https://doi.org/10.11647/OBP.0213.29

hybrid), shows that the econference format can be adapted to a wide range of needs. The results from the case study show how econferencing, while not without its challenges, can be a viable alternative to face-to-face conferencing that retains many of its benefits without the environmental cost.

Introduction

The Around the World (AtW) series of econferences that ran from 2012 to 2018 was a sustained experiment in developing alternative conference forms. AtW was organized by the Kule Institute for Advanced Study at the University of Alberta to show that econferences are a viable carbon-neutral alternative to face-to-face meetings and to develop a practical guide for running econference events that could be adapted by colleagues, both at the University of Alberta and at other institutes more broadly.

The AtW case study is part of a small but growing body of scholarship on econferences, which includes the chapters by Terry Anderson and Nick Byrd that appear in this collection. Academic institutions are starting to take notice of the environmental impact of conference-related air travel, as shown by the internal study conducted by the University of British Columbia in 2018.[2] Other notable online research gatherings include the Australia-based Follow the Sun conference;[3] the Hawaii-based Teaching Colleges and Community (TCC) Worldwide Online Conference;[4] the South Africa-based e/merge online conferences;[5] the

2 See, for example, Seth Wynes and Simon Donner, *Addressing Greenhouse Gas Emissions from Business-Related Air Travel at Public Institutions: A Case Study of the University of British Columbia* (Victoria, BC: Pacific Institute for Climate Solutions, 2018), https://pics.uvic.ca/sites/default/files/AirTravelWP_FINAL.pdf.

3 Angela Murphy and Shirley Reushle, 'Following the sun: Sustainable conferencing in a climate of change', *29th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (ASCILITE) (Wellington, NZ, November 25–28, 2012), http://www.ascilite.org/conferences/Wellington12/2012/images/custom/murphy%2c_angela_-_following.pdf.

4 Bert Kimura and Curtis Ho, 'Online conferences and workshops: Affordable & ubiquitous learning opportunities for faculty development', *Distance Learning and Internet Conference 2008* (Waseda University, November 19–22, 2008), pp. 61–65, http://www.waseda.jp/DLI2008/program/proceedings/pdf/session3-1.pdf.

5 Tony Carr and Sten Ludvigsen, 'Disturbances and contradictions in an online conference', *International Journal of Education and Development using Information and Communication Technology*, 13.2 (2017), 116–140.

Nearly Carbon Neutral (NCN) series run by Ken Hiltner at the University of California at Santa Barbara;[6] and the Library 2.0 series headed by Steve Hargadon and Sandra Hirsh at the School of Information at San José State University.[7]

The growth of econferences has reinvigorated a larger discussion about the academic potential of communications technology that dates back to the mid-twentieth century. At that time, many theorists optimistically projected that networked electronic communication would transform society for the better.[8] Marshall McLuhan, one of the leading theoreticians to first look at the emerging information age, captured a part of the early optimism when he wrote about the electronic age. In his seminal 1964 work, *Understanding Media*, McLuhan said that the new technology would change the status of people so that we would become uncontainable and mutually engaged in each other's lives, regardless of race, age or gender.[9] McLuhan introduced the concept of a global village with the electronic age, where ideas can be woven together at the speed of light.[10] Many of McLuhan's predictions have proven relevant, as innovations like Wikipedia and open source software have created new capacities for nearly instantaneous knowledge co-creation and sharing.[11]

However, the circumstances responsible for the sudden rise of remote work in 2020 could not feel further from the utopian connectivity envisioned by McLuhan. As pointed out in 'An Intro to Econferences' (Chapter 15 in this collection), despite advances in communications technology, it is only recently that online conferences have gained momentum, having been propelled from the margins into the mainstream by the coronavirus pandemic and the subsequent restrictions on air travel. Quarantine has had a profound impact on academic life. As researchers scramble to find ways to gather and share knowledge

6 Ken Hiltner, *A Nearly Carbon-Neutral Conference Model: White Paper/Practical Guide* (n.d.), http://hiltner.english.ucsb.edu/index.php/ncnc-guide/#intro.

7 *Library 2.0*, https://www.library20.com/.

8 See Steven Bell, 'A conference wherever you are', *Library Journal*, 136.16 (2011), 28–31, https://www.libraryjournal.com/?detailStory=a-conference-wherever-you-are; Claudia Goldin and Lawrence Katz, *The Race between Education and Technology* (Cambridge:Belknap, 2008).

9 Marshall McLuhan, *Understanding Media: The Extensions of Man* (Cambridge: MIT Press, 1994).

10 Ibid.

11 Vladimir Zwass, 'Co-Creation: Toward a tTaxonomy and an integrated research perspective', *International Journal of Electronic Commerce*, 15.1 (2010), 11–48.

online, many are diving (or rather being pushed) into econferencing for the first time. The following case study was conducted prior to the COVID-19 outbreak, and reflects the perspective of a vastly different, pre-pandemic world. Yet, it brings to light enduring questions about the practical challenges and potential benefits of organizing online events, which are more relevant than ever given the impact of the current health crisis on the research community. These questions include: How do you gauge the success of an online event? What essential supports should the organizer be responsible for? What strategies can you use to generate lively online discussions? How can online gatherings present an opportunity to include more diverse voices?

Econferences can take myriad forms, and there is no single model or 'greenprint' that works for all. That said, we hope that this case study can familiarize academics with the process of running an online event, so that they can experiment with econferencing with confidence. The study itself is divided into two parts. The first section focuses primarily on a narrative overview of the AtW econference in 2013, documenting the experiences of organizers and highlighting key issues that carried through to subsequent years. The second section uses quantitative evidence, including website traffic and viewer data, to paint a clearer picture of presenter and participant engagement in the AtW series as a whole. The case study concludes with challenges and lessons learned, including suggestions for how to build better supports for econferencing into academic institutions, while also pointing to future avenues of research.

AtW Overview

The AtW econference series was organized and hosted by the Kule Institute for Advanced Study (KIAS) at the University of Alberta (UAlberta). KIAS's broad focus is to help build research potential in the social sciences, humanities and arts at the University of Alberta[12]. In terms of an overall communications strategy, KIAS hypothesized that the AtW series could:

12 For more information please see: www.ualberta.ca/kule-institute/about.

1. Model and help build capacity to conduct affordable, accessible, and more environmentally friendly research dialogues;
2. Showcase UAlberta research strength, particularly in the social sciences, humanities, and arts;
3. Contribute to building KIAS's profile on the UAlberta campus as well as locally, nationally, and internationally.

Initiated in 2013, the AtW series has explored and modeled variations of econference design and implementation using live videoconferencing. The goal was to conduct research dialogues with lower financial and time costs as well as a significantly lower impact on the environment, while still being broadly accessible for participants. KIAS attempted to remove or reduce many of the economic and technical barriers and invite scholars' participation in as positive a manner as possible.[13]

The basic structure of AtW was to facilitate online research presentations using a live video stream hosted on a dedicated website where comments could be moderated online. The research presentations were then made accessible to a broader audience in a video archive. Essentially, KIAS created an online research channel centred on a particular digital culture topic, and past years' themes include privacy and surveillance in the digital age; digital media in the post-truth era; and libraries, archives, and public life.

Feasibility Test—AtW 2013

The first AtW in 2013 was originally conceived as an online conference that would move around the world from institute to institute in two-hour segments for twenty-four hours. Despite the fact that variations of econferences have existed for over two decades, organizing the plenary event proved to be a challenge. The first issue was to build up the administrative and technical capacities of local support staff who had little experience organizing online conferences. The second was to find a stable technical platform that the econference would run on. The third was to secure commitments from interested UAlberta scholars and

13 See Appendix 2 for a sample invitation letter.

international scholars who would be willing to present their material in this digital format.

Engaging with Key Stakeholders

The AtW organizers mobilized experience, social capital and leadership to achieve the strategic partnerships and collaborations which helped make the first AtW possible. The KIAS Director, Geoffrey Rockwell, is a well-established digital humanities scholar who mobilized his extensive local, national, and international networks to solicit individual and organizational participation. Looking back at the communities of inquiry (CoI) conference model mentioned in 'An Intro to Econferences', it is conceivable that a significant portion of the receptivity of scholars to participate in the prototype 2013 conference can be attributed to Rockwell leveraging his leadership presence and his social capital as an experienced and innovative researcher.

To maximize interdisciplinary engagement, KIAS chose a broadly accessible theme: technology and culture. In order to encourage cross-institutional collaboration and build a network of like-minded academic leaders who believe in the value of the econference format, KIAS first focused on identifying and contacting prospective research partners at other institutes. These individuals were asked to commit to organizing a one to two-hour segment of the econference, often a panel or roundtable discussion. In this way, the AtW organizers hoped to both engage a set of strong research teams and distribute some of the responsibility for setting the tone of the conference and selecting content to other organizations. The focus on interdisciplinarity and cross-institutional collaboration was so successful that it was carried forward through subsequent AtW conferences, and in fact many of our research partners participated in the AtW event for multiple years.

Conference participants were recruited by direct email correspondence from the KIAS Director, followed by communications with an AtW project coordinator. In later iterations of the AtW conference series, the event information was also circulated through academic listservs and social media posts. The promotional materials made clear the environmental objectives of the AtW conference organizers, highlighting the carbon savings of past events, which proved to be an effective way to generate

enthusiasm and goodwill on the part of prospective participants. In the first year of the AtW series, approximately 74 invitations were sent to institute coordinators and researchers, including 16 researchers from UAlberta. The result of these recruitment efforts was that a total of 57 researchers (including 14 researchers from UAlberta) from 11 institutions in 6 countries participated in the first AtW econference. It would be an oversimplification to make a linear calculation of the response rate, for example, 60/74 = 81% acceptance rate, as the invited researchers sometimes brought research collaborators who were previously unknown to the AtW organizers. However, the overall response to the 2013 AtW invitations proved that the econference modality could be attractive to a significant group of academics locally and internationally.

Econferences, while not requiring hotels or catering, are still labour and resource intensive. In fact, because many of the AtW participants had never taken part in an econference before, organizers needed to take an even more involved role in creating and communicating the conference protocols and establishing a workable online environment for hosting the event. KIAS committed the financial and personnel resources to support project management, communication, website design and hosting, video conferencing, streaming, recording, and creating an electronic archive of the conference. With these supports in place, participants could feel confident in focusing on their presentations and leave the heavy lifting to the AtW organizers and technicians.

Participants were also given broad flexibility in terms of the presentation format. In addition to the live vs pre-recorded option, of which more will be said in the subsequent section, participants could also choose from among different presentation styles, which gave them more control over the type of conference experience they hoped to create: formal (or conversational), structured (or fluid), less interactive (or more so). Among the accepted formats were panel discussions, roundtables, keynotes, slideshows with voiceover, and interviews. In the final year of the AtW event, whose theme was sustainable research, we even welcomed creative submissions. The panel on 'Art and/in the Anthropocene', whose speakers contributed a chapter to this anthology, included poetry readings and a live musical performance, and it turned out to be one of the conference's most electrifying and engaging segments.

Exploring Technical Design

The technical design of the AtW econference focused on an accessible website space, a social media conversation channel, a video conference system, a stable streaming platform, and creation of an archive of the research presentation videos. The livestream was embedded at the top of the website so that visitors could easily locate it and participate in the conference. A countdown clock gave participants a sense of immediacy. The presenters were asked to provide a simple biography and photo to allow presenters to see each other in advance as well as give audience members a better connection to the research backgrounds of the presenters. To highlight the internationality of the econference, the Speakers tab of the website was designed to sort presenters by country. Essential technical requirements for presenters were listed directly on the website, as well as links to more details and the technicians' contact information.

The key members of the UAlberta Arts Resource Centre (ARC) technical team who assisted with AtW 2013 were Clare Peters and Grant Wang, both of whom have won institutional awards at UAlberta for their excellent technical service. Social capital was again mobilized as Peters negotiated with another UAlberta department to allow KIAS to use the Clearsea/LifeSize platform for AtW 2013. Without this support, the cost of accessing professional-grade livestreaming would have been significant. KIAS continued to use the Clearsea/LifeSize platform for video-conferencing in subsequent years. However, in 2017, we experimented with livestreaming the AtW event on YouTube, hoping to take advantage of the platform's capacity for audience engagement vis-a-vis the comment and chat section. We also hoped to learn more about our audience through the YouTube Analytics report, which gives creators access to data about viewership.

The conference livestream was broadcast on the AtW website according to the conference schedule. However, as mentioned, not all presentations were 'live', as some speakers opted to pre-record their talks. The option for pre-recorded presentations was especially appreciated by international participants based in different time zones. These speakers might otherwise have had to present at extremely inconvenient hours, which may well have discouraged them from taking part in the

conference entirely. Similarly, participants without access to reliable internet connections were better served by the pre-recorded format.

In addition to the longer sessions, such as the panels and keynotes, UAlberta graduate students were also invited to submit short, pre-recorded 'lightning talks', which were interspersed throughout the conference schedule. These lightning talks not only afforded new scholars the opportunity to share their research, but also improved the programming. The clips were screened in-between the regular sessions, in order to transition from one livestream location to another, and could be rebroadcast in case of technical difficulties. The result was a much smoother, continuous series of presentations.

It should also be noted that pre-recording a session did not limit the possibility for audience interaction. Speakers could tune into the livestream of their talk and respond to viewers' questions in real-time, either in the chat or on Twitter, and in doing so achieve a type of 'dual presence'.

Creating 'Hallway Conversations'

A major challenge for econferencing is how to create engaging spaces for social conversations.[14] Social presence is one of the key reasons academics attend traditional face-to-face (f2f) conferences.[15] According to a major study of nearly 2000 academics, 'social media has become an important complementary channel for disseminating and discovering research'.[16] Twitter is one of the most popular microblogging sites in the world and has been used during a variety of academic conferences, including the AtW series.[17] The KIAS Twitter stream was embedded in

14 Lynne Anderson and Terry Anderson, *Online Conferences: Professional Development for a Networked Era* (Charlotte: Information Age Publishing, 2010).

15 Anderson and Anderson (2010); Andrew Glover, Yolande Strengers and Tania Lewis, 'The unsustainability of academic aeromobility in Australian universities', *Sustainability: Science, Practice and Policy*, 13.1 (2017), 1–12, https://doi.org/10.1080/15487733.2017.1388620; N. Jacobs and A. McFarlane, 'Conferences as learning communities: some early lessons in using 'back-channel' technologies at an academic conference—distributed intelligence or divided attention?', *Journal of Computer-Assisted Learning*, 21.5 (2005), 317–329, https://doi.org/10.1111/j.1365-2729.2005.00142.x.

16 David Nicholas and Ian Rowlands, 'Social media use in the research workflow', *Information Services and Use*, 31.1–2 (2011), 61–83 (p. 61).

17 Denis Parra et al., 'Twitter in academic events: A study of temporal usage, communication, sentimental and topical patterns in 16 computer science

the AtW website, and over 400 Tweets were associated with each annual event.

Leading up to each conference, KIAS collected the Twitter handles of researchers and their host institutions. Participants were also encouraged to use specific hashtags, such as #UofAWorld and #AtW2016. Note, for instance, the following Tweet announcing the 2014 AtW conference by Susan Schreibman, Director of the Digital Humanities Centre at Maynooth University. Schreibman, who collaborated with KIAS on several AtW conferences, increased the visibility of the Tweet by tagging both keywords and prominent users in the post (see Fig. 1).

Fig. 1 Tweet by Susan Schreibman, May 20, 2014, https://twitter.com/schreib100/status/468863538115919872?s=20.

Hashtags not only boost the prominence of an event through the use of trending topics, they also help participants search for and locate conference-related questions, comments, and discussion; in this way, facilitating interaction and knowledge sharing.[18] During the actual

conferences', *Computer Communications*, 73 (2016), 301–314, https://doi.org/10.1016/j.comcom.2015.07.001; Joanna Dunlap and Patrick Lowenthal, 'Tweeting the night away: Using Twitter to enhance social presence', *Journal of Information Systems Education*, 20.2 (2009), 129–135.

18 Parra, et al. (2016).

conferences, Rockwell and other organizers live-tweeted extensively with short comments or quotes from research presentations or links to relevant material online. Tweets can, in a sense, function like annotations that supplement and contextualize the main material, as seen in the following Tweet by Teresa Swist, a Postdoctoral Research Fellow at the University of Western Sydney (UWS) (Fig. 2).

Fig. 2 Tweet by Teresa Swist, May 21, 2014, https://twitter.com/teresaswist/status/469271382618931200?s=20.

As discussed in 'An Intro to Econferences', one of the benefits of econferences is that the conversations generated from the event can continue even after the event itself officially ends. The online commentary can also be preserved and even presented anew in a different format. Using the Storify application, for instance, AtW organizers were able to locate, compile, and archive a 'story' of the event. In this way, econferences create opportunities to preserve a record of research dialogues, which might otherwise be lost to the ether.

Overall, the use of Twitter helped to raise the profile of the AtW series. For example, the KIAS tweet announcing that the AtW 2017 events were archived on Storify received more than 2100 'impressions', which refers to the number of times a tweet has been seen, making it among the most visible tweets that KIAS made in 2017. Tweets about the presentations, which acted as online commentary, also had the advantage of being able to be preserved. However, we had less success using the social media platform to spark more lively and interactive discussions about the content; and this and other difficulties with the platform are discussed in more detail further on in the section on 'Challenges and Lessons Learned'.

With this narrative overview in mind, let us now review other data we used to assess whether the AtW model met key KIAS communicative goals.

AtW Data

Measuring Engagement

In a traditional conference, success can be measured by examining the levels of engagement in terms of the number and diversity of conference participants and the caliber of the presenters. For an econference, in addition to the aforementioned information, organizers can also use metadata gathered from the conference website and the video streaming applications to gain a clearer picture of the event's online presence.

Table 1 AtW overview of 2013–2018 presenters.

Year	Total # Presenters	International	Canadian (Other)	UAlberta (Tenured)	UAlberta (Early Career)
2018	43	20	11	9	3
2017	44	24	4	10	6
2016	21	9	4	2	6
2015	50	34	8	5	3
2014	45	35	3	4	3
2013	60	43	4	6	7
Total	**263**	**165**	**34**	**36**	**28**
Avg	44	28	6	6	5

Looking at Table 1, we can see that the number of presenters varied slightly over the years, particularly in 2016 when KIAS experimented with a very small conference format. Overall, the average number of presenters for each conference was more than 44. While there is no available data on the average size of an academic conference, Meeting Professionals International (MPI) has estimated the average number of

participants at private sector conferences to be 74.[19] However, this data from the private sector found that only 5% of the business conference attendees were speakers, for an average number of between 3 and 4 speakers at these conferences.[20] In other words, an average of 44 presenters, particularly with an average annual representation from over 16 organizations in 13 cities, might be seen as a respectable threshold.

Building International Presence

Considering that there are nearly 200 countries in the world, having representation from an average of 8.2 different countries at each conference might not seem particularly impressive; however, to determine the overall participation in the conference, we should also look at website visitor and presentation viewer data in Table 3 and Table 4 below. Having a majority of presentations in English and being based in Canada, may have created conditions that led to a predominance of researchers from North America, Europe, and Australia. There was under-representation of researchers from developing countries, with presenters from only one country in Africa (Nigeria) and one country in South America (Brazil). Notably, however, the proportion of international participation far exceeds the baseline in the private sector. International participation rates in standard conferences is less than 7%.[21] Overall, more than 66% of presenters in the AtW series were international researchers, demonstrating that it is possible to bring international researchers together via an econference.

Showcasing UAlberta Researchers

Does the data support the hypothesis that the AtW series could showcase UAlberta research strengths? Overall, nearly a quarter of the presenters—64 out of 263—were from UAlberta.[22] The AtW econference

19 Meeting Professionals International (MPI), *Meetings Activity Profile Report Canadian Economic Impact Study 3.0 (CEIS 3.0), 2012 Base Year* (2012), https://www.mpiweb.org/docs/default-source/research-and-reports/meetings-activity-profile-report_ceis-3-0.pdf.

20 Ibid., p. 17.

21 Ibid., p. 18.

22 See Appendix 1.

experience created unique opportunities for collaboration, such as in 2014 when four UAlberta researchers from the Faculties of Arts and Law engaged in an online discussion with Alberta's Information and Privacy Commissioner. Creating opportunities for research collaboration and career progression is one of the key elements of conference participation.[23] Of particular importance was the fact that over 10% of the total AtW presenters were early career researchers from UAlberta, including graduate students and pre-tenure academics. In terms of creating visibility for early career academics, at last count, two of the graduate student AtW presentations in 2014 were among the top 10 most viewed videos of all time on the KIAS YouTube channel.[24] Broadly speaking, the evidence suggests that the AtW series has successfully showcased both established and early career UAlberta researchers.

Enhancing the KIAS Profile

Showcasing KIAS and building its profile was another goal of the AtW series. KIAS employs several communications streams including a website, Facebook, YouTube, and Twitter. The KIAS YouTube channel is a repository of videos of visiting speakers and panel discussions hosted by KIAS. Looking at Table 2 below, we can see that the AtW series has provided seven of the top ten KIAS YouTube videos in terms of watch time.

Coordinating the AtW series also raised KIAS's profile on the UAlberta campus and abroad. KIAS used the AtW conferences as an opportunity to engage with 64 UAlberta researchers from 20 departments, 9 faculties, and several central areas. In addition, KIAS was awarded an Office of Sustainability 2016 Exemplary Green Spaces in a public ceremony

23 Jacobs and McFarlane (2005); Peter Kalmus, *Being the Change: Live Well and Spark a Climate Revolution* (Island, BC: New Society Publishers, 2017); T. Storme et al., Mobility and professional networks in Academia: An exploration of the obligations of presence', *Mobilities*, 12.3 (2017), 405–424, https://doi.org/10.1080/17450101.2015.1116884.

24 'Around the World 2014—UAlberta Michael Zajko', 8:01, posted online by KIASualberta, *YouTube* (June 12, 2014), https://www.youtube.com/watch?v=e22rZdAG3Ds&list=UU0Q1jEKGmaui8DMGE8BZWWw&index=50; 'Around the World 2014—UAlberta Ajay Sandhu', 12:51, posted online by KIASualberta, *YouTube* (June 3, 2014) https://youtu.be/ZuMNUgVR_gU.

Table 2 Top 10 KIAS YouTube videos (to September 1, 2020).

KIAS Rank	ATW	Video Title	Views	Watch Time (Hours)
1		Donna Haraway—SF: String Figures, Multispecies Muddles, Staying with the Trouble	19,949	4,731
2	ATW 2017	KIASualberta Livestream	381	146
3	ATW 2018	ATW2018 Livestream—Sustainability in Practice: Revolutionary Ideas to Change How we Live and Learn	305	56
4	ATW 2018	ATW2018 Livestream—Art and/in the Anthropocene: A Debate on Sustainability and Ecology	232	48
5		Kimberly TallBear: Decolonizing Science and Technology	1,039	48
6	ATW 2018	ATW 2018 Livestream—Sustainability and the Public	189	39
7		Responses to the Refugee Crisis: Reflections from Government, Community and Academia	221	36
8	ATW 2018	ATW2018 Livestream—Green Philosophies: Re-Defining our Sustainable Past (and Future)	243	35
9	ATW 2016	Frank Tough: 'The Great Digital Transformation: Enclosing the archival commons'	276	28
10	ATW 2016	Guylaine Beaudry: Academic Libraries, Digital Culture, Spaces, and Public Life	317	24

attended by a range of staff, students, and institutional leaders.[25] UAlberta academic leaders, including Deans, Directors, Department Chairs, and Vice-Presidents attended AtW events, contributing social capital and presence to KIAS.

25 University of Alberta, 'Campus sustainability leadership awards: Award recipients' (2016), https://www.ualberta.ca/sustainability/about/leadership-awards/winners

Hybrid Model

One of the most engaging formats that emerged was the hybrid of f2f and online streaming. The video recording of Donna Haraway's keynote speech, 'SF: String Figures, Multispecies Muddles, Staying with the Trouble', whose viewing data is represented in Table 2, is an excellent example of a hybrid model. A KIAS-supported research team, led by Natalie Loveless, brought Haraway to UAlberta for a well-coordinated series of academic events in 2014. Haraway's keynote presentation was viewed by a live audience of over 200 people who overflowed the room. Since the talk was made available online, it has been viewed nearly 20,000 times.

Hybrid presentations were also conducted during AtW econferences by research teams at Trinity College Dublin and Western Sydney University. Interestingly, members of these teams became among the most consistent collaborators both in terms of participation and the number of researchers who engaged with each topic. The University of Haifa in Israel also frequently used the hybrid model, beginning in 2014.

KIAS once more replicated its previous successes with the hybrid model with the 'An evening with Edward Snowden' event in 2018.[26] In this case, the speaker was streamed in virtually, while the audience gathered live at two separate locations at the North and South University of Alberta campuses. The Snowden event is a particularly good example of how virtual conference technology can be used to overcome geographic and political barriers, which can otherwise make presenting impossible. The enthusiastic response to the event, with over 700 students, faculty and members of the public in attendance, shows that virtual presentations can still generate an audience and prove just as engaging.

As each of these examples demonstrate, the flexibility of hybrid presentations, which can involve f2f and digital aspects in both delivery and reception, allows them to reach wider audiences. What is more, in the case of keynote or special presentations, because of the compact running time and the focus on a single speaker, the added benefits of a

26 University of Alberta, 'An evening with Edward Snowden on security, public life and research', *Kule Institute for Advanced Study*, https://www.ualberta.ca/kule-institute/snowden-ualberta.

digital presence can often be achieved with little additional cost or effort in comparison to an entirely f2f event.

Estimating Participation: Viewers and Visitors

Measuring engagement and participation in econferences is much more nuanced than with traditional f2f conferences, and this is even more true of hybrid models. Consider the viewership and website visitor data presented in the following two tables (Table 3 and Table 4).[27]

Table 3 Viewer analytics: YouTube and ClearSea/LifeSize.

Year	Topic	Estimated Total Views	LiveStream Views	YouTube Views	Watch Time (Hours)
2018	Sustainable Research	1,765	n/a	1,765	226.53
2017	Digital Media in a Post-Truth Era	2,912	n/a	2,912	261.88
2016	Libraries, Archives and Public Life	3,474	273*	3,201	190.52
2015	Big Data	2,049	444*	1,605	63.02
2014	Privacy and Surveillance	2,907	552*	2,355	85.05
2013	Technology and Culture	780	251*	529	20.50
Total		13,885	n/a	12,367	847.50
Avg		**2,315**		**2,061**	**141**

Estimating the number of online attendees presents numerous challenges. On one hand, there is a risk of overcounting. For instance, a single person can be responsible for repeat visits to the websites and/

27 The YouTube data was taken directly from the YouTube Analytics page, while the livestream view data was provided by the technician running the livestreaming software LifeSize 2013–2016.

or multiple video views, inflating the results. On the other hand, there is also the possibility of undercounting. Viewer data can be lost in the process of re-uploading a video, as often happens when breaking down a continuous livestream into shorter clips of each individual speaker or panel. Views can, moreover, continue to accumulate after the event has officially concluded. There is also the added complexity of hybrid events. As mentioned, a number of AtW sessions were attended by a live audience in addition to the online viewers. Because we lacked the house data from these hybrid sessions, the total number of spectators may have been higher.

One also has to consider how sustained the level of audience engagement is. How many hours are virtual participants tuning in for? Do they attend multiple sessions? We found that most website visitors and video viewers were not spending long periods on the website. From this, we can speculate that econferences attract more viewers and visitors, but for shorter periods of time in comparison to traditional f2f conferences.

Table 4 AtW website visits annual totals.

Year	Topic	Countries	Cities	New Users	Sessions
2018	Sustainable Research	52	289	1,122	1,935
2017	Digital Media in a Post-Truth Era	47	205	801	1,383
2016	Libraries, Archives and Public Life	47	199	745	1,247
2015	Big Data	56	354	1,402	1,844
2014	Privacy and Surveillance	31	173	663	1,192
2013	Technology and Culture	22	160	651	1,038
Total				**5,384**	**8,639**
Avg		**43**	**230**	**897**	**1,440**

There are undoubtedly difficulties with estimating the size of a virtual audience. That said, according to the metadata gathered from YouTube

and the AtW website, over the entire course of the AtW series the event garnered 4,262 new website visitors and 13,885 livestream and video views. Each annual econference event attracted an average of 2,315 livestream and YouTube views, while the average number of website visitors was 897. The yearly fluctuations in views and visitors might be attributed, at least in part, to discrepancies in data gathering practices. Still, if even half of the livestream and YouTube viewers were unique, that would represent over 1,000 virtual attendees. While more research on how to accurately assess online participation is needed, this is nonetheless promising evidence in support of econferencing as an effective mode of hosting academic conferences.

AtW Accessibility

In addition to reaching a broad audience, the results from the AtW series are also an indication of how econferences can help to overcome the barriers to participation in f2f conference, which were outlined in 'An Intro to Econferences'. On average, researchers from 17 different cities in 8 different countries took part in each AtW econference event (see Table 5). Examples of international speakers include Omolara Kikelomo Owoeye and colleagues from Ekiti State University in Nigeria in 2014 and 2015, Marcus Bastos and colleagues at Pontificial Catholic University in Brazil in 2015 and Oren Meyers and colleagues at the University of Haifa in Israel. There were also presentations from Canadians researchers based in northern communities, such as Amy Amos in Inuvik and Jean Polfus in Tulit'a, both as part of the AtW 2018 panel on sustainable research initiatives in the North. In all these examples, the financial, temporal and environmental costs of flying would have been prohibitive for a f2f conference. For instance, Amos estimated that it would have cost over $4,000 for her to fly to Edmonton, Alberta, where the KIAS institute is headquartered. Furthermore, it would have required three days of travel and emitted over 0.54 metric tons of CO2 equivalent (CO2e).[28] For Owoeye, the flight from Ado Ekiti, Nigeria would have cost approximately $2,350, required between 32–46 hours of flying time,

28 'ATW 2018 (Edited): Sustainability in Practice—Revolutionary Ideas to Change How we Live and Learn', 2:10:28, posted online by KIASualberta, *YouTube* (May 30, 2018), https://youtu.be/Ph5JpLfj_aY?t=5086.

and emitted over 3 metric tons of CO2e.[29] Overall, the distribution of AtW presenter locations suggests that the model allowed a diverse range of research perspectives to be shared, or, at a minimum, that geographical access issues were not a major barrier to participation.

Table 5 AtW Presenter Distribution by Institutions, Cities, Countries.

Year	Total # Presenters	Institutions	Cities	Countries
2018	43	20	18	4
2017	44	15	11	6
2016	21	13	10	6
2015	50	18	20	12
2014	45	20	15	11
2013	60	14	9	6
Total	**263**	**100**	**83**	**45**
Avg	44	17	14	8

Communication accessibility is another area that econferencing shows promise in, due to the availability of manual and automatic closed captioning technology. From the experience of the AtW organizers, archiving presentations in a dedicated YouTube section of the website helped to make the conference material accessible in a number of ways.[30]After the conference material was broadcasted live on the website homepage, the video was immediately archived on the site and available to be rewatched. Later, the full video was broken down into shorter clips of each individual presentation and uploaded to the KIAS YouTube channel. One benefit of using YouTube for the AtW video archive was that it afforded KIAS free automatic closed captioning, greatly improving the accessibility of the content for academics who are, for example, deaf or hearing impaired.

29 Flight cost based on round-trip economy airfare in spring 2018, using the Flight Hopper application; CO2e estimate based on round-trip Economy airfare using the Carbon Footprint Calculator.

30 'Around the World, Category: Archive', http://aroundtheworld.ualberta.ca/category/archive/.

The same technology also allowed researchers the ability to present in languages other than English. Given the overwhelming dominance of English in academia, econferences have the potential to improve language diversity and fight against the 'marginalization' of 'non-English research'.[31] For instance, at the 2013 AtW conference, a Brazilian research team from Federal University of Espírito Santo pre-recorded their presentation in Portuguese and added English subtitles. Likewise, Montreal-based research teams, such as the Centre de recherche interuniversitaire sur les humanités numériques, gave bilingual and French presentations. Even so, overall, very few AtW speakers chose to present in non-English languages. Further work could be done to promote language diversity at econferences and avoid defaulting to English, especially when it comes to collaborative, multi-institutional and multinational events. For instance, organizers might, at a minimum, make the opportunity to present in non-English languages explicit in the conference material and facilitate video captioning with the option for presenters to edit and/or submit their own captions.

The econference format can work to challenge other biases within academia, including gender bias. The gender imbalance in academia is well-documented. A research team at the University of Berkeley found that women are less likely to get tenure-track jobs and to be promoted.[32] The same study showed that while there are more women in visible leadership positions, there are also more women in lower-paying part-time and adjunct jobs.[33] For these reasons, one can conclude that female scholars are more likely to face economic and social barriers to conference travel. Econferences, by comparison, might be more conducive to inclusivity, which appears to be supported by the AtW case

31 Adam Huttner-Koros, 'The hidden bias of science's universal language', *The Atlantic* (August 21, 2015), www.theatlantic.com/science/archive/2015/08/english-universal-language-science-research/400919/; Matt Pickles, 'Could the dominance of English harm global scholarship?', *BBC News* (January 20, 2016), https://www.bbc.com/news/business-35282235.

32 Mary Ann Mason, Nicholas H Wolfinger and Marc Goulden, *Do Babies Matter?: Gender and Family in the Ivory Tower* (New Brunswick: Rutgers University Press, 2013), p. 84.

33 Mary Ann Mason, 'In the ivory tower, men only', *Slate* (June 17, 2013), https://slate.com/human-interest/2013/06/female-academics-pay-a-heavy-baby-penalty.html; Mason, Wolfinger and Goulden (2013), p. 36.

study findings. 45% of the UAlberta presenters in AtW conferences were female, which compares favorably to the overall UAlberta context in which only 34% of tenure track positions are held by women.[34] However, further research on this subject is needed, and much more work needs to be done to figure out how econferencing can be mobilized to strengthen diversity and inclusion in research.

AtW Affordability

Affordability is an accessibility issue on an individual level and a sustainability issue on an organizational level. Financial constraints can make traditional f2f conferences inaccessible to many vulnerable populations, including early career academics. Despite the fact that hosting traditional conferences can be a financial challenge for organizations, there are both strong pressures and motivations for universities to organize conferences.

In the AtW series, KIAS wanted to model a type of conference that reduced the financial burden on organizations and research teams. The budget for conducting the AtW conferences was $12,500 CAD per year. To put this into perspective, a presenter travelling from Paris, France to Edmonton, Canada might estimate $2,500 CAD for flights, accommodation, meals and ground transportation. In other words, the entire AtW econference budget was comparable to bringing five presenters from Europe to Canada. The AtW budget covered all aspects of conference coordination, technical support, video editing, archiving, and website design and hosting. As shown in Table 6, the estimated savings in flight costs alone for the AtW presenters was $236,000 CAD in total, for an annual average of just under $40,000 CAD. Considering the other potential travel costs of accommodation, food, and ground transportation it is clear that KIAS was able to conduct legitimate conferences at less than one-quarter of the cost of flying and hosting all of the presenters to a physical location.

34 Academic Women's Association, 'The diversity gap' (June, 2016), https://uofaawa.files.wordpress.com/2016/06/awa-diversity-gap-professors-gender-diversity-intersectionality.jpg.

Table 6 AtW presenter flight distances, costs and CO2 by year.

Year	Flight Distance (Return) (1)	Flight Cost Estimate (2)	CO2e Avoided (3)	CO2e with Radiative (3)
2018	342,028	$36,470	25.31	47.86
2017	331,276	$26,150	23.99	45.39
2016	152,906	$14,310	10.98	20.76
2015	689,572	$53,770	50.15	94.73
2014	619,552	$50,270	44.7	84.46
2013	776,880	$55,230	55.97	105.86

(*1) Travel distances calculated using www.greatcirclemapper.net

(*2) Based on round-trip Economy airfare estimator using the Hopper app available at www.hopper.com

(*3) Based on round-trip Economy airfare using the Carbon Footprint Calculator at www.carbonfootprint.com/calculator.aspx

Modelling Sustainable Research Practices

One of the KIAS goals for initiating the AtW series was to model sustainable research practices. Table 6 shows that the carbon dioxide equivalent (CO2e) that the AtW conferences avoided was between 211 and 399 metric tons of CO2e. This chapter will not enter into the debate about whether or not the radiative forcing of high-altitude flights should be factored into CO2e estimates.[35] The average of the two CO2e estimates for the AtW econferences is over 300 metric tons, which is more than sufficient to demonstrate the impact made. According to the United States Environmental Protection Agency website, 300 metric tons of CO2e is equivalent to the annual energy use of 32.4 homes, or

35 See, for example: Borgar Aamaas and Glen Peters, 'The climate impact of Norwegians' travel behavior', *Travel Behaviour and Society*, 6 (2017), 10–18, https://doi.org/10.1016/j.tbs.2016.04.001; Duncan Clark, 'The surprisingly complex truth about planes and climate change', *The Guardian* (September 9, 2010), https://www.theguardian.com/environment/blog/2010/sep/09/carbon-emissions-planes-shipping; Piers Forster, Keith Shine and Nicola Stuber, 'It is premature to include non-co2 effects of aviation in emission trading schemes', *Atmospheric Environment*, 40.6 (2006), 1117–1121, https://doi.org/10.1016/j.atmosenv.2005.11.005; A. Gettelman and C. Chen, 'The climate impact of aviation aerosols', *Geophysical Research Letters*, 40.11 (2013), 2785–2789, https://doi.org/10.1002/grl.50520.

64.2 passenger vehicles driven for one year.[36] In other words, the carbon footprint avoided by the AtW econference model was equivalent to nearly one-quarter of AtW all presenters not driving their passenger cars for a year.

Between 2014 and 2018, the AtW series served as a model for several important UAlberta initiatives. Olenka Bilash, from the Faculty of Education, engaged the growing econferencing expertise of ARC staff to host the Contemporary Ukraine Research Forum (CURF) in 2014. Initially hesitant, Bilash was impressed by the number of participants and viewers that CURF garnered and went on to use the econference model for the Research Initiative on Democratic Reforms in Ukraine (RIDRU) conferences in 2015 and 2016.[37] Elizabeth Turner, from the Faculty of Arts, and Ivan Fair, Faculty of Engineering, are two of the lead organizers of Mysterious Barricades, an across-Canada concert to raise awareness for suicide prevention. Turner and Fair modelled Mysterious Barricades on the AtW econference concept, conducting a site visit during the 2016 AtW. They used the hybrid model of having musicians play to live audiences in each city and livestreaming the presentations to online audiences.[38] Fair suggested that the Mysterious Barricades project would not have been possible without the capacity-building work that KIAS had done over the previous years at UAlberta.[39]

Perhaps the clearest success of modelling sustainability is the econference toolkit,[40] which KIAS co-produced with the Office of Sustainability in the spring of 2018.[41] The primary audiences for this document are tenured academics and conference organizers who

36 United States Environmental Protection Agency, 'Greenhouse gas equivalencies calculator' (December 2018), https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

37 Olenka Bilash, Conversation with Oliver Rossier (2018).

38 Lianne Faulder, 'Mysterious barricades: Edmonton-based national concert raises awareness of suicide', *Edmonton Journal* (September 8, 2016), http://edmontonjournal.com/entertainment/music/mysterious-barricades-edmonton-based-national-concert-raises-awareness-of-suicide.

39 Ivan Fair, Conversation with Oliver Rossier (2016).

40 Available at http://aroundtheworld.ualberta.ca/wp-content/uploads/2018/05/E-Conferencing-Toolkit.pdf.

41 Trevor Chow-Fraser, Oliver Rossier and Chelsea Miya, *Moving Ideas without Moving People: How to Econference at the University of Alberta* (2018), https://aroundtheworld.ualberta.ca/wp-content/uploads/2018/05/E-Conferencing-Toolkit.pdf.

can immediately influence change. There was some urgency to this initiative given that UAlberta had set a goal of reducing the university's greenhouse gas emissions to 17% below 2005 levels by 2020.[42] The hope is that the toolkit will continue to encourage researchers at UAlberta to purpose more sustainable, online versions of traditional conferences.[43] In fact, another one of the outcomes of the AtW series was the creation of a Kule Institute-funded econference grant, which gives colleagues the opportunity to run econference events of their own.[44]

Challenges and Lessons Learned

There were many lessons learned over the course of planning and organizing the AtW series, and the next section summarizes our key takeaways.

Technical Support/Training. A number of the obstacles addressed in AtW 2013 and in the subsequent years required experienced technical personnel to navigate. The availability of freely available video conference platforms like Skype and Google Hangouts, and recent livestreaming options like YouTube Live and Facebook Live, might make it seem like econferences should be easy to set up and organize. However, just as we engage architects to design the safe and secure flow of people in physical spaces, we need to involve experts to design secure and stable online conversation spaces. For example, in 2013 we had a research team who did not realize that their presentation had started streaming as there was a fairly significant delay between when the video stream was processed and then re-streamed out. They had turned down the volume on the communications channel from our technician. Without an audio connection, the only way we could communicate with them was through the video feed. One of our team wrote: 'You are now live!' in large font and held the message up to the video camera so they could see it. The researchers quickly realized that

42 University of Alberta, *Sustainability Plan 2016–2020: Building a Sustainable Future* (2016), https://cloudfront.ualberta.ca/-/media/sustainability/1-about/sustainability-plan/sustainabilityplan20162020201703l7singlesoptimized.pdf.

43 Chow-Fraser, Rossier and Miya (2018).

44 University of Alberta, 'Kule econferencing grant call for proposals', *Kule Institute for Advanced Study* (2019), https://www.ualberta.ca/kule-institute/funding/kule-econferencing-grant.

they were streaming and began their presentation. Afterwards, the AtW technicians were able to edit the final version of the presentation to remove the awkward initial portion of the presentation. In future iterations of the conference, we created 'cheat sheets' or technical guides for our participants to consult.[45] Scheduling 'test runs' with speakers prior to the event, so that they could familiarize themselves with the software and we could have an opportunity to identify and debug any issues, also proved essential. Other econferences, like the Nearly Carbon Neutral Conference and Library 2.0, opt for online training, using instructional videos and livechats to teach participants how to do things like: record and upload presentations, use software, and join live sessions.[46]

Scheduling. Hosting synchronous online conferences can be difficult, particularly when engaging a global set of researchers, and Hiltner makes a strong case for moving to asynchronous online conferencing. During the AtW series, the challenges of having presenters from a wide range of time zones was addressed in several ways. We set up a Google Sheet to manage scheduling (see Appendix 4). Key information included: local time in Edmonton, presentation format (live or pre-recorded), local time for presenters, name of the institution, contact information (access to a cell phone number was vital), and any special notes about the research team. Early in the 2013 planning we had indications that teams from the University of Western Sydney, Trinity College Dublin, and the University of Tokyo were interested in participating. We immediately locked down the best potential time periods that would be convenient for them, even though that meant that our own workday might be very stretched. Indeed, the 2013 conference ran for seventeen straight hours and was physically challenging for the AtW organizers and technicians to conduct. All subsequent conferences were scheduled to be twelve hours or less.

Another key finding for conducting econferences is the importance of having short pre-recorded sessions ('pre-records') readily available. If the presenter does not have access to a reliable internet connection,

45 See Appendix 5.

46 'Tips for speakers for recording your talk', *Climate Change: Views from the Humanities*, http://ehc.english.ucsb.edu/?page_id=12523; 'Training', *Library 2.0*, https://www.library20.com/page/training.

it is better not to risk a livestream and instead request a video file in advance. The pre-record option can also be used to accommodate scheduling issues and even as a backup to be re-aired in case of technical difficulties.

Stimulating Online Dialogue. One of the most important aspects of participating in conferences is social networking. However, as organizers, we found it challenging to maintain a sense of shared presence and conversation online. Indeed, while many of the participating researchers and organizers had Twitter handles, a significant number were not very active on the platform. Very few specific questions delivered via Twitter were content-related and interactive. Most tweets were instead focused on building an audience, summarizing key presentation quotes, or congratulating the presenter.

Drawing on Eisenstein's observations of the persistence of the past, it should be apparent that academics who have become accustomed to the f2f interaction of traditional conferences will not simply and suddenly transition to econferences with social media.[47] How then to generate online dialogue? One model we briefly tried in 2016 was to have prepared papers and designated respondents, an approach also used by the Minds Online philosophy conference.[48] Designating responders ensures an audience, which is important in econferencing; there is no risk of talking into the void. However, this approach might discourage unexpected connections between participants. The conversation could risk becoming forced and insular, with commentary dominated by the assigned reader(s).

In 2018, KIAS also tried using comments on the conference website, along the lines of NCN and Minds Online, to create more flexible communicative opportunities. The level of engagement appeared to slightly improve. However, in our case, the commentary was now spread out over multiple platforms (the website, YouTube, Twitter). A better approach might be to stick to a single platform, in order to streamline the conversation as much as possible, and to find creative ways to engage participants with using the platform early on in the conference process.

47 Elizabeth Eisenstein, 'The end of the book?: Some perspectives on media change', *The American Scholar*, 64.4 (1995), 541–555.

48 See Chapter 17 for more on Minds Online.

Participation Data. Another lesson learned is the value of developing a plan for evaluating econference participation. Though the improvement of video conferencing technology has aided the mainstream appeal, the academic community has been hesitant to recognize the value of the econference medium for nurturing scholarly discourse. Reliable data helps make the case that organizing econferences is indeed serious academic work, which can, in turn, be used to secure institutional funding and other supports.

However, online events can take place across multiple platforms, each of which have their own processes and protocols for data capture and analysis, which makes gathering and aggregating user/viewer data a challenge. For instance, the ClearSea/LifeSize platform, which was used for the livestream, only retains data during the actual transmission. As a result, any interruptions in internet connections will result in data loss. Similarly, YouTube analytics can be easily lost if any of the video's core identifying information is changed, which can happen when retitling a video or splitting a long video into shorter segments. In other cases, the application itself can become obsolete. Storify appeared to be a useful system for archiving Tweets. However, the application was shut down in 2018, five years into the AtW series, and all of the 'stories' collected from these past events had to be promptly saved or they would have been deleted. Streamlining the event to focus on a single platform can simplify the information gathering process, in addition to streamlining (and energizing) the dialogue, so that participants gather in a single space for discussion.

The importance of the data also plays a role in the project management strategy. The AtW technical team was, naturally, much more focused on maintaining the flow of communication than preserving viewing data. To make matters more complicated, our technicians were able to negotiate our use of a livestreaming software subscription through other parts of the campus at a reduced rate. While this reduced costs, it created a situation where KIAS was dependent on an external group for data and in the end, there was data loss due to communication issues with partners and lack of understanding of YouTube analytics protocols.

The process of experimenting with technology will inevitably lead to some data loss. However, this can be mitigated by developing a concrete and robust strategy and system for capturing participation metrics. This

may involve alternative means of evaluating conference engagement, such as post-conference surveys to reach out directly to participants.

Hybrid Model. Econferencing need not, and almost certainly will not, replace f2f conferencing.[49] However, hybrid modes of presentations and online discourse can augment f2f conferencing and give important alternatives to flying all participants and presenters to a single location for a synchronous meeting. Hybrid models include having local or regional f2f meetings connected by econference. In the case of the AtW series, several research teams hosted local events at their institutions as part of the larger, multi-institutional and multinational conference dialogue. Hybrid events create opportunities for both the interaction of f2f presence and the sustainability benefits of hosting the extended dialogue online. We need to try more variations of hybrid formats.

Avoid remediating the traditional conference. It is tempting when designing an econference to remediate the f2f conference, but there is no reason to stick to the continuous, intensive two to five-day conference model. For AtW 2018, we split the conference into two-hour sessions, which ran over five days. Similarly, other conferences like the Minds Online series are spread out over a week or more. One can also have local events that tie into the larger conference. As mentioned in 'An Intro to Econferences,' the online format also offers the opportunity to think outside of the traditional hotel venue and experiment with various digital platforms, from social media platforms like YouTube to game-based virtual environments, which can in turn attract new audiences and create new possibilities for interaction and dialogue..

Sustainability: Plates vs Planes. Ironically, KIAS was in jeopardy of not receiving a campus sustainability recognition certificate for the AtW 2017 conference based on the use of an ineligible type of paper plate. To put this in perspective, the estimated CO2 output from each paper plate used in 2017 was 3.8 g.[50] The total estimated CO2 emissions avoided by not flying presenters to Edmonton that year was 44.17 metric tons. In other words, AtW 2017 was saving the CO2 emissions equivalent to over 11.6 million paper plates, but the sustainability program used a

49 Storme, et al. (2017).

50 Winnie Chan and Kevin To, 'A life-cycle and economic analysis: Paper versus ceramic plates in the barn restaurant' (UBC Social Ecological Economic Development Studies (SEEDS) Student Reports, 2006), https://doi.org/10.14288/1.0108084.

methodology which did not recognize the environmental benefits of econferencing. The carbon cost of conference travel is less visible than other forms of waste on campus, which is perhaps why it has, until recently, been easy for the academic community to ignore. Shifting our flying habits requires a shift in mindset. Fortunately, communication efforts allowed KIAS not only to help bridge this knowledge gap at UAlberta, but also set the stage for broader collaborations with the Office of Sustainability.

Building Econferencing Infrastructure. Though there have been significant strides in the efforts to focus attention on the climate impacts of conference travel, there is much more that can be done, both on an institutional and individual level. In terms of immediate action, academics can advocate for econference and hybrid options inside their home departments and institutions, as well as when they are invited to give research talks at remote locations. Conference organizers can likewise add digital participation to the set of options available to presenters and participants; and major conferences, like the Congress of the Humanities and Social Sciences, can and should take the lead in creating incentives for econference capacity-building.[51] When it comes to granting, national funding agencies like SSHRC should include online hosting as an alternative to f2f conferencing. Finally, department heads must make it clear that econferences are legitimate forms of scholarly research dissemination and 'count' just as much as traditional conferences when it comes to hiring and promotion, and issue statements to that effect.

Conclusion

The AtW case study demonstrates that econferencing can be an effective communicative tool for knowledge dissemination and academic discourse. One of the greatest challenges we face as a society is climate change.[52] Academics are uniquely situated to model behaviour that will

51 Federation for the Humanities and Social Sciences, *Congress of the Humanities and Social Sciences 2019* (2019), https://www.congress2019.ca/.

52 United Nations, 'Climate change: A global issue', *Research Guides* (2019), https://research.un.org/en/climate-change/introduction; Gwynne Dyer, *Climate Wars: the Fight for Survival as the World Overheats* (Oxford: Oneworld Publications, 2010); Barack Obama, 'Barack Obama on food and climate change: "We can still act and

help mitigate the amount of air travel, and concurrent CO2e emissions, associated with research conferences.[53] Given the importance of reducing C02e emissions generally and the unsustainable impact of academic flying in particular, demonstrating viable sustainable research alternatives is vital. We simply cannot continue as before and must confront our unsustainable practices. The AtW econference series contributes to a growing body of practice that uses technology to mobilize global academic discourse without relying so heavily on face-to-face meetings, and we have an indisputable climate imperative to do so.

Afterword

The need for academics to have econferencing options became very apparent during the coronavirus pandemic travel disruptions of 2020. Conferences either moved online or were cancelled. Significantly, a national survey of post-secondary instructors and staff in Canada, which was conducted in wake of the COVID-19 outbreak, found that two-thirds of the respondents were doing less research, or none at all, and the primary reason given was that they were not able to attend or host conferences.[54] Clearly, there are many opportunities for academics and conference organizers to explore using econferences in order to regain research momentum, and we hope this case study provides a useful model in this regard.

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53 Glover, Strengers and Lewis (2017); Hiltner (n.d.); Holden, Butt, Plein, Stringer and Chadès (2017), Academic conferences urgently need environmental policies. *Nature ecology & evolution*, 1(9), 1211–1212; Nevins, Joseph, 'Academic jet-setting in a time of climate destabilization: ecological privilege and professional geographic travel', *The Professional Geographer*, 66.2 (2014), 298–310.

54 Canadian Association of University Teachers, 'What impact is the pandemic having on post-secondary teachers and staff?' (August 2020), https://www.caut.ca/sites/default/files/covid_release-impacts_of_pandemic-en-final-08-19-20.pdf.

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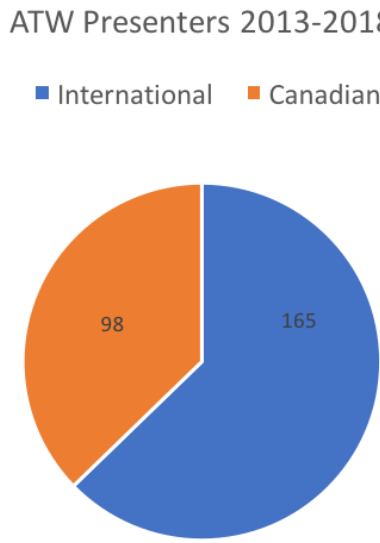
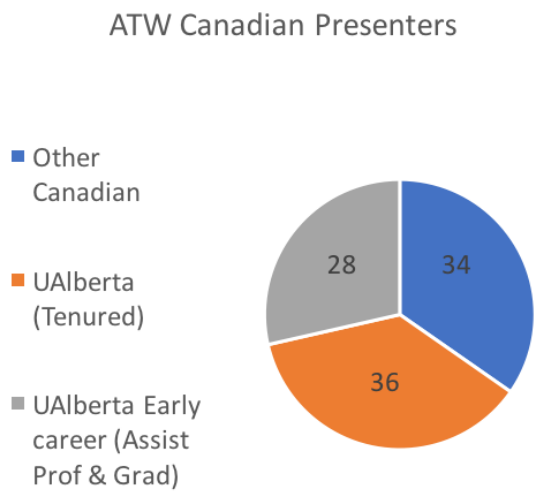
Appendix 1: Charts of Overall AtW Presenters





Appendix 2: Call for Expressions of Interest in 2013

The Kule Institute for Advanced Study (KIAS) at the University of Alberta would like to invite your research team to participate in an international Around the World Symposium on Technology and Culture.

At this stage we're looking for expressions of interest from key institutes around the world. The idea is that among us we would organize a symposium that travels around the world, with each institute being responsible for approximately 1 to 2 hours of internet conferenced talks on a common theme. Imagine a 24-hour conference that winds its way around the world bringing together institutes with recognized strengths in the area of culture and technology!

The specific theme and date would be something that we, the participating centres and institutes, would decide. KIAS has funding to support the project management and promotion, as well as the conferencing technology, recording the talks and archiving the conference.

Right now all your institute will have to do is commit to is the local organization of a tightly curated 1–2 hour panel, made up of faculty, fellows, researchers or graduate students working on projects related to the theme we decide on.

Are you interested? If so, please send me (and CC the coordinators) an email and we will send you more details. We hope you will join us in this research symposium experiment.

Yours,

Geoffrey Rockwell

Interim Director of the Kule Institute for Advanced Study

University of Alberta

Coordinators:

Justine Gill

Oliver Rossier

Appendix 3: AtW 2013 General Invitation and Schedule

The Around the World Symposium on Technology and Culture is an innovative forum that will bring together scholars from around the world to talk about digital culture! The entire Symposium will be livestreamed worldwide and archived after the event.

The theme is Digital Culture. This event will be livestreamed on May 30th, 2013.

Hosted by the Kule Institute for Advanced Study, with partner institutions from around the world, the Symposium presents live panels or pre-recorded content over a 24-hour period.

Imagine a full-day conference that winds its way around the world bringing together leading institutes in the digital humanities! Imagine a sustainable conference that is global in scope!

Visit this web site on May 30th or later and catch the talks and panels that interest you. Be a part of this exciting experiment!

Join us at any time during the Symposium. Comment through Twitter or by using this site! #UofAWorld

UAlberta reception and panel
May 30—11AM MST
3–26 Arts & Convocation Hall
Please join us in person, online, or both!
Program: http://aroundtheworld.ualberta.ca

The following represents a *tentative* schedule of events for MAY 30, 2013.

All events can be streamed on this site—Click the 'Stream Online' tab, above.

- 06:00 – 07:00 MST – USA, U.Virginia, Scholars' Lab their Neatline Tool
- 07:00 – 08:30 MST – Ireland, LongRoomHub
- 08:30 – 08:45 MST - Canada, UofAlberta: David Holmes
- 08:45 – 10:30 MST – Brazil, DH at Vitoria, Universidade Federal do Espírito Santo

- 10:30 – 10:40 MST – Canada, UofAlberta: Pipelines Project (Dr. Heather Zwicker, ErikaLuckert, Dr. Kisha Supernant); part of the KIAS family
- 10:40 – 11:00 MST – Canada, UofAlberta: Shannon Lucky
- 11:00 – 11:15 MST – Canada, UofAlberta: Dr. Natalia Kononenko
- 11:15 – 11: 30 MST – Canada, UofAlberta: Dr. Russell Cobb
- 11:30 – 11:50 MST – Canada, UofAlberta: Dr. Scott Smallwood
- 12:00 – 14:00 MST – Canada, UofAlberta: Dr. Geoffrey Rockwell, Dr. Maureen Engel, Dr. Julie Rak, Dr. Ofer Arazy
- 14:00 – 16:00 MST – USA, U.Virginia and the Innovation in Pedagogy Summit
- 16:00 – 17:30 MST – USA, IDHMC at Texas A&M: IDHMC, Dr. Laura Mandell
- 17:30 – 17:45 MST – Canada, UofAlberta: Dr. David Kahane
- 18:00 – 18:30 MST – Canada, York University and Institute for Research on Learning Technologies: Dr. MaryLeigh Morbey; Maureen Senoga; Dennis York
- 19:00 – 20:00 MST – Japan, University of Tokyo: Dr. A. Charles Muller (University of Tokyo); Dr. Toru Tomabechi (International Institute for Digital Humanities); Mr. Kiyonori Nagasaki (International Institute for Digital Humanities)
- 20:00 – 22:00 MST – Australia, DH at University of Western Sydney

Appendix 4: AtW 2017 Scheduling Notes

Edmonton Time	Length	Local time	Institution	Organizer	Contact Email, Phone	Panelists	Other contact info (ie: cell phone, IP or ClearSea)	Notes
7:30	5 min		UAlberta	Geoffrey Rockwell				
07:35 - 08:45	55 - 70 min?	LOCAL TIME IRELAND: 2:30 PM GMT	National University of Ireland Maynooth	Neale Rooney		Speakers: Gavan Titley, Jane Suiter, Andrea Martin, Peter McGuire, Chris Brunsdon Chairs: Neale Rooney, John Chambers, Susan Schreibman		**May need more grad, or other video
08:45 - 9:00	15 min	**Depends on Ireland						
09:00 - 10:00	60 min	LOCAL TIME MONTREAL: 11:00 EST	Université de Montréal	Michael Sinatra		Speakers: Marcello Vitali-Rosati, Servanne Monjour, Enrico Agostini		
10:00 - 10:45	45 min (vid. 50:48)	LOCAL TIME HAIFA: 7:00 PM	Haifa University (sending via FTP wed. night)	Ofer Arazy		Speakers: Oren Meyers, Roei Davidson, Noa Lavie		**Length of video is 50:48... May need to fade out after 45? (Full video will be on website)
11:00 - 11:45	45 min		UAlberta Panel 1	Julie Rak		Speakers: Sourayan Mookerjea, Carrie Smith-Prei, William Anselmi, Steve Patten, Donia Mounsef Chair: Julie Rak		
11:45 - 12:15	30 min (vid 19 min)	LOCAL TIME MALTA: 7:45 PM	University of Malta	Marc Kosciejew		Solo Presentation: Marc Kosciejew		**May need more grad, or other video
12:15 - 1:00	45 min		UAlberta Panel 2	Geoffrey Rockwell		Speakers: Tami Oliphant, Jennifer Chesney, Gerald Beasley Chair: Geoffrey Rockwell		
1:00 - 1:30	27 min	LOCAL TIME NEW YORK: 15:00	Fordham University	Shira Atkinson		Panelists: Shira Atkinson, Kindra Becker-Redd		
1:30-1:55	25 min	LOCAL TIME SAN FRANCISCO: 12:30 PDT	Internet Archive	Roger Macdonald		Q&A with Roger Macdonald Moderator: Geoff Harder		
1:55-2:05	10 min		Grads or Short talk					
2:05-3:00	55 min	LOCAL TIME TEXAS: 3:05PM CDT	Texas A & M	Laura Mandell		Speakers: Heidi Campbell, Sandra Braman, Laura Mandell		
3:00-3:30	30 min (vid. 28 min)	LOCAL TIME CALIFORNIA: 2:00 PM	UC Irvine	Peter Krapp		Speaker: Peter Krapp Moderator: Catherine Liu		
3:30-4:40	68 min	LOCAL TIME SYDNEY: 7AM	Western Sydney University	Rachel Hendery		Speakers: Hart Cohen, Jason Ensor Chair: Rachel Hendery		
4:40	5 min		UAlberta Closing Words	Geoffrey Rockwell				

Appendix 5: Technical Details for AtW

For Pre-Recorded Video Submissions

We would like to have the video in 16:9 format if possible, shot in landscape (not portrait) orientation. In order to ensure the high-quality video for web-streaming, we would prefer it to be in **720P resolution**. File format for the video is something we can be fairly accommodating on but preferences will be MP4 and then Apple Quicktime's .MOV or Microsoft's .WMV but we can also accept AVI or MPEG.

If you are shooting with a cell phone please attach it somehow to a stand or tripod so it is solidly anchored.

If you are using slides but are unable to edit the slides into the presentation, we have found the best way to overcome this issue is to stand in front of the projector screen (so that both you and the slides are visible). If you are using a presentation clicker or your computer to change slides, make sure the screen is not being blocked.

Tips for Uploading Large Video Files

We will send you a link to a GoogleDrive folder where you can upload your video. GoogleDrive supports free storage of video files up to 5TB. However, it can sometimes take awhile to upload large video files. Here are a few tips:

- **Upload from your university, not from home:** home networks often have fast download but very slow upload times.
- **Compress the video for web-streaming:** If the file is very large (eg. several GB), it is also helpful to compress it for web-streaming. This will help achieve a higher quality video with a much smaller size.
    - **Using Quicktime (for mac users):**
        - ◇ Open the video in Quicktime.
        - ◇ Choose File > Export > ipad, iphone, ipad touch & apple TV > and choose the **second option (up to 720p)** *It should list under each option how large the final compressed file will be.

*Click here for more detailed instructions.

- **Using Adobe Media Encoder (for mac or windows):**
  - Under System Presets scroll to Web Video and choose YouTube HD preset settings. For this conference, you would want to choose the **YouTube HD settings in 720p** HD format (not 1080p HD). Leave the other settings as is (with the YouTube HD settings the target and maximum bitrate are both automatically set to 16 which is what you want).

*Click here for more detailed instructions.

For Live Streamed Presentations

- **Option one: use a video conferencing room**
  - The best option is for you to find a video conferencing room at your institution and make arrangements to use it for the times you are 'On Air' with us here at the University of Alberta.
- **Option two: use a laptop/computer,** requirements:
  - Laptop/Computer
  - Preferred wired LAN connection
  - External Webcam and microphone (if possible)

Downloaded software app (https://call.lifesizecloud.com/download)

If it is not possible to use a video conference room, you can also stream from your laptop/computer by connecting to our conference using the Lifesize app (similar to Skype but with better quality video and audio that requires a higher standard of bandwidth). The Lifesize app also gives you the ability to screen powerpoint presentations and maintain a live video of you doing the presentation at the same time. ******You will need to practice this so we set aside time to do test calls with all participants.*****

If you are using your own computer, we would prefer that you **use an external webcam** with a good quality microphone (e.g. a Logitech C930). The reason we ask for this is that the camera and mic on your laptop

are basic equipment offerings and are really not meant for a broadcast situation. In order to ensure better quality streaming (with less chance of accidentally dropping the call), we also ask that you **connect your laptop directly to your internet modem** using an LAN cable (see here for instructions). If possible, it is also best to **do your presentation from your institution** rather than from home. Home networks are typically not capable of uploading enough bandwidth to do video conference properly (that is why Skype calls need to be reconnected often), so if you can do the presentation from your institution you will be attached to a much higher bandwidth network.

******If you are using tech support, it might be easier to have our tech team to coordinate with yours directly. Send us your tech member's contact info and/or contact us with any questions******

Appendix 6: AtW 2017 Invitation to Research Institutes

Dear (**XXXXX**),

The Kule Institute for Advanced Study at the University of Alberta is again organizing a livestreamed world-wide conference, this year on the topic of **Digital Media in a Post-Truth Era**. The Around the World Conference is an annual event sponsored by KIAS that brings together research institutes and researchers from around the world for a dialogue without the environmental and other costs of traditional conferences. The full-day internet event will be held on **Thursday, May 4, 2017**.

I am pleased to invite you and your colleagues at **XXXXX** to participate in this year's Around the World Conference. Would you be interested in getting involved in this event by organizing a panel of speakers on this subject?

Why the theme of 'Digital Media in a Post-Truth Era?'

The unfolding of recent political events in the United States has sparked much debate around 'fake news', disinformation and trustworthiness on the web. We hope to use these developments as a starting point for a broader discussion of how digital media has challenged and/or unsettled our notion of truth. The conference theme of 'post-truth' is loosely-defined and we welcome considerations of this topic from a wide range of perspectives: from the algorithmic to the philosophical. We welcome, as well, discussion of 'post-truth' as a notion reflecting a certain insularity and how questions of the 'truthiness' and the web resonate differently across the world.

On the day of the event, participants will be asked to give a short presentation, either streamed live or a pre-recorded video clip. The presentation will be followed by a live discussion with fellow panelists.

The Around the World Conference organizers pride ourselves in making sustainable and inclusive practices part of our core mandate. For this reason, we would especially like to reach out to members of institutions for whom international travel can be a barrier. We are also happy to accommodate presentations from non-English speakers.

We ask each participant in the conference to:

- email interest to the project manager, Chelsea Miya, by Friday, February 24;

- submit a brief abstract and biography as well as a photograph by Friday, March 31;
- help to publicize the event at your home institution and participate on the day.

KIAS will:

- support all the technological requirements in association with your tech support contact;
- create the schedule and event infrastructure, including the pre-recorded talks;
- advertise online and locally;
- digitally archive the event and host the talks for future use.

If you would like to take part in the Around the World Conference on Digital Media in a Post-Truth Era, contact the Around the World project manager Chelsea Miya by Friday, February 24.

We hope you will join us in this research symposium and look forward to hearing from you soon.

Yours,

Geoffrey Rockwell
Director, KIAS

Appendix 7: eConferencing Presentation Guides[55]

Choose a format–or invent your own!

Both live presentations and pre-taped videos can be used with any of the following delivery modes.

1. **Traditional conference**: a live audience interacts in-person with presenters.
2. **Livestream**: a single camera captures a presentation and broadcasts to the world. There may be a live audience interacting with presenters.
3. **Video conference**: interaction is between two or more locations connected over video stream.
4. **Hybrids**: may combine aspects of all three of the options above. Hybrids can be very technically complex and require careful planning.

Comparing livestreaming and video conferencing:

Livestreaming includes YouTube Live, Facebook Live, Vimeo Live, IBM Ustream and Livestream. These services broadcast a one-way video feed to a worldwide online audience. There is no limit to the number or geographic location of this audience. Unlike video conferencing, interaction is possible using messaging or comments on the livestream, but not by two-way voice or video.

Because the video stream isn't interactive, livestreaming can incorporate a slight delay and provide higher quality video. Most of these services will also provide low bandwidth versions so that viewers can tune in on a tablet or smartphone. After broadcasting, most services save your video and you can choose to keep it private or to publish it for later viewers to watch.

Video conferencing includes Skype, Google Hangouts, LifeSize, Zoom and BlueJeans. Video conferencing enables conversation between two or more screens, including meeting spaces and individual computers. Live, real-time interaction between presenters and participants is possible. The maximum number of participants varies. Free services

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can reliably handle 2–4 participants, but may have trouble if they are on different continents. Paid services can handle 10–25 participants or more without trouble.

Since video conferencing is interactive, it is typically more technically advanced than livestreaming. Dedicated video conferencing facilities using subscription services can help mitigate the technical challenge. These facilities tend to have more dependable connections and their picture quality can be close to HD, which is important if the feed is being projected onto a large screen (for an auditorium audience, for instance).

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About the Team

Alessandra Tosi was the managing editor for this book.

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Anna Gatti designed the cover. The cover was produced in InDesign using the Fontin font.

Luca Baffa typeset the book in InDesign and produced the paperback and hardback editions. The text font is Tex Gyre Pagella; the heading font is Californian FB. Luca produced the EPUB, MOBI, PDF, HTML, and XML editions—the conversion is performed with open source software freely available on our GitHub page (https://github.com/OpenBookPublishers).

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This book and additional content is available at:

https://doi.org/10.11647/OBP.0213

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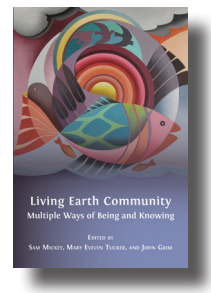

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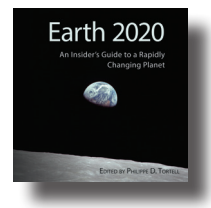

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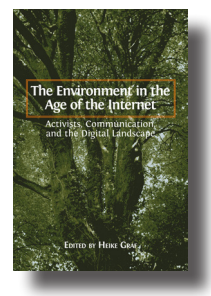

Right Research: Modelling Sustainable Research Practices in the Anthropocene

Edited by Chelsea Miya, Oliver Rossier, and Geoffrey Rockwell

Educational institutions play an instrumental role in social and political change, and are responsible for the environmental and social ethics of their institutional practices. The essays in this volume critically examine scholarly research practices in the age of the Anthropocene, and ask what accountability educators and researchers have in 'righting' their relationship to the environment. The volume further calls attention to the geographical, financial, legal and political barriers that might limit scholarly dialogue by excluding researchers from participating in traditional modes of scholarly conversation.

As such, *Right Research* is a bold invitation to the academic community to rigorous self-reflection on what their research looks like, how it is conducted, and how it might be developed so as to increase accessibility and sustainability, and decrease carbon footprint. The volume follows a three-part structure that bridges conceptual and practical concerns: the first section challenges our assumptions about how sustainability is defined, measured and practiced; the second section showcases artist-researchers whose work engages with the impact of humans on our environment; while the third section investigates how academic spaces can model eco-conscious behaviour.

This timely volume responds to an increased demand for environmentally sustainable research, and is outstanding not only in its interdisciplinarity, but its embrace of non-traditional formats, spanning academic articles, creative acts, personal reflections and dialogues. *Right Research* will be a valuable resource for educators and researchers interested in developing and hybridizing their scholarly communication formats in the face of the current climate crisis.

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