Debating Higher Education: Philosophical Perspectives 4

Robyn Barnacle
Denise Cuthbert *Editors*

The PhD at the End of the World

Provocations for the doctorate and a future contested

Springer

Debating Higher Education: Philosophical Perspectives

Volume 4

Debating Higher Education: Philosophical Perspectives is a new book series launched by Springer and is motivated by two considerations.

Higher education has become a huge matter globally, both politically and socially, commanding massive resources, national and cross-national decision-making, and the hopes of many. In parallel, over the last four decades or so, there has been a growing interest in the academic literature in grappling with technical issues in and around higher education. In particular, work has developed drawing on philosophical perspectives and social theory. This is evident right across the world, especially in the journal literature and in research students' doctoral theses. In effect, we have witnessed the formation of a new sub-discipline, a shorthand of which is 'the philosophy of higher education', and which includes perspectives drawn not only from philosophy and social theory but also feminism, ethics, geopolitics, learning theory, and organizational studies.

Through this book series – the first of its kind – the editors want to encourage the further development of this literature. We are keen to promote lively volumes which are informed about changing practices and policy frameworks in higher education and which engage seriously and deeply with matters of public interest, and are written in an accessible style.

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The editors are keen that the series is open to many approaches. We wish to include work that focuses directly on the university as a social institution and on higher education as an educational process; on the idea of the university and on higher education as a sector with political and policy frameworks; on students and learning, and on academics and academic knowledge; and on curricula and pedagogy, and on research and knowledge processes.

Volumes will examine policy and practical issues including, for example, internationalisation, higher education as a set of 'public goods', access and fairness, and the digital era and learning as well as more conceptual and theoretical issues such as academic freedom, ethics, wellbeing, and the philosophy of social organizations.

The editors very much welcome informal inquiries at any time.

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The PhD at the End of the World

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To all the children of the world and our own children in particular:
James and Max
Daniel, William, Louis, and Claudia

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Lynn McAlpine is Professor Emerita at both the University of Oxford, UK, and McGill University, Canada. At this point in her career, it is her research on doctoral students and post-PhD researchers' careers for which she is internationally recognized. Her work conducted in Canada, the UK, and Europe examines how PhDs and graduates navigate their life and career trajectories both in and outside the academy. The results of her research have important professional development implications – which leads to frequent international invitations to do workshops and keynotes that explore these implications for PhDs, post-PhD academic researchers, PhD supervisors, as well as university administrators.

Mahsa Mesgar is a PhD researcher at Monash University and an urban planner, with a track record working on upgrading projects in the Middle East and Indonesia. Her research explores spatial and land tenure complexities of infrastructure retrofit in sanitation-deprived areas and aims to offer a practical methodology for location decision-making and upscaling.

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Erich Wolff is a researcher and educator with a civil engineering and architecture background. His research includes investigations on infrastructure planning, risk analysis, and landscapes. His work on "citizen science" explores floods and community-based ways of understanding water, particularly in data-poor contexts vulnerable to the impacts of climate change.

Chapter 1
The PhD at the End of the World: Provocations for the Doctorate and a Future Contested –Introduction

Robyn Barnacle and Denise Cuthbert

> When the rug is pulled out from under your feet, you understand at once that you are going to have to be concerned with the floor. (Latour 2018: 8)

We live in a world in which post-truth rhetoric and challenges to the role of higher education institutions as arbiters of knowledge are commonplace. When faced with sustained attacks on the authority of evidence-based knowledge, unease is widespread. As Latour's haptic analogy so vividly suggests, there's nothing like a crisis to focus the mind on what really matters. In this case, Latour argues, it is a matter that matters more than ever: Earth. No less at stake in the Anthropocene is the survival of life on earth. Turning our gaze to the floor means inquiring into the fundamentals: the viability of life on earth when the impacts of one species (ours) are on a planetary scale.

This book was conceived in 2019, in the context of increasing alarm over the impending climate crisis. Unbeknown to us at the time, the writing of the book would coincide with the confluence of *two* global crises: that of the climate, and associated mass extinctions, and the COVID-19 pandemic. In the intervening year much has changed. By the end of 2020, the title of the book, conceived provocatively in mid-2019, has become disturbingly prescient. While the COVID-19 pandemic is and remains horrific in it's personal, social and economic consequences world-wide, at first there was concern that its immediacy might detract attention from the ongoing climate crisis. While this remains a valid concern, it has subsequently emerged that the two are related. Humans intrude deeper into hitherto wild ecosystems. Wild animals are hunted and grouped together in live-meat markets, providing ideal conditions for the interspecies transmission of zoonotic diseases.

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The COVID-19 pandemic appears to be yet another consequence of environmental destruction, in this case, the endless human encroachment into already scarce natural habitats—aided and abetted by mass, rapid global travel. On a positive note, however, the COVID-19 pandemic of 2020 has also revealed that global cooperation is possible at an unprecedented scale. The challenge? How to harness global cooperation towards lasting change with environmental and health benefits for all.

'What has all this got to do with the PhD?' you might ask. This volume examines the role of the PhD, in and of itself, and, as representative of research, the university and evidence-based knowledge, in relation to this crisis or these series of crises. The assembled essays, or provocations, address the future of the PhD and how this advanced research degree may respond to, and hopefully contribute to averting or ameliorating, the predicted environmental catastrophe. Both in terms of environmental degradation, destruction and decline, but also in no small part through the COVID-19 pandemic. Indeed, the latter demonstrates the dramatic human health impacts. The world's environment and climate are now so altered and degraded by human activity that fears for the continued existence of humans and human society are now being articulated by experts in many fields. We have a collective responsibility to ensure PhD programs, the most advanced university award, respond, and to find ways to harness the collective efforts of our best and brightest inquiring minds to address these existential challenges.

Calls to re-think and re-direct PhD programs are not new. Numerous stakeholders have declared that a crisis besets the PhD (Barnacle et al. 2018; Cuthbert and Molla 2014). We see this crisis 'talk', especially in advanced higher education systems, in claims that too many PhD graduates are being produced, that they cannot find the jobs they want, and are over-qualified for many of the jobs they get. Further, PhD graduates are said to have specialisations which are too narrow and lack the kinds of transferable and enterprise skills for which the global labour market is hungry. Proponents of this crisis discourse call for urgent and thorough-going reform of the PhD to make it more serviceable to the needs of the transforming world economy (Cunningham et al. 2016; Golde and Walker 2006; McAlpine and Amundsen 2016).

In response to this prevalent PhD crisis discourse and by way of challenging it, this book addresses another, far graver crisis: that of the environment. We flip the questions currently preoccupying discussions of the PhD, by turning from a focus on a supposed crisis in doctoral education to a crisis in the state of the world. The core question is this: how can the PhD serve the planet, and what is the role of the PhD in addressing the material and existential perils currently facing the human and natural world. Given the current context, arguably researchers have a heightened ethical responsibility to consider the role of research and researchers generally and research education in particular. How should those who train the next generation of researchers respond to these issues and what forms should training in doctoral programs take?

The key philosophical inspiration for this book is the work of Bruno Latour. Particularly his insight that the climate crisis is not only an environmental crisis, for which there is ample physical evidence, but that it is also an epistemological one.

Latour articulates the connection between these crises in his lecture 'Is Geo-logy the new umbrella for all the sciences? Hints for a neo-Humboldtian university' delivered at Cornell University, on 25 October 2016. He has kindly reproduced this essay here, and it was circulated to authors as part of the pre-reading for this volume. In this chapter and elsewhere (Latour 2018; Latour, this volume, Chap. 2), Latour articulates the connection between the environmental crisis and the epistemological crisis which it has engendered and which in turn is complicating and compromising our capacity to respond to the former. As Latour observes, the dire state of the environment is compounded and complicated by the highly contested politics of climate change. Ample evidence exists for this in the deep and disabling divisions in the apprehension of the climate and the state of the world's environment that now dominate world politics. Our current peril, therefore, is twofold: the state of the environment as signalled by climate change and its denial by powerful interests and entities—chiefly illustrated by, in Latour's account, Donald Trump in the United States. Trumpism and populism more broadly, however, are neither confined to this single presidency nor region.

Latour highlights, therefore, the interconnectedness of multiple crises: health, environmental, political and of understanding and education. Education is implicated in this situation in several complex ways and it is incumbent on those of us engaged in education and research to respond. This volume examines the challenges that climate change and Latour's wider analytical category of the new politics of climate, with its epistemological dimension and political implications, present specifically for the PhD, and for universities charged with training the next generation of researchers. What do the climate / extinction crisis and its associated politics mean for conceptions of the role and purpose of the PhD?

To examine these issues, we have assembled a highly disciplinary and geographically diverse group of leading research educators and scholars. We were delighted the vast majority of those we approached enthusiastically accepted our invitation to contribute. Despite fears the COVID-19 pandemic might undermine progress on the volume, for many its emergence galvanised their interest and, for some, deepened their engagement with the issues and Latour's work. In addition to preeminent, internationally recognised philosopher Bruno Latour, the volume includes leading doctoral education scholars Lynn McAlpineand Susan Porter (Past President of the Canadian Association for Graduate Studies), and leading international higher education scholars, such as Ronald Barnett and Paul Gibbs. Contributors span a broad range of disciplinary backgrounds, including the technological and natural sciences, architecture and design, the creative arts and humanities; and regions, comprising Australia, North America, Europe, the United Kingdom and South Africa. In summary, the collection assembles a range of disciplinary, geographical, theoretical and philosophical perspectives under the single, unifying theme of the role of the PhD in averting the end of the world. In terms of scope, the focus of this volume is the PhD and research doctorates broadly. While noting the considerable regional and disciplinary variations, our considerations address what is common to research doctorates, that is the predominance of research and the discovery of new knowledge.

Some authors also extend their consideration to professional doctorates and the post-doctoral period to address these broader considerations as they relate to the PhD.

The book is arranged according to the concept of the earth and its preservation. Following this introduction, Chap. 2 begins with Latour's reproduced Cornell lecture. As discussed earlier, this explores how we might position ourselves to live in the strange space of an earth made perilously new by our (destructive) actions. In searching for an adequate descriptor, Latour proposes the notion of the 'critical zone' to frame his discussion of how might learn to see the world in the new way necessary for survival. Latour's considerations of what this means for universities are developed through three 'hints' at a post-Humboldtian vision. By way of summary, these encompass university outreach, new communication literacies and new disciplinary formations.

The first section of the book, 'Down to Earth—the PhD Lived-Experience', digs down into the actual experience of doing a PhD in the context of complex intersectoral, inter-disciplinary, and international projects, drawing out the lessons, insights and models potentially transferable to others. In Chap. 3, 'STEM PhD Student Preparation in the Eras of Cross-sector Convergence and Global Climate Crisis: An Autobiographical Exploration', recent PhD graduate Bryan G. Moravec and his advisor/supervisor, Matthew M. Mars, discuss the influence of cross-sector convergence on the preparation and socialization of STEM PhDs. Based on an autobiographical, lived -experience, approach, they reflect on how cross-sector convergence is influencing the academic training and professional intentions of PhD students with career trajectories that intersect the global climate crisis. This is followed, in Chap. 4, by an in-depth analysis of what it looks like to train action-oriented PhD scholars, steeped strategically in a highly complex, international, transdisciplinary and inter-sectoral, research context. 'Operationalising Research: Embedded PhDs in Transdisciplinary, Action Research Projects', led by Diego Ramirez-Lovering and Michaela F. Prescott, chronicles the trials of a group of four PhD candidates, also co-authors: Brendan Josey, Mahsa Mesgar, Daša Spasojevic and Erich Wolff. All are embedded in a health study revitalizing 24 informal settlement communities in the Asia-Pacific. Their reflections provide insight into how impact-oriented PhD programs can operate in such contexts to deliver social, environmental as well as academic outcomes.

Section two, 'Earthing the PhD Curriculum', pulls-out from a focus on the candidate experience to examine program level considerations, including how the redesign of PhD programs can address the climate crisis and the role of curriculum and other factors in re-shaping the PhD candidate experience. Susan Porter does this in Chap. 5, 'Postformal Learning for Postnormal Times', by examining the University of British Columbia's innovative PhD program, the Public Scholars Initiative. This work challenges the over-reliance on 'normal' ways of thinking, being, and working within PhD programs and argues that graduates need to know in different ways and be effective change agents in a diversity of settings. The Public Scholars Initiative provides an important exemplar of how this can be done.

Lynn McAlpine continues the examination of innovative PhD programs in Chap. 6, 'How Might the (Social Sciences) PhD Play a Role in Addressing Global Challenges?' Posing a practical and thought experiment, McAlpine argues that PhD reform needs to move beyond disciplinary considerations to radically re-conceive of the PhD as encompassing solution-oriented inquiry. In what is a recurrent theme in the book, an 'expanded frame' is proposed that would 'expand and deepen our interactions with those beyond our own disciplinary colleagues: not just researchers in other disciplines, but those in other labour sectors and civil society'. Reforming the PhD for impact is a theme we also take up in our Chap. 7, 'A Public and Persuasive PhD: Reforming Doctoral Education in the Outreach-Focused University'. Taking Latour's idea of the reformulation of the mission of university around outreach as the key organising principle, we argue for reform of the PhD to produce graduates who are proponents of public and persuasive science. The question of reform is examined further, this time from a regional, political perspective. In Chap. 8, 'Remaking the PhD in US Higher Education: An Assessment'Deane E. Neubauer embraces the framing proposed by Latour and explores the conundrum it creates given the particularly 'tortured frames of reference,' of the USA. He grapples with the challenges of re-conceptualizing the PhD to focus on addressing unprecedented national and global challenges in this context. How to employ Latour's categories and insights to confront the transformative dynamics of climate change, while appreciating how theoretically and analytically isolating the prevailing US perspective became under the Trump presidency?

The third section, 'Earthing Beyond the PhD', turns attention to the PhDs nearest neighbours, the post-doctoral period and cognate degrees, such as the Professional Doctorate. Leading this section, Ruth Müller, scholar of science, technology, society and policy, explores the notion of crisis in context of academic values. In Chap. 9, '"I'm sorry, but it's kind of business": Crisis, Critique and Care in and Beyond the PhD', Müller draws on the experience of postdocs' in the life and environmental sciences to expose rich narratives about the interconnecting values guiding—and distorting—academic work, from the PhD and beyond. Reorienting these core values, she argues, is essential to the ability of academic science to respond to the multiple social and ecological crises of our time. Chap. 10, by doctoral and higher education scholar Liezel Frick, explores the epistemologically vexed role of creativity in the STEM PhD. In 'Doctoral Creativity as an Epistemological Force in Saving and/or Destroying the World', Frick examines the complex and problematic status of creativity in STEM, arguing that harnessing the potential of creativity in these fields is essential to enabling doctoral researchers to address current and future socio-environmental issues. In Chap. 11, 'The Contribution to Climate Change Research of the Professional Doctorate and PhD: More of the Same but of a Different Flavour?' Paul Gibbs, philosopher of higher education, examines the relative potential of these two doctoral programs to contribute to climate change research. While establishing no epistemological or educational reason to distinguish the two, he reflects on the respective potential of *praxis* and *poiesis* in addressing climate-oriented research agendas.

In the final section, 'Theorising an Earthy PhD', the recurring concept of ecology draws together a range of theoretical perspectives on what PhD training is and could become. Chap. 12 is a contribution from cultural theorist, Ross Gibson, 'Expert Not Specialist: Doctoral Ecologies for Focused Frogs and High-Flying Birds'. Gibson presents a wide-ranging essay, exploring the etymological 'filigree' of the PhD in experimentation, experience, knowledge, wisdom and its credentialing of holders to not only teach and instruct but also to take on major and complex issues, such as the current environmental emergency. Drawing on the work of Dyson Freeman, he imagines a curriculum to enable the flourishing of 'focused frogs and high-flying birds'. His avian–amphibian model of the PhD graduate imagines an all-rounder, who can dig deeply into a specialisation *and* fly high enough to apprehend the broader landscape.

Chapter 13, 'The PhD Revolution: World-Entangled and Hopeful Futures', higher education scholar Søren S.E. Bengtsen provides an alternative conceptualization, and narrative, of the current state and aim of researcher education and the PhD. Arguing in contrast to the commonly held idea that the PhD foundation is eroding, he instead points to a powerful PhD revolution from within researcher environments, spreading throughout social and professional domains, and reaching crescendo in societal and cultural contexts. He argues such institutional optimism is crucial if the PhD should itself be filled with hope and find the courage to engage with climate issues and other global challenges. The final Chap. 14, by Ronald Barnett, calls for the PhD to be re-situated ecologically. In 'Re-situating the PhD: Towards an Ecological Adeptness', Barnett extends the ecological beyond its customary associations with the natural environment, to emphasise inter-connectedness, systems, fragility, sustainability and humanity's responsibilities for the world. In his words, 'this new PhD would be a trans-disciplinary voyage of discovery, a wisdom-doctorate, synoptic and far-reaching, of societal and even global value, and yielding moments of large insight as well as personal self-discovery on the part of the student'. In this chapter, Barnett explores the nimble footwork required for institutions, PhD programs, supervisor(s) and students to become ecologically adept.

To conclude this introductory chapter, we wish to extend our sincere gratitude to everyone involved in this project in which our work as editors has been buoyed by wonderful conversations with contributors while reading and commenting on successive drafts of their work. Most of this was done while many of us were in COVID-19 lockdown in various parts of the world. Most notably, we owe thanks to the 'Debating higher education: philosophical perspectives' series editors, Paul Gibbs, Amanda Fulford, Ronald Barnett, and Søren Bengtsen, for supporting our proposal. We also wish to thank Lay Peng Ang, Springer's Senior Editorial Assistant, for patiently and thoughtfully guiding us through the manuscript preparation and publishing process. We extend our immense gratitude to all of the volume's contributors who have entered into the spirit of the book with enthusiasm and enriched our own thinking and understanding considerably in the process.

We are a long way from having all the answers, and this book is a long way from providing them. The idea for the book came out of a deep and strongly held conviction of the need to do something about the pressing problem of our time—the

climate-extinction emergency—via the PhD in which we are all variously personally and professionally invested. This volume has provided us with an opportunity to commence this conversation with some of our most respected and admired peers. The next step, for us at least, is to apply some of these ideas more concretely within our own institution, where there is already a strong appetite to engage meaningfully with the UN's Sustainable Development Goals and to orient graduate research education towards finding solutions for the great problems faced by the communities we serve. Working on this book has deepened our commitment to this mission and heightened our sense of urgency. As we argue in our own chapter, a different way of thinking about and doing PhDs is needed to meet the challenges we all face and if not now, when?

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Chapter 2
Is Geo-logy the New Umbrella for All the Sciences? Hints for a Neo-Humboldtian University

Bruno Latour

Abstract In this chapter, originally presented as a lecture at Cornell University in 2016, Latour extends his inquiry into how we inhabit the territory of the earth, and how we must position ourselves to live in the strange space of an earth made perilously new by our actions. The first part of this chapter is an extended rumination on our earthliness and how this is to be understood and lived—and indeed expressed in language. In searching for an adequate descriptor of life in the world made strange through human action which is also a world in ruins, and how this is to be negotiated, Latour mobilizes the idea of critical zone—as in the Critical Zone Observatories (CZOS)—as a metaphor for how we might learn to see the world in the new way required to survive. Latour then turns to some considerations of what this means for universities. The post-Humboldtian hints reference the role of the Humboldtian model of the university in driving industrialization, whereas a decidedly post-Humboldtian vision is required to ensure our survival in the world in ruins. Three major hints are provided: the need for universities to organize themselves around the principle of outreach: the needs for new literacies in politics, performance, design, and communication, especially the communication and visualization of big data; and the urgent need for new disciplinary formations and co-locations to enable the kind of science required for planetary survival. Latour concludes with an invitation to university educators to take up this challenge.

The supposition is not as strange as it sounds: we seem to lack a shared definition of the territory inside which we are supposed to exert our political rights. By territory I don't mean only the legal framework within which state and private owners exert their sovereignty, but the very shape, composition, nature and even, to put it simply,

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the very *place* where it is supposed to lay. Where are we supposed to live is no longer clear cut. To say that we live on Earth, or in nature, does not seem to clarify the situation that much.

My hunch is that the disorientation everybody feels about the dislocation of politics—even more evident at this time of the presidential election—is the direct consequence of this other disorientation regarding the territory. If politics appears so vacuous, it might be because it has not a solid and shared ground on which to raise issues of substance. How can you expect to have substantial policy debates if there is no territory to map, no cosmos to share, no soil to inhabit? How could we maintain a minimum of decent common institutions if we have no land in common, literally no *common ground*?

In this lecture I want to diagnose the origin of such disorientation and to imagine how this very special institution that we call the University could in some ways help us to land somewhere, to reach a place drawn realistically enough so that politics could start afresh. Let me look at some of the reasons why we feel so disoriented.

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I will begin with space. I find especially telling that it is a journalist (or rather an activist *qua* journalist) Bill McKibben (2010) who suggested that the planet on which we are supposed to reside is so new (M*aking a life on a tough new planet* is the subtitle of his book) that it has to have another name altogether. The one he proposed, Eaarth, is so horrible that it deserves to be quickly forgotten, but we should not forget McKibben's counter-intuitive injunction to rediscover a planet that we thought we knew. This time it is not a novel continent in addition to the land we used to inhabit—as was the case at the time of the European land grab—but the *same land* whose behavior has become unrecognizable. As Michel Serres proposed to say, what we hear today is no longer Galileo's protestation that "*eppur se muove*" "yet it moves", but something much more scandalous for all the ears of Earth's inhabitants: "yet it is moved"—that is, it has a behavior, it is a source of movement, emotions, effects, and affects. It's no longer indifferent to our own movements (Serres 1995). Going from a stable Earth that is décor of human history, to an Earth active on the stage of a common drama, is transforming our world view much more deeply than the rather innocent move from geo- to helio-centrism that no one has actually experienced much (Fig. 2.1).

I am well aware that any talk of "discovering" a new land has become suspicious after so much postcolonial critique, but that's precisely one origin of our disorientation: those who believed they were "on Earth" are feeling that the ground on which they were supposed to stand is being taken away from them. To live on a land whose status is being disputed is no longer the tragic privilege of older nations and cultures that were brutally "discovered" by others in the past, but the common situation of every collective, including those of the former "discoverers". This is the other unexpected sense of the expression "*post*-colonial": the progressive realization that the tragedy of losing one's land is now the only situation that can be shared by all

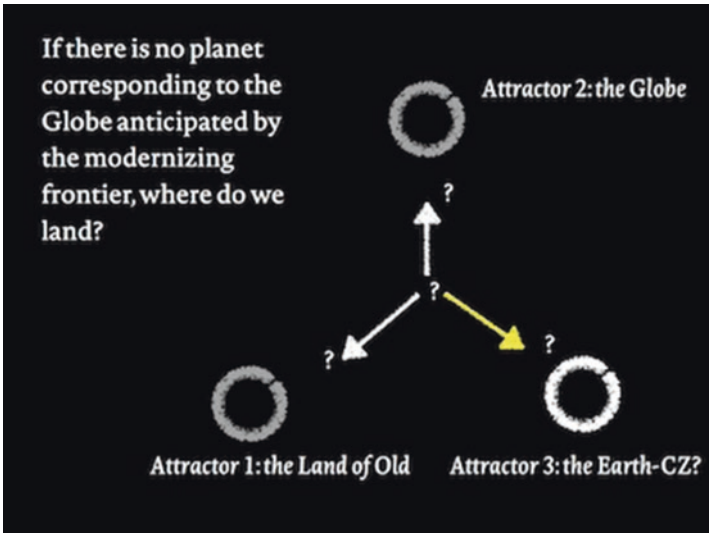

Fig. 2.1 Transforming world view

humans and non-humans alike, a new type of tragic universality. What Anna Tsing (2015) calls "living among the ruins" is what is going to unite us all in the same way.

However, this refreshing of the old trope of discovering a new land, a new planet, also has the advantage of mobilizing an immense reserve of hope and energy that is entirely missing from so much ecological doomsday literature (and that certainly includes McKibben's "Eaarth" book). If where we have to land is so new and unknown, so surprising and refreshing, then the trope might be the way to reload politics with issues of substance and to discover margins of maneuver and new settlements that would take politics out of its present depression. Instead of still dreaming of uploading ourselves into some sort of post-human future—either by uploading our mental selves into digital robots, or by transporting the human race to the Moon or to Mars—it would be much more realistic to rediscover the present planet—the only one we have—that for several centuries has apparently been not only misinterpreted, but literally *misplaced*. Such a transportation, such a migration to another planet, one that we could call rightly "ours", requires much more ingenuity, infinitely more technical and scientific innovations, and a level of mobilization and institutional invention several orders of magnitude greater than sending a few cosmonauts to Mars. "Discovery" of *new* land, I agree, is a suspicious expression, but "*re*discovery" of an old land might deserve our attention and mobilize our forces in a different way.

After space, what about time? Disorientation in space is compounded by the disorientation in history. I am alluding of course to what can be called the "quarrel of the Anthropocene". The quarrel is fascinating in itself and I have commented on it extensively, but I prefer tonight to stay away from its stratigraphic and geological

dimensions—What is the best date? Where to put the golden spike? What is the clearest evidence? Does it make even any sense to name a period that is not terminated? I prefer to concentrate on what I have called the New Climatic Regime and that Dipesh Chakrabarty (2018) has called "geohistory" or better "geostory". What the Anthropocene quarrel manifests is a much more empirically based version of what many years ago I diagnosed by using the odd expression "we have never been modern". What was already obvious in 1991—that we will not, that we cannot, modernize the whole planet—has now become common sense: there is no planet corresponding to the modernizing frontier planned by the 199 nations assembled in Paris for the COP 21st in November 2015. In other words, what could be called the horizon of the global, the infinitely receding frontier of the Globe, appears now as a sort of overshoot, a land of nowhere, an *Erewhon* where, just as in Samuel Butler's essay novel, everything has been inverted (1872/2013). What was infinite in the pull toward the Globe, has become finite; everything we thought was showing the way to the future is now taken to be leading to disaster. The arrow of time is all twisted.

If we want to understand the rage of so many voters today, I think it is not far-fetched to ask what all of you would do if you learned that all the sacrifices you had to suffer in order to modernize yourself are of no avail since there is simply no land, no common ground available so that all of us might inhabit the same planet in the same way. The shared global horizon has vanished. In my view, the deeply entrenched climatic skepticism comes from the feeling of having been so totally betrayed: "We were promised universal modernity, and it will never come. Why did you not tell us? Why did you let us abandon all our old ways? Why did you ask us to break away from the land of old, if the result was to leave us suspended in mid-air, with no way and nowhere to go?" What is called ecological mutation and global climate change is registered by most people as a raging protestation: "You betrayed us! We don't believe you anymore". Before lamenting "post-truth politics", we might wish to weigh the claims of the modernist project against realism and solid common sense: When did the project ever lead to a truth-based politics if there was no realistic planet to ground it?

And that is the third element in the present disorientation: Who is the "we" that is supposed to suddenly enter on the stage of the new geohistory, that is asked to migrate to a planet that is so different it deserves a new name? If there is something totally disorienting, it is to be said that the "human" has become also a geological force of such a magnitude as to rival the "forces of nature". Oliver Morton (2016) in *The Planet Remade* (by the way another of those titles referring to *re*discovered planets) summarized the contradiction best: "The paradox in a nutshell is this: humans are grown so powerful that they have become a force of nature - and forces of nature are those things which, by definition, are beyond the powers of humans to control"! (p. 220) The agency with which humans are suddenly saddled has no recognizable shape, nor is it possible to design the political body that could compose this new agent of history. If "post-human" has any meaning, it is probably this situation that the concept tries to describe. I cannot resist quoting from a recent paper in the *New York Times* by Roy Scranton (2016), an author who wrote a book with the

fairly dystopic title *Learning to die in the anthropocene: reflections on the end of a civilization* (Scranton 2015) (another lugubrious sign of the times!):

> Thinking seriously about climate change forces us to face the fact that nobody's driving the car, nobody's in charge, nobody knows how to "fix it." And even if we had a driver, there's a bigger problem: no car. There's no mechanism for uniting the entire human species to move together in one direction. There are more than seven billion humans, and we divide into almost 200 countries, thousands of smaller sub-national states, territories, counties and municipalities, and an unimaginable multitude of corporations, community organizations, neighbourhoods, religious sects, ethnic identities, clans, tribes, gangs, clubs and families, each of which faces its own disunion and strife, all the way down to the individual human soul in conflict with itself, torn between fear and desire, hard sacrifice and easy cruelty, all of us improvising day by day, moment to moment, making decisions based on best guesses, hunches, comforting illusions and too little data.

Okay, I have said enough about the reasons for our disorientation lost in space, lost in time, and unable to stabilize the agency that is supposed to put all of us into action. No wonder that politics seems so empty: politics, what I define as the *progressive composition of the common world*, needs a world upon which to operate, a solid ground, since it has always been issue- and object-oriented. How can you say anything of substance if you have lost your bearings to the point of not knowing where you stand, what period you are in, and with what sort of entities you are supposed to be dealing.

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When faced with vast philosophical concepts like mutations in space, time, and agency, my research strategy has always been the same: let's try to find a neat empirical site where it is possible through fieldwork to obtain precise answers to speculative questions. For many years I have been interested in soil sciences or pedology, and I have always wondered why such a crucial discipline, the interface between agriculture, life forms, property laws and ecology, remained such a modest, mundane and, frankly, disregarded discipline. My friends the soil scientists, with their boots in the ground, their soil samples, their focus on third world countries, really looked like the poor cousins of much more prestigious disciplines like geoscience and of course chemistry or physics. There was no way that soil science could become the queen of the sciences. It had too much mud on its shoes.

This is why I became immediately attentive when I met scientists who, to define themselves, were using a label designed to prick up the ear of a philosopher: *critical zones*. The network of critical zone observatories or CZOs in the USA and now many other countries is, in effect, a reinvention of the soil sciences, except that it is greatly extended, first in space—from the top of tree canopies to the deep undisturbed rock beneath—but also in time—from the nanoseconds of biochemical reactions to the millions of years of geomorphology—and finally, in the number of disciplines being mobilized—from hydrology to geobiochemistry. Having always been interested in the questions of instruments and standardization of data, I was fascinated by the way this CZO network equips watersheds and how it begins to fathom the complexity of sites that I thought geography had already thoroughly

studied. What is surprising to me is that, in the study I begin to make of this critical zones network, the scientists I follow seem literally to discover a new planet, each locality having its own idiosyncrasy. Of great importance to me, the CZO offers a handle on the key question of how to interpret Lynn Margulis' and James Lovelock's Gaia theory (Lovelock 1987; Lovelock and Margulis 1974). Because it is not directly concerned with life forms per se—by contrast with the other networks such as the Long-Term Ecological Research (LTER), but foregrounds first rock weathering, plate tectonics, volcanic and seismic activity, as well as hydrology, and grasps the forces of life essentially sideways through the course of biochemical cycles, it offers many local points of entry into the vast question of Gaia's behavior. While Earth system science is difficult to embrace because of its vast proportion and its reliance on models, each critical zone offers a smaller but just as complicated a scale model of the question as to how living organisms elaborate their own environment and hold it together.

This feeling is reinforced by the presence, in each of the field sites, of the massive disruptive or let's say the transformative presence of human intervention, even in sites that were chosen to serve as a baseline because they had not been disturbed by humans. While the quarrels of the Anthropocene require settlement through a complex decision inside the equally complex bureaucracy of the International Geological Society, there is no doubt that each critical zone offers an image of humans as a powerful geomorphological force, presenting us with a new image of *geomorphing,* of *geomorphed* humans. Here Tsing's (2015) expression "living in the ruins" takes on a very literal sense.

That's where the shift I alluded to earlier from Earth-as-a-décor to Earth-as-an actor modifies also the politics of those geomorphing humans. Each critical zone multiplies the instruments so that the composition and processes of, for instance, a watershed, may begin to be felt first by scientists, then by the myriad of other actors directly interested in gaining the sensitivity necessary to inhabit and survive on this piece of land. Everything happens as if each watershed entered in intensive care where the associated humans begin to gain or to recover some feeling for what they are doing, thanks to the feedback loops built by the instruments and interpreted by the models. Human agents are rendering themselves sensitive to their own actions through the multiplication of instruments.

The Southern Sierra CZ is a good example since for most practitioners there seems to be no directly visible connection that is experienced between the green coniferous forest up in the mountains and the flat, desiccated, overexploited, highly polluted Central Valley half an hour below. Farmers in the Valley continue to be blissfully unaware of the connection between the upstream and downstream water levels. They are, to say the least, careless. Establishing a connection between the two requires placing the watershed into intensive care and rendering the instruments, the water meters, and the models so precisely and in such sophisticated fashion that the action of agribusiness and the evolution of the local climate become describable for all to see, to feel, and to react. This requires not only more hydrology, more biology, more geochemistry, but also more regulation since a totally different legal framework is the only way to balance the output of water with the

input—especially at a time of intense and some say durable drought. It also requires, I will come back to this in a minute, that scientists become able to sustain the violent controversies that their science will necessary trigger.

Peter Sloterdijk has said that the movement of history is not toward revolution—the modernist project—but toward *explicitation*; that is, the rendering explicit of hitherto taken-for-granted conditions of existence. Not a movement forward, but a continuously *retrograding* movement of explicitation when human actors belatedly realize what they should have done earlier (see Latour 2012). Organisms have no eyes to see things ahead; they have eyes only in the back, after the fact. Blindness to the future is a life condition. But organisms can be slow or fast in registering the consequences of what they have done. John Dewey would say that speed at detecting consequences and reacting to them by changing course, is what allows the differentiation of a higher civilization from a lower one (Dewey 2005). It is not clear how Dewey would grade our present late industrial societies.

What I think I am witnessing in the CZO is the slow and belated equipping of the planet with some sort of *haptic* technology—defined by the dictionary as "technics that allow you to regain the sense of touch through kinaesthetic communications, by applying forces, vibrations, or motions to the user". Such a haptic technology is of great use in robotics, but it is vastly more important for landscape, watersheds, and ecosystems. If we are out of touch, if we feel "off shore," if politics is vacuous, it is largely because of the yawning gap between what we do and how we come to register the consequences of our action. Whatever the definition of New Climatic Regime, it is clear that it is taking us into dizzying loops of explicitation, revision, and reflexivity.

So, when I began to study the CZO it became quickly apparent to me that if the older pedology had no chance to become the queen of science, something was happening in those new networks of disciplines and instrumented sites and watersheds that put the Critical Zonists, as I affectionately dubbed them, at the center of a crucial shift in natural history. I am not quite sure yet how to define simultaneously: a return to the older *natural history*, that of Humboldt—Alexander not Willem—and a formidable amplification, through the powerful instruments and models they are developing, of what could be called, so as to accentuate the contrast with what is more traditionally called *earth* science, *earthly* or *terrestrial* sciences. Earth and Earthly captures the same contrast as geo- and gaia- in the many expressions like geo- or gaia-logy, geo- or gaia-politics, geo- or gaia-graphy. The last expression being probably the best: the inscription, the writing, the marking of Gaia through the reflexivity of its inhabitants finally learning where they inhabit.

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Let me take one step further. If you agree to extend the concept of critical zone from the name of a network of field stations—an institutional financing scheme inside the National Science Foundation—to that of the thin layer a few kilometers up and a few kilometers down within which everything alive we have ever encountered is being processed, then we might begin to draw a first sketch of this strange planet I mentioned earlier which has the puzzling character of being totally familiar and totally new.

I have time to underline just one feature of that old-new planet. I am obsessed, I have to confess, by the visual contrast between two ways of considering the Earth. The first is as a Globe—the famous Blue Planet viewed from out in space. In the second view the Earth is totally different; it is tiny, fragile, and far from equilibrium (another meaning of the word "critical" in the expression critical zone). It resembles a pellicle, a varnish, a skin that is always considered not from the outside as a globe, but from the inside as a highly controversial, multilayered, and disputed set of intermingling entities. One way to express this contrast is to say that humans are not *on* Earth—as on a décor from which they are detachable—but *in* Earth—among overlapping entities from which they cannot detach themselves.

The difference is so great between the image of the Globe and the image of Gaia as a critical zone, that I am tempted to say that it would make a lot of sense to distinguish that zone *from nature* as it is generally construed. This could seem shocking at first, but nature is too vast a concept to pay justice to the complete originality of this tiny, fragile, slim, contested critical zone. And for one good reason that will be easily understood by historians of science and STS scholars: while what is above and beyond the critical zones is known to us indirectly only through instrumentations—which means that those who do not have access or are not qualified to interpret the data are not able to mount a durable controversy and fight the scientific world view with any efficacy, it is not the case for the critical zones where every discipline, every instrument enters into durable and fierce conflicts with other versions of the same territories.

The pseudo-controversy over the anthropic origin of climate change is a case in point. But the example of the South Sierra is even more obvious: why would one expect the data produced by that Observatory about the diminishing water supplies in the reservoirs of the Sierra to be easily accepted by the Central Valley farmers down below who pump each other's fields out of existence? While the natural sciences properly construed can expect a relative epistemological peace about their claims, it is totally impossible for the critical zones and for the disciplines of natural *history* (if you accept to slightly modify the meaning of this venerable term by stressing the word "history") (see Fig. 2.2).

Those disciplines are necessary in conflicts—sometimes at war—with other definitions of the land. To situate the contrast between the sciences of nature and those of natural history (geohistory if you wish), it might be convenient to reintroduce the older meaning of nature that is still present in the Latin etymology of the word but even more in the older Greek meaning of "*phusis*". While everybody knows that the Galilean gesture has been to extract from the range of motions, emotions, affects, and effects included in the older *phusis*, only one movement—that of falling bodies—it is also clear that natural historians engaged in fierce disputes about the proper use of territory have in effect reintroduced all the other types of processes that Galileo had pushed aside: birth, generation and death, growth and decay, life and pollution. To the point that Gaia—again not the Global Earth but the skin-thin Critical Zone—requires a different treatment, a different style of study, a different politics than the vast expanses of nature. This different approach does not mean that the models of natural historians don't use the same laws of nature that are active at

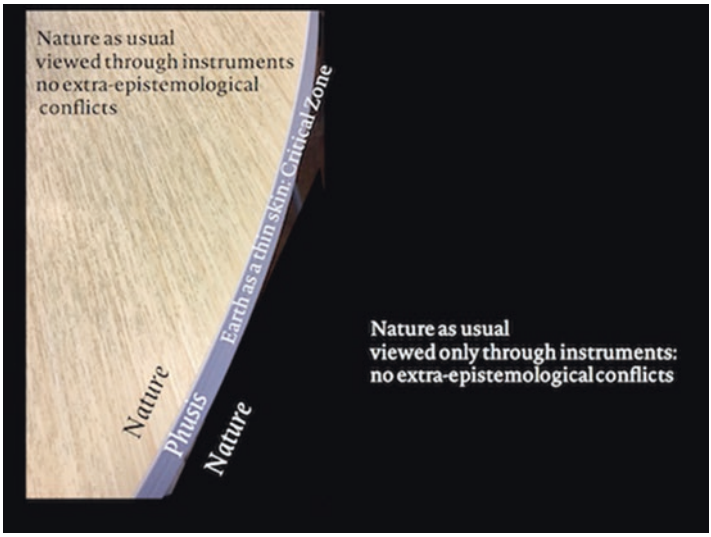

Fig. 2.2 The critical zone

the center of the Earth or in Mars and Jupiter, but that there is something so specific to the earthly sciences that it should be protected, so to speak, against a confusion with the strange and utterly modernist attempt to treat the Earth as if it was another planet, viewed from out in space. No wonder no one is moved when it is proposed to "go back to nature" or "to care for nature"; this nature is the projection onto our planet of a conception coming from out in space. And of course, things are even worse, especially in this country, when nature is confused with wilderness.

What I propose to do, then, is to introduce a division between nature and the natural sciences, on the one hand, and phusis and the earthly sciences on the other. A fully geo-centric move, if you wish, provided that you take geo not as a globe but as a critical zone. It is not as speculative as one might think, since there are lots of good technical reasons to utilize such a partition. Witness Timothy Lenton's version of the same divide in his book: "For many Earth system scientists, the planet Earth is really comprised of two systems -the surface Earth system that supports life, and the great bulk of the inner Earth underneath. It is the thin layer of a system at the surface of the Earth -and its remarkable properties- that is the subject of my work" (Lenton 2016).

This is something that Humboldt would have understood easily. We, the Earthlings, the Earthbound, the parents, and children of the Anthropocene, are not born in nature first and then later graduate into the worlds of symbols and society, but spend all our life from cradle to the grave inside the *phusis* out of which we will never extract ourselves, even in dreams. This what it means to be *in* Earth and not *on* Earth. Nature is too vast and too homogeneous a concept to serve as a basis for the composition of the common world.

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If we were told that the planet as we know it was going to be devastated soon and that we have to quickly vacate the premises so as to be transported to another one, there is no doubt that the whole institutional apparatus—civil, military, religious, intellectual, scientific, technical—would be on something of a war footing. A frenzied activity, as is known only in periods of war, will mobilize everybody, triggering passions as well as innovations and panic. If you have followed me until now, this is indeed a realistic description of where we stand today: collectively, at the time of the New Climatic Regime, we are contemplating a hard landing on a planet—the critical zone—that in recent times we thought we could escape from or at least ignore altogether.

To reorient ourselves we need to realize that in addition to the Globe—the infinitely receding horizon of the frontier, and in addition to the Land of Old—this mythical land that many long to go back to (for instance, the Great Britain that Brexiters dream of reaching after having abandoned the other dream of the global market, or the America Great Again that white men dream to regain after having lost the optimistic movement to the fully modernized Globe)—that in addition to those two poles, Globe and Land of Old, there is *a third pole*, a third attractor if you wish that is differently polarizing our political life, forcing us to define what is a movement forward and backward along totally different paths of evaluation. Even though the general mood seems to be a wait-and-see attitude when faced with the perspective of such a hard landing, this planet-shifting process is a realistic description of what is happening under our eyes. If most people don't seem to react, I think it's because they are anesthetized by the size of the necessary change and the novelty of the definition of a land so different from nature. From the beginning of this talk, I have taken the apparent vacuity and raucousness of present politics as the best proof of this hesitant, suspended but radical reorientation. It is thus very important that intellectuals, artists, statesmen, activists, begin to sketch the landscape that we will have to inhabit.

Since we are here at Cornell, almost exactly 40 years after the first meeting of my professional association, the Society for the Social Studies of Science, I thought it would be fitting to propose one view of how a university can adjust to this situation. In addition, it would offer a good baseline to register the immense changes that have taken place in the conceptions of scientific disciplines since we started this field of science studies.

That what follows remains totally speculative should not be surprising at a land grant university such as this one, founded, as you all know, to propose innovative research and teaching at a time in the past when a new land was to be occupied, tilled, renewed, and reinvented. Paradoxically, the rediscovery of an old land—and the necessary painful landing that goes with it— requires just as much innovation in research and teaching.

The first visible reorientation is to decide toward which goals the whole energy of the University is being directed. When the modernist project was still extant, the university took itself to be at the vanguard of a teaching and research process; its results—progressively through education and training, then through outreach and what in some place they nicely enough call "extension"—would trickle down,

eventually reaching the general public marching courageously at the rear-guard that had been mobilized for the great movement forward. So ideally, after multiplying university laboratories, accumulating starts up, grads, undergrads, and PhDs, plus a few educational museums, a shared world view would finally be constructed where everybody would have become, if not scientifically enlightened, at least able to follow, maybe to obey, the expert vanguard in important matters.

It is somewhat cruel to be reminded of this ideal at the time of the US election since the trickle down project has been such a radical failure that a large segment of the population of this country believes neither in Darwinist evolution nor in the anthropic origin of climate change, and, worst of all, believes that those are questions of belief and value, not of science! The true meaning of universities as ivory tower was revealed to me when I was in Cambridge, England a few weeks back and learned that the college city had voted 75% for Remain in the Europe referendum while the rest of the shire voted from 54% to 75% for Brexit. We can of course lament the backwardness of the people, but it is also a dismal proof of the isolation of the experts. Trickle down epistemology does not work better than trickle-down economics. Universities no longer offer a preview of what will become future common sense, but rather isolated archipelagos in a sea of discontents.

If you have followed the planet shifting movement I described earlier, the new university, what we might call the neo-Humboldtian university (again taking more from Alexander than from his brother Willem), goes exactly in the opposite direction from that of the nineteenth and twentieth centuries: soon, eight-billion people will need help in landing on a territory, on a land, which has none of the characteristics modernists had prepared them for and which is totally new to everybody (Guarin 2004). It will require of each member of the public an amazing effort to adjust, to inquire about the right way to survive there, to propose changes in lifestyles, to resist conflicts over land appropriations and to entirely retrofit goals, morality, and values. There would be some trickling down, to be sure, but it might run in the opposite direction, moving from the surprised public to the experts suddenly forced to discover the extent of their ignorance.

So here is the first radical reorientation: what used to be called extension, outreach or pedagogy is no longer the last but the *first front line* and alongside which all actions of the future university will be evaluated. All departments are mobilized to service the public engaged in this migration of biblical proportion. This does not mean that basic research is jeopardized, quite the contrary, but that the order, priority and goals have been reversed. To survive in the critical zones without killing each other and rediscovering the multiple layers of Gaia so as to obtain margins of maneuver in technology, energy, and resource requires immense advances in scientific inquiry. This is what I meant when I said that rediscovering the old new planet should create as much creative energy as during the period that had been called the "age of discovery". Especially that now the project of reinventing how to live on the planet might be a project shared with the formerly dispossessed.

The meaning of "public engagement" is now considerably changed. It is no longer an afterthought, added once basic research has been completed; it is that toward which basic research is directed. But how to establish the links between those two

lines of activities? Two words have cropped up everywhere when institutions of higher education have realized that to cope with the planet shift required a major change or orientation: *performances and design*. The fortune of design as a metaterm replacing dozens of activities that before would have been understood as engineering, management, activism, or policy is extraordinary. The word design now means a general method to cope with the traumatic experience of having to readjust the totality of our conditions of existence. This is what Peter Sloterdijk meant with his argument that explicitation was the only way to deal with the new existential situation (see Latour 2012). When you talk about designing or redesigning it means you have abandoned revolution and tabula rasa, and that the best you can expect is to make life more livable. It is slightly more ambitious than remediation, but it is much less heroic than revolution. Adapting? Adjusting? Coping? All sorts of words that mean how to live in the ruins.

The fortune of performances and performance studies is also rather extraordinary. This other metaconcept does not simply mean the older arts of dance, music, or theater but a much larger set of transdisciplinary skills that provide players and audience with a sensitivity for situations where there was none before. What I have called the "political arts" is a way to explore the three aesthetics of arts, science and politics, where aesthetics is understood as gaining a sensitivity for the new planet on which we are supposed to land—sensitivity which is gained by scientific instruments, by political representation but also by what the arts have to offer. Performances have the crucial advantage of allowing the *dramatization* what is at issue, but also the *dedramatization* of issues since they are artificially staged. No politics of the Anthropocene is possible as long as its players are paralyzed and inarticulate. Without the arts, people will remain stuck in the old planet without moving an inch, terrified by guilt and willful ignorance. In that sense, performances, much like design, offer key metamethods to prepare for the planet shift.

A third metaterm is easier to detect since it has become common sense; rare are universities not investing massively in big data: namely visualization and what some of us call "digital methods." A key side effect of the digital is that people of completely different disciplines are pushed to compare their data sets no matter where they come from. Today an art historian, a spy, a geographer, an activist, an administrator, or a physicist can begin to have, on their respective screens, documents, tables, traces, inscriptions which share many characteristics that were not visible before. The down side is that wherever you go, from biology to cosmology, from social networks to archaeology, the same problem arises: too much data, not enough visualization. And yet building recognizable and shareable landscape through multiple and often controversial data sets is essential for the landing operations we are readying ourselves for. Look at what is necessary for landing one robot on a Mars mission: imagine what it will require to land eight billion people on Earth!

So, the first front line is public engagement; the second line is design, performance and data visualization. What is the third line? Time is running out, but it would be refreshing to imagine what will happen to the earthly sciences once they are mobilized in the direction I indicated. Remember that we leave aside, for now, the natural sciences, those dealing with what is either above or below the Critical

Zone. All the remaining disciplines have become branches of Geo-logy or rather Gaialogy since they all have to handle the planet shift and prevent a hard landing. Contrary to the natural sciences, the earthly sciences cannot ignore that they are engaged in controversies for the production, interpretation, and application of data. Natural history is, by definition, full of history. So, the training of geo-historians implies a lot of science studies and politics. This new insistence on history will actually be nothing but a return to the origin of the discipline of geology and stratigraphy proper since their birthplace, as Martin Rudwick (2014) has so beautifully shown, is the same as archaeology. Historical disciplines they were, historical disciplines they will be. With the added twist that the Anthropocene has sped up the rhythm of this story quite a bit (see Fig. 2.3).

If I were a science fiction writer I would have great fun sketching the destiny of disciplines mobilized in the shift to earthly science. Having been the dean of my school I know that disciplines are simultaneously indispensable for training and job markers and useless for defining issues and new fields. Still, it would be more than simply entertaining to watch sociology turned earthly—at least people will stop asking me if social is limited to humans and how things could have agency too; it would be greatly inspiring to see economics turned earthly science, reinternalizing everything that it has externalized beyond the limits of its calculations and beginning to multiply the currencies instead of limiting their numbers; how fascinating to see the law school fully engaged in the redefinition of property rights and inventing many new ways for the various agents to have standing in courts; we should not be surprised to see that political scientists are helping the public redefine the limit of sovereignty and elaborating with the performance departments new ways of assembling political bodies finally able to be representative of life on earth; those who

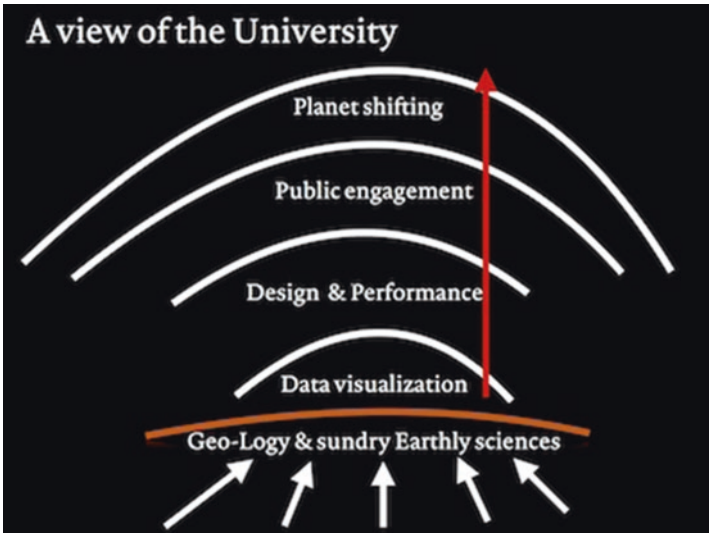

Fig. 2.3 A view of the university

certainly feel most at ease in this new situation are the anthropologists, precursors of all the other earthly sciences, since they are the ones who keep alive the experience of those who have been dispossessed most vividly for all the other disciplines to learn from; even the divinity school is changing its relation with the sciences it had loved to hate for so long, rediscovering in the dogma of incarnation an access to the earthly and mundane existence well-adjusted to the planet shift; humanities are not behind either since in them reside the immense reservoir of alternative definitions of what it is to be a human and to be surrounded by different kinds of agencies, and just at the time when the humanities looked obsolete in the horizon of globalization, they become indispensable to compose the common world idiosyncrasy by idiosyncrasy; philosophy? Ah, that's true I have not enough imagination to invent ways in which departments of philosophy could become earthly. I am sure others can do so better than me.

Anyway, this lecture is coming to a close and it is your job to follow those few hints for a neo-Humboldtian university. I propose that we ask knowledge designers and performance studies experts to help us through the brainstorming sessions necessary to adjust to the new situation. What is sure is that we have not that much time and that we cannot remain an island in a sea of disgruntled voters who have come to believe that questions of life on earth are questions of belief.

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Part I
Down to Earth – The PhD Lived-Experience

Chapter 3
STEM PhD Student Preparation in the Eras of Cross-sector Convergence and Global Climate Crisis: An Autobiographical Exploration

Bryan G. Moravec and Matthew M. Mars

Abstract Research universities have over the past four decades become increasingly entangled with private industry and government agencies largely due to growing resource constraints and rising pressures to commercialize discoveries. The cross-sector convergence that underpins this so-called triple helix model has received significant scholarly attention. Yet, the influence of cross-sector convergence on the preparation and socialization of STEM PhD students, and in particular those with academic and professional intentions relevant to the global climate change, has been neglected. In this essay, we rely on the concept of blended institutional logics to guide an autobiographical exploration of one of our own lived experiences as an environmental science PhD student and before that an environmentalist within government, private industry, and the public sector. From the insights generated, we develop early propositions on how cross-sector convergence is likely influencing the academic training and professional intentions of PhD students with career trajectories that intersect the global climate crisis. Recommendations for instructional practice and mentoring and future research are provided.

Introduction and Background

For nearly four decades, scholars have worked to develop an understanding of the implications of the increasing entanglement of academia, industry, and government, which is now widely known as the "triple-helix" model (Leydesdorff and Etzkowitz

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1996). The underlying claim of the triple-helix model is that the public good is most effectively and efficiently served when scientific and technological innovations are developed and diffused via market channels that involve strategic partnerships between research universities and private corporations. These channels have been fostered through neoliberal government policies that blur the once clear lines between the academy as a public good and the private marketplace as a standalone institution (Slaughter and Rhoades 2004). For example, consider the Bayh-Dole Act of 1980, which enabled American universities and colleges to protect and profit from the rights to intellectual properties developed through federally funded research activities.

Critics of the triple helix model and the research paradigm it now supports argue that it leads to an inherent bias that favors market-oriented activities over those that are more intellectually and socially oriented (Carayannis and Campbell 2009). Such concerns have led some scholars and policymakers to call for the inclusion of civil society as a fourth paradigmatic element to form what is being referred to as the "quadruple helix" model. Advocates for such a model are particularly attentive to the need to purposefully stimulate and advance innovations that are not only commercially viable, but also environmentally and socially just (Carayannis et al. 2012; Gouvea et al. 2013). Other more adamant critics of the helix model, regardless of the inclusion of a socioecological strand, argue for an entirely different approach to transdisciplinary environmental science that is altogether isolated from market-based pressures and politically biased influences (Klenk and Meehan 2015).

There is an extensive body of research that interrogates the various economic, scientific, and socioecological implications of academic-industry-government-societal entanglements, which hereafter we refer to as cross-sector convergence. Yet, inadequate attention has been directed specifically at how the convergence of the once relatively isolated sectors of academia, industry, and government and the resulting implications on society, to include the environment, is influencing the training, perspectives, and professional trajectories of Doctor of Philosophy (PhD) students. Thus, there is a pressing need to better understand the influence of cross-sector convergence on the preparation and socialization of PhD students who are entering scientific and technological fields that are on the forefront of either confronting or exacerbating the global climate crisis. Research on how to best prepare the next generation of scientists and engineers to negotiate the complex intersections of academia, industry, government, and society in environmentally centered ways, whether at bench, in the field, or in the boardroom, is desperately needed. In response to this need, we conducted an autobiographical study of one of our own lived experiences first as an environmentalist within government, industry, and the public sector, and then as a PhD student in an environmental science program.

Graduate students in the science, technology, engineering, and mathematical (STEM) disciplines have not been entirely neglected within the cross-sector convergence literature. In some cases, increased interactions with industry professionals and government representatives have been found to be effective in preparing students for research careers that span academic, government, public, and industry boundaries (Mendoza 2007; Thune 2010). In other cases, cross-sector activities

have been shown to encourage PhD students to more purposefully consider the entrepreneurial potential of their research interests and career paths (Bienkowska and Klofsten 2012; Mars et al. 2014).

More critical assessments of the effects of cross-sector convergence have also been provided. Examples of such criticisms include the dilution of academic values held by PhD students and subsequent declines in their engagement in traditional activities (i.e., basic research, journal publications; Lee and Miozzo 2015). More broadly, the inclusion of PhD students in industry collaborations has been associated with the shift of higher education away from a public good regime and toward what has been widely referred to as academic capitalism (Gumport 2005; Slaughter and Rhoades 2004). Critics of academic capitalism argue that market permeation in higher education in part incentivizes graduate students, and especially those in the STEM fields, to view their current and future research through an entrepreneurial lens that privileges resource acquisition over more altruistic aspirations that are tied to the public good (Mars et al. 2008, 2014; Mars and Metcalfe 2009).

Finally, the effects of PhD student engagement in cross-sector collaborations and networks have been further considered under the contexts of economic development and organizational competitiveness. For instance, Gustavsson et al. (2016) provide evidence that PhD student participation in university-industrial collaborations has positive effects on both the competitiveness of their universities and the growth of the surrounding economies. Similarly, the competitive benefits realized by firms that participate in university collaborations involving PhD students, which most commonly come in the forms of knowledge transfer and talent acquisition, are well documented (e.g., Assbring and Nuur 2017; Mendoza 2007; Thune 2009).

Conceptual Framework

In this chapter, our aim is to develop neither further support for nor critique of cross-sector convergence relevant to how STEM PhD students are being prepared to respond to the global climate crisis. Instead, our focus is on how these students come to recognize, understand, and negotiate the entanglement of academic, industrial, political, and societal beliefs, norms, values, and activities relevant to their PhD-level training and academic and professional aspirations specific to the current climate crisis. We frame our exploration in the context of institutional logics, which Thornton and Ocasio (1999) define as, “the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality” (p. 804). The theoretical root of institutional logics is the recognition that individual actors, the organizations they compose, and the broader institutions in which they are positioned are being influenced by constant shifts between states of coordination and compatibility to those of competition and discord (Lounsbury and Boxenbaum 2013).

A full review of the extensive body of work on institutional logics is well beyond the scope of this chapter (see Greenwood et al. (2011) and Thornton et al. (2012) for more thorough reviews of the institutional logic and complexity literature). Instead, we focus specifically on the concept of logic multiplicity, which refers to the concurrent presence and influence of multiple logics on the activities, perspectives, and values of organizational actors (Besharov and Smith 2014). No less than five co-occurring logics (environmental, market, political-regulatory, scientific, societal) are likely influencing STEM education at the PhD-level and its relation to the global climate crisis in this era of academic capitalism and cross-sector convergence.

Logic multiplicity requires constant negotiation on the part of organizational actors. In some cases, actors are able to constantly navigate back and forth between the influences and pressures of multiple logics that are sometimes compatible and other times oppositional (Reay and Hinings 2009; Saz-Carranza and Longo 2012). Examples of studies on the navigation of co-existing logics that are particularly relevant to our current work include academics who balance the simultaneous demands for both basic and applied research (Bullinger et al. 2015), environmental managers within firms who are accountable to both market- and environment-based goals and motives (Dahlmann and Grosvold 2017), and ecopreneurs who routinely shift between the quest for profits and commitment to moral decision making (Suckert 2019). In other cases, actors draw on one dominant logic to resist the influence, if not adoption, of a competing logic, as Marquis and Lounsbury (2007) depict in the case of community bankers working to prevent their locally based institutions from being acquired by corporate banks.

Actor response to logic multiplicity is not limited to accommodation, negotiation, and/or resistance. Instead, actors sometimes work within the contexts of their organizations and respective fields to couple otherwise disparate elements from competing logics and thereby forming new hybrids (Pache and Santos 2013; Ramus et al. 2016). Such logic blending is a strategy that actors often pursue when introducing and eventually legitimizing new and disruptive practices within otherwise rigid and well-established organizations and fields (Mars and Schau 2017; Skelcher and Rathgeb-Smith 2015; Tracey et al. 2011). In the specific context of the global climate crisis, logic blending has been shown to be a highly common feature of the environmental work that is performed by a diverse set of actor types that include, but not limited to activists, college student entrepreneurs, and sustainability officers in private firms (Ansari et al. 2013; Mars and Lounsbury 2009; York et al. 2016). This rich line of inquiry points to logic blending as an approach to embedding conservation and sustainability into the activities, practices, and values of well-established organizations and fields. This functional view of embeddedness is framed as a strategic alternative to directly challenging well-established and firmly positioned organizations and fields.

Clearly, the ways in which actors are influenced by and respond to logic multiplicity and the resulting implications on practice, whether at the individual, organization, or field level, are both opaque and highly complex. Considering PhD students, and especially those in the STEM fields, are on the leading edge of confronting the global climate crisis, a greater understanding of how logic multiplicity

is shaping their learning, current practices, and anticipated career trajectories is warranted. These PhD students are being trained in organizational settings that are simultaneously shaped by elements that stem from environmental, market, political-regulatory, scientific, and societal logics. Accordingly, their scientific preparation involves, implicitly or explicitly, the confrontation and navigation of multiple logics. Yet, to our knowledge we are the first to directly consider how individual students come to recognize and make sense of logic multiplicity specific to both their PhD-level education and their future roles in responding to the global climate crisis. Moreover, the theoretical work on logic multiplicity has been conducted almost entirely at the organization and field levels. We depart from this tradition by exploring how an individual actor, in this case a PhD student in environmental geochemistry, makes sense of and responds to the various influences and pressures that intersect the role of scientific research and development in responding to the current global climate crisis.

Autobiographical Approach

Here, we use an autobiographical self-study approach to explore the ways in which one of us, Bryan, made sense of and responded to cross-sector influences and pressures as a PhD-level environmental geochemistry student with a deep interest in addressing climate change. This approach is particularly well suited for our exploration in that self-study fosters an intimate connection between readers and the insights contained within the lived experiences of the researcher (Bullough and Pinnegar 2001). Moreover, there is precedence of conducting research using self-study design in the fields in which our exploration is most firmly anchored, specifically education and sociology (e.g., Bullough and Pinnegar 2001; DeGloma 2010; Friedman 1990; Hamilton et al. 2008; Swedberg 2016),

Bryan's written reflections on how he recognized, navigated, and generally made sense of the various influences and pressures of cross-sector convergence during his experience as a PhD student relevant to the global climate crisis served as our data. The analytical use of reflective narratives written by researchers is an established self-study practice (Connelly and Clandinin 1990). Our decision to take this approach was aided by Bryan's longstanding practice of purposeful reflection on his professional experiences and overall personal growth and development that began in earnest as a Peace Corps volunteer in the early 2000s. The reflective process he routinely engages is informal and thus not structured according to any particular set of prompts or objectives, or for that matter overarching theme. As such, we applied a conceptual lens specific to cross-sector convergence and logic blending to a more freely formed reflective account of the diverse array of academic, civic, and professional experiences that have over time contributed to Bryan's development as a now PhD-level environmental scientist. The application of a theoretical lens to derive objective meaning within reflective accounts is a technique commonly deployed during autobiographical inquiry (Polkinghorne 1995; Smith and Sparkes 2006).

The analysis of reflective narratives is typically bound to a specific timespan that is appropriate to the phenomenon of study (Polkinghorne 1995). Our general focus is on the period when Bryan was a PhD student. However, we recognize his prior experiences working as an environmental engineer in both government and the mining industry, as well as his early experience immediately out of his undergraduate degree program working for a non-governmental organization (NGO), heavily influenced his perspective on the global climate crisis. Accordingly, Bryan temporally bound his reflections to 2001, which is when he began his post-baccalaureate position with the Peace Corps, to December 2020 when he completed a PhD degree in environmental geochemistry. Two themes remained particularly prevalent throughout this bounded period of reflection that made the narrative particularly amendable to the analysis: (1) the range of cross-sector experiences that Bryan accumulated up to and throughout his PhD training and (2) the consistent progression of his development and evolving identity as an environmental scientist.

Researchers inherently begin to apply subjective meaning to their experiences and perspectives as they engage in reflection and journaling processes (Bamberg 2012). Thus, Bryan used a qualitive memo format (Mason 2017) to record in "real time" any early insights into the potential patterns or themes on how as a PhD student he navigated and made sense of cross-sector influences and pressures relative to the global climate crisis. We initiated formal analysis only after Bryan was no longer generating new reflections on how his perspective on the global climate crisis came to be prior to entering his PhD program and how he navigated the influences of cross-sector convergence thereafter.

Formal analysis began with us each individually coding the written narrative and subjective memos using a deductive framework composed of the quadruple helix and logic multiplicity concepts described earlier in the chapter. We also each performed a round of inductive analysis of the narrative using an open code framework. Next, we engaged in researcher triangulation in order to reveal both consistencies and discrepancies in our individual findings (Denzin 1978; Onwuegbuzie and Leech 2007). We continually discussed the consistencies ad discrepancies, to include individually and collectively returning to the data on multiple occasions, until consensus on the salient themes was reached. We then engaged in a final round of both deductive and inductive analysis of the narrative and memos in order to further refine the themes into what ultimately became our final set of findings.

Establishing trustworthiness in the analytical processes that are associated with self-study and narrative inquiry is especially challenging given the inherent presence of subjectivity (Bullough and Pinnegar 2001; Feldman 2003). Our engagement in researcher triangulation, as just described, was one measure we took to enhance the trustworthiness of our findings. Additionally, we also developed an audit trail that articulates the decisions we made and the steps we took when designing and carrying out our approach (Creswell and Miller 2000). Finally, we frame our findings as initial propositions to be empirically pursued in future studies that have a greater capacity to generate more transferable findings.

Findings

Bryan's autobiographic narrative is centered on his experiences as a PhD student (2015–2019). Yet, he recognizes that his perspective on global climate crisis upon entering the PhD program was significantly influenced by his previous experiences as a Peace Corps volunteer in West Africa, as an environmental engineer with several local and federal government agencies in the United States, and as an environmental consultant for the mining industry. Accordingly, the following narrative draws from these experiences to provide deeper context on his viewpoint of how cross-sector convergence influenced his perspective on the global climate crisis throughout his PhD-level training. In 2001, Bryan completed a Bachelor of Science (BS) degree in geology from the University of Colorado. He worked for the US Geological Survey from 1999 to 2001 while completing the BS degree, which was his first professional experience related to the climate crisis. Following the completion of the BS, Bryan served as an environmental Peace Corps volunteer in Benin, West Africa from 2001 to 2004 working on development projects focused on the urban environment in a city located on the edge of the Sahara Desert. Upon returning to the USA, he next worked for a Public Works Department in a small resort town in the mountains of Colorado. Recognizing the need for advanced training, Bryan returned to academia in 2005 to pursue and eventually earn a Master of Science (MS) degree in hydrogeology from Washington State University and then a second MS degree in environmental engineering from the University of Arizona (UA). While at the UA, Bryan concurrently expanded his professional experience first as an engineering technician for the City of Tucson Wastewater Reclamation Department (2009–2011) and then as a senior project environmental engineer for an international consulting firm (2011–2018), focusing on environmental assessments and remediation associated with large-scale mining projects in the western USA, Mexico, and South America. In December 2019, Bryan completed a PhD in environmental science with a focus on geochemistry. He has since joined the UA faculty as an assistant research scientist with current projects focusing on geochemical processes at closed mine sites in the western US, with an emphasis on contaminant fate and transport processes that are driven by changes in the regional and global climate.

Bryan's written narrative clearly articulated an academic and career progression that has been continually influenced by multiple logics that are sometimes compatible and other times in conflict when it comes to the global climate crisis. The five primary logics that were identified within the narrative as having had the most consistent influence on Bryan's academic and professional development leading up to and continuing through his doctorial training: environmental, market, political-regulatory, scientific, and societal (see Table 3.1). Our focus hereafter is on how Bryan negotiated the various and often competing pressures that these logics brought to bear on his PhD-level training and evolving perspective on the global climate crisis. Specific attention is given to the processes that he consistently engaged as a PhD student to negotiate the influence of cross-sector convergence and

Table 3.1 Logic-types

Logic-type	Description
Environmental	GCC is framed specific to environmental impact and change
Market	GCC is framed specific to profit making and loss
Political-regulatory	GCC is framed specific to political agendas and government oversight
Scientific	GCC is framed specific to knowledge generation and dissemination
Societal	GCC is framed specific to the security and well-being of communities and society

logic multiplicity relative to the global climate crisis. The processes are (1) self-reflection, (2) bargaining, and (3) adaptation.

Bryan first identified as an environmentalist as an undergraduate student studying geology. He entered college with deep appreciation for nature, which was largely instilled and reinforced by his upbringing and family value system. He writes, "Viewing the environment as the key issue that I wanted my professional career to focus on, I pursued my Bachelor's degree in geology with the intention to using it towards solving problems related to environmental contamination and cleanup." This appreciation became more formally anchored in an environmental logic throughout his undergraduate studies, which included participation in various environment-related co-curricular activities and experiences (e.g., student organizations, internships).

It was also during Bryan's undergraduate years that he first experienced the complexities associated with cross-sector convergence and the pressures of logic multiplicity. In particular, he observed firsthand through his work in the US Geological Survey the slowing and sometimes crippling effects of governmental bureaucracy on environmental action. This experience helped him better understand bureaucratic realities and the relationship between regulated activity and environmental stewardship. He also came to realize a government career entrenched in a political-regulatory logic would not provide the degree of impact he aimed to have on environmental renewal and conservation. This early career self-reflection marks Bryan's first experience in logic negotiation as he worked to retain alignment with a core environmental logic, while making sense of what is best described in this instance as an overlapping political-regulatory logic. Minimal negotiation was needed in this instance due the exploratory freedoms that typify the developmental trajectory of an undergraduate education. The need for more complex negotiation was soon to come.

Bryan's next encounter with logic multiplicity came during his time volunteering with the Peace Corps. On one hand, he recalls the societal logic that guided the Peace Corps being clearly aligned with the activities, strategies, and values that characterized the environmental movement. On one hand, the blending of the environment and societal logics required the integration of a community development focus with his environment-oriented agenda, which demanded little to no compromise on his part. On the other hand, he was also forced to negotiate the tension between applying entrepreneurial approaches (i.e., a market logic) to environmental

and social causes that were both justice-oriented and rooted in local culture. Looking back, he attributes the impact he was ultimately able to have on the local community and its surrounding environment to his growing sense of adaptability. He writes:

> I had to be willing to blend social and environmental justice with capitalist ingenuity and entrepreneurship, while at the same time honoring local social norms and cultural identities. I learned to adapt the scope and motivation for the project to align with community needs and be more willing to sacrifice time and materials without immediate progress.

Pointing to his own experience and several well-known cases of Peace Corps volunteers-turned social entrepreneurs, Bryan now embraces the promise of a blended societal-market logic that fosters social change and environmental justice through entrepreneurial activities. Thus, the experience and perspective he gained in the Peace Corps enhanced his early capacity to blend otherwise competing logics in ways that remain consistent with his own environmental and social values.

Following a brief period working in a city public works department, Bryan returned to college to pursue his first master-level degree in hydrogeology. He entered this program under the belief that academic laboratories are fully isolated from outside pressures and thereby driven solely by scientific curiosity. He was quickly confronted with the reality that external pressures tied to both market and political-regulatory logics continually permeate the walls of the academy. Market pressures are tied to inherent resource scarcities and the ongoing need to support research activities (including graduate student employment) through outside funding. Political and regulatory pressures stem from the need to align research projects with the funding priorities of government agencies, as well as the rigid and often complicated policies associated with subsequent support. Market pressures, as well as those that are political and regulatory in nature, did not explicitly influence Bryan's daily routine as a Master student. Instead, his attention remained mostly fixed on experiments, manuscript writing, and other typical student activities. Upon reflection, however, he recognizes the immediate, yet implicit influence cross-sector pressures had on both his training and how he was socialized as an emergent scientist. Specifically, he describes having to "modify my [his] ideological view of science to fit with my [his] supervisor's expectations and funder priorities. I [he] had to learn to mix a sense of idealism with one of reality."

Presently, Bryan increasingly sees the value in being a scientist with the ability to find and act on cross-sector synergies, no matter how subtle. He especially recognizes the value of his "bargaining skills" now that the global climate crisis has become a contentious point of political rhetoric and public debate. While Bryan began to gain these bargaining skills first as a Peace Corps volunteer and then as a graduate student, it was during his time in industry that he clearly recognized their value and began to purposefully sharpen and utilize them. As an environmental engineer in the mining industry, Bryan had to be flexible enough to perform under a market logic that viewed environmental responsibility as a regulatory obligation that should be kept to a minimum, while retaining and when possible acting on his core environmental beliefs. He summarizes his role in the mining industry and the associated challenges in the following way:

> I was part of the water group that dealt with environmental issues at primarily copper, gold, and silver mines across the western US and Mexico. Those of us in the water group were viewed as "tree huggers" and mostly a burden to the company, in comparison with the design engineers that were at the profit center of the mines – we [hydrologists] were just added cost, taking away from the profitability of the mines with whom we worked.

Despite the challenges and sense of alienation, Bryan was able to adapt to the market logic in ways that allowed him to quietly pursue environmental justice along the margins. He says, "understanding and adapting to the profit-driven perspective is necessary for the industry-based scientist to do their job and satisfy their need for environmental justice." Though, over time the intensity involved in constantly bargaining and adapting to the convergence of environmental, market, political-regulatory, and scientific logics eventually pushed Bryan to return to academia to further pursue his graduate education and recapture a stronger sense of "environmental altruism."

Bryan's decision to return to graduate school was not driven by a single dominant logic. Rather, he was motivated by an environmental-scientific-market blend that was continually evolving with each new experience. He had by now come to see the notion of pure research as being overly idealistic and that his scientific career, even if positioned in academia, would require the negotiation and blending of elements from otherwise distinct and oftentimes competing logics. This realization that had developed out of various experiences accumulated through volunteer work, earlier graduate training, and time working in both industry and government created within Bryan a "pragmatic view of how science can be used to solve the climate crisis."

From the start of his PhD program, Bryan noticed a difference in how he understood the research process compared to his younger, more traditional peers who entered their programs with less depth and breadth of experience and perspective. He writes,

> I think my experience navigating competing agendas and pressures in the different positions I have had perhaps better prepared me to recognize and learn to deal with the capitalist realities and political controversies that influence how science needs to be approached and framed when it comes to the climate crisis.

He observed other students struggling to accept that science, even in universities, does not happen in a bubble and that scientists have to adapt in order to account for the constant outside push for practical solutions with market potential, shifts in the political climate, and so on. He writes,

> I know firsthand that flexibility is necessary to move research forward. You have to bend without breaking at times in terms of your agenda and values. If you don't, you'll get stuck and be unsuccessful in making any kind of impact. Other students with less experience believe academic freedom releases them from compromise and thus have a really hard time adapting to the realities.

Overall, Bryan's observations of his peers suggest that the romantic view of academia that incoming PhD students seem to hold when entering their programs is inconsistent with how research is approached, framed, and conducted in this era of

cross-sector convergence. The disillusionment that is likely to develop from such naivete puts students at greater risk of abandoning their research aspirations altogether and consequently the scientific arm of the environment movement.

Bryan concluded his narrative with a reflection on how faculty work with students relevant to the influences of cross-sector convergence on the research process and, more generally, the scientific process. His reflections indicate that faculty primarily aim to protect graduate students from external pressures to acquire and sustain funding. Bryan writes:

> Faculty wanted us focused on learning scientific theories and research techniques, doing analysis, writing papers, etc. They did not want us to be concerned about or distracted by what was needed to support us doing this work. This really helped us develop our scientific abilities, but at the same time it left many of us in the dark about overarching realities. When some type of funding issue or political nuance interrupted or halted a project, students often became very unsettled and even jaded. I think this is because they simply didn't have enough understanding of all that was going on around them. I, too, got frustrated, but also seemed to be able to cope and adapt much more easily.

This particular reflection not only makes clear the strategic value of logic negotiation relevant to the influences and pressures of cross-sector convergence, but also provides indication of the need to more purposefully embed the development of associated skills in STEM PhD programs. As Bryan warns in his reflection, not doing so may be contributing to the attrition of young scientists who entered their PhD programs motivated and poised to make meaningful contributions to the efforts to overcome the global climate crisis.

Discussion and Conclusion

Bryan's story is somewhat unique in that he entered his PhD program with a diverse range of experiences that spanned the academic, government, NGO, and private industry sectors. He is an outlier in this regard. Yet, the wisdom gained through his experiences equipped him with a unique perspective from which to compare how he and his peers with more conventional backgrounds responded differently to various cross-sector tensions that now permeate the STEM PhD experience. From his vantage point, we have been led to argue the need to integrate new training and socialization approaches designed to better prepare the next generation of scientists who aim to confront the global climate crisis within this era of cross-sector convergence. Specifically, we conclude the chapter with a call for the integration of the skills, insights, and knowledge associated with what organizational scientists and sociologists have termed "boundary spanning" (Aldrich and Herker 1977; Comacchio et al. 2012; Schotter et al. 2017; Tushman and Scanlan 1981).

Our argument for the inclusion of boundary spanning in the preparation of PhD scientists is anchored in the assumption that the quadruple helix model and the era of cross-sector convergence will remain firmly intact for the foreseeable future. Meanwhile, the global climate crisis will unfortunately continue to escalate without

the development and implementation of more effective scientific and technological interventions. Thus, our aim is to constructively influence how STEM PhD students are being prepared as entrepreneurial scientists who are as well-equipped as possible to, in relative terms, quickly contribute to the alleviation of the global climate crisis.

Boundary spanning refers to the strategies actors deploy in order to resist, counter, and/or leverage the external pressures and influences that continually permeate the boundaries of their organizations and fields (Wang et al. 2018). For reasons described in the introduction section, the researcher capacity to effectively engage in boundary spanning when working under the influence of cross-sector convergence is especially important (Lundberg 2013). Yet, meager attention has been directed at how PhD students are being equipped to not only cope with, but to strategically leverage cross-sector convergence to the benefit and impact of their science on the global climate crisis (Meyer et al. 2016). The little work that has been done in this area is mostly focused on how graduate students are increasingly engaging in sustainability research by spanning disciplinary boundaries within the academy (Gosselin et al. 2016). This type of work is critical and to be applauded. However, equally important is how students are being both trained and socialized to engage in boundary spanning across sectors that extend beyond the partitions of their labs and the walls of the academy.

We explored the rich set of cross-sector experiences that Bryan called on to make sense of the organizational conditions under which he completed his PhD program through the lens of logic multiplicity. In doing so, we identified and illustrated the consistencies and clashes between the logics that shape the otherwise disparate sectors that become entangled under the quadruple helix model. We also showed how Bryan's diverse experiences enhanced his capacity to productively navigate the underlying tensions and remain committed to helping end the global climate crisis through scientific research. Unfortunately, his peers generally lacked similar breadth of experience and thus were at greater jeopardy of abandoning their research career trajectories as their idealistic views on the sanctity of science became clouded. This comparative gap leads us to recommend greater attention be given to the inclusion of mentoring approaches in STEM PhD programs that directly address logic negotiation and cross-sector boundary spanning, especially in the context of the global climate crisis.

Three overlapping inter-organizational boundary spanning skill sets can provide a foundation upon which faculty can begin to more directly mentor students in logic negotiation. The first of these sets pertains to cultural skills (Barner-Rasmussen et al. 2014). Recall that dominant logics work to establish and protect the cultures of fields (Marquis and Lounsbury 2007). Accordingly, students must learn to recognize the similarities and differences in the cultures that guide the activities, priorities, and strategies of the various sectors that converge under the quadruple helix model. Such recognition should not be aimed at determining who is right and who is wrong. Instead, the goal is to identify differences, act on opportunities for adaption, and acknowledge elements that are non-negotiable. This objective approach

prioritizes the discovery of common ground rather than the accentuation of differences and impasses.

The second and third skill sets center on information processing and language acquisition. Information processing refers to the capacity of actors (e.g., researchers) to take in, make sense of, and act on the various cross-sector information that converges on their work (e.g., science) (Adler et al. 2003; Tushman and Scanlan 1981). Similarly, effective change agents are able to understand and engage in a shared language that enables productive collaboration across inter-organizational boundaries (Barner-Rasmussen et al. 2014; Harzig et al. 2011). Accordingly, faculty are encouraged to work with their mentees in ways that increase their abilities to translate cross-boundary information relevant to the aims of their research. The focus of such translation should be on adapting to and maximizing that which is conducive to their aims, adjusting their aims as necessary and appropriate, and strategically resisting influence when deemed detrimental to the outcomes. This translation process flows two ways. That is, after receiving, processing, and adapting to external information, students must be prepared to effectively convey their responses and underlying rationales to those outside of the academy. Students should be mindful of the likelihood that external actors are equally unfamiliar with the alternative logics that dominate fields other than their own. Overall, the bargaining that occurs when negotiating the tensions inherent to logic multiplicity requires the ability to openly receive, objectively process, and strategically convey information across inter-organizational boundaries.

Faculty mentors are also encouraged to take great care in how they frame the importance and potential impact of boundary spanning relevant to overcoming the global climate crisis. In particular, the role of the boundary spanner has been positively associated with a change in leadership across a number of contexts that range from market-based collaborations to social movements (e.g., environmentalism) (Roberts and Beamish 2017; Wang et al. 2018; Wright and Nyberg 2012). Students should be prepared to view logic negotiation and boundary spanning as strategies for maintaining (not compromising) their scientific integrity and commitment to environmental justice and stewardship, while effectively advancing the impact of their work on the alleviation of the global climate crisis. In this light, the strategic goal is to maintain the core in adherence with scientific, environmental, and societal logics, while innovating on the margins in ways compatible with market and political-regulatory logics. The empowerment to come from a deeper understanding of cross-sector convergence and the development of negotiation and spanning skills and strategies stands to offset the disillusionment and fleeing of otherwise promising scientists and environmental change agents.

There is also a moral dimension to the purposeful integration of skills and strategies for boundary spanning and logic negotiation with environmentally oriented PhD programs. Indeed, many, if not most, students are likely to enter these programs with values and motives that are directly tied to environmental justice and stewardship. Yet recognizing that environmental crises such as global climate change are not universally accepted concerns, such values and motives may through cross-sector convergence come into conflict with other, less progressive agendas.

Boundary spanning and logic negotiation skills and strategies have the promise of helping students strengthen and retain a sense of agency over their work as competing pressures converge on their training and development. It is imperative that students learn to effectively navigate the complexities of cross-sector engagement without abandoning the moral compasses that direct their quests to contribute to the alleviation and reversal of the global climate crisis. This proposition is consistent with a growing line of inquiry that confronts the authoritative degradation and homogenization of researcher value systems by virtue of the socialization processes and operational realities of PhD programs, post-doc positions, and early-stage career experiences (e.g., Fochler et al. 2016; McAlpine and Amundsen 2009; Roumbanis 2019).

We recognize that faculty themselves will not always be adequately equipped to span boundaries and strategically navigate multiple logics. This is all the more reason to more purposefully engage their colleagues and students in discussions and initiatives that foster the underlying skill sets. True to most mentoring models, the mentor and mentee both stand to learn and grow through the process (Meyer et al. 2016). Conversely, isolating students from external pressures will only serve to stunt their development, as well as that of a scientific community with the promise of creating viable solutions to the global climate crisis.

In summary, the mentoring model we are proposing here is, to our knowledge, the first to directly consider how STEM PhD students are being prepared to contribute to the alleviation of the global climate crisis in an era of cross-sector convergence. Our proposition is anchored in an autobiographical analysis of one of our own stories. While systematically and rigorously conducted our analysis, the insights we have generated here are not transferable. Accordingly, the theory-driven mentoring model that we have framed warrants piloting and subsequent empirical examination and refinement. To this end, we close by suggesting the following three research questions that are likely to be fruitful in carrying forward in the line of inquiry we have initiated here:

1. How, if at all, do faculty introduce STEM PhD students to the realities of cross-sector convergence relevant to work that targets the global climate crisis?
2. How, if at all, do faculty mentor STEM PhD students in the areas of logic negotiation and boundary spanning specific to the global climate crisis?
3. What are the impacts of cross-sector convergence on the career trajectories and attrition patterns of STEM PhD students with interests and goals specific to the global climate crisis?
4. How, if at all, can logic negotiation and boundary spanning enhance the capacities of STEM PhD students to retain their sense of agency and moral commitment to the alleviation and reversal of the global climate crisis?

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Chapter 4
Operationalising Research: Embedded PhDs in Transdisciplinary, Action Research Projects

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Abstract This chapter explores strategies for operationalising PhD studies in the context of a large research project addressing the unrelenting problem of ill-health in the growing population of informal settlements in the Global South. We advocate that PhD training presents an opportunity to contribute to these contexts by both training a new kind of action-oriented scholar, but also by strategically deploying the enormous energies and original work generated through PhD candidates towards this critical mission. Driven by the desire to give agency and utility to PhD researchers in a much-needed domain of transdisciplinary research, the chapter chronicles the trials of a group of four PhD candidates embedded in a large health study using innovative approaches to the revitalisation of 24 informal settlement communities in the Asia-Pacific. Through a discussion between the candidates and supervisory team, the chapter uncovers three types of embedded PhD's. It articulates the challenges and opportunities of the model and reflects on the forces at play, producing practical advice for instrumentalising PhD research in the context of transdisciplinary research.

The Complex and Urgent Global Context

We find ourselves in a time of crisis. Here in Australia, Black Summer has ended with a staggering 186,000 square kilometres of bushfire ravaged land. At the peak of the bushfires, air quality dropped to hazardous levels (Tiernan and O'Mallon 2020). Meanwhile, 2020 is still set to be the hottest year on record. Then, there is COVID-19, the pandemic with more than 18 million reported cases and over 730,000 deaths (as of 11 August 2020; Dong et al. 2020). The impacts on vulnerable

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populations, while still unknown to their full extent, are horrific as the number of cases continues to rise. Informal settlements in the Global South are not only the most vulnerable communities in global society, they are also the most affected by such disasters, pandemics and climate change. Beyond these still, there is a range of other social and planetary challenges at large, worst felt by these vulnerable communities. Informal settlements provide the context and the mission for our research and action.

We write this chapter following physical isolation measures from home. But amid our numerous video conference meetings, we feel that our mission and its attendant research and research training frameworks are now more relevant and indeed urgently required. A conversation that was critical, regarding the relevance of built environment research to such global challenges as disease and homelessness, urban design and public health, the climate emergency, and systemic inequality, has now become urgent. We believe that contemporary research needs to be nimble, able to shift in response to crises. To adequately and quickly respond and contribute to these dynamic contexts, we need research that is supported by transdisciplinary[1] and cross-sectoral modes and networks to quickly and effectively respond to accelerate the cycle of translation between discovery research and on the ground implementation.

If we are seeking transformative change in these difficult contexts, we need to deploy all resources and shape engagements to contribute in tangible and direct ways to these challenges. We advocate that PhD training presents an opportunity to contribute to these contexts by both training a new kind of action-oriented scholar, but also by strategically deploying the enormous energies and original work generated through PhD candidates towards this critical mission. This approach, however, is fraught with difficulty and complexity, and we recognise the need for frameworks which guide research training and can support candidates, supervisors and the complex network of actors involved in these projects, towards more positive and productive engagements. We also need to shape these frameworks so that PhD research can contribute to the broader mission and projects at hand in direct and tangible ways. We aim here to add to the repertoire of PhD training models by articulating different types of entanglements of PhD candidates within transdisciplinary research.

Operationalising PhD Research: The Shifting Focus in Doctoral Research

There is a noticeable shift in the focus of higher education programs. In our home discipline of architecture, we see a groundswell of degrees worldwide which seek to increase the utility of research, and lessen the divide between education and practice

[1] We adopt both definitions of transdisciplinary research aiming at "a more thorough integration of knowledge by focusing either (1) on transdisciplinary concepts and methods which are shared by more than one scientific discipline or (2) on the implementation of participatory processes within the research process which allow, from the beginning, deliberations with practitioners, citizens, and stakeholders about the purposes of a research project on the one side and an integration of first-hand non-scientific knowledge on the other." (Carayannis 2013).

(Tang and Mitchell 2016; Ramirez-Lovering 2015). This has led to the development of alternative models of education and research that are increasingly "in a condition of readiness to perform some intended function" (Merriam-Webster n.d.), or rather, becoming *operationalised*.

The postgraduate education sector is experiencing this change through an increasing demand for a different type of PhD—one not only concerned with pathways to academia, but as high-level training leading to new professional opportunities in government, industry or civil society organisations. In our experience, prospective candidates increasingly seek projects and topics that address critical problems and see the PhD as a pathway to contribute to a larger mission. This change in the disposition of doctoral researchers is supported by a transition in the university sector towards impact directed education and research. High impact scholarship is often aligned to key social and environmental challenges that characterise the contemporary global context, and isolated to science, technology, engineering and mathematics (STEM) disciplines. Yet the complexity of global challenges like climate change, means that integrative, transdisciplinary and creative approaches are necessary (Brown et al. 2015). As such, in action-oriented research, we seek to break down barriers between disciplines and to enable creative dialogues between researchers, communities and government working on live projects for real-world impact. In this paradigm, "the researcher is no longer the scholar, but a developer, bureaucrat, partnered with government, communities and industry to develop new solutions. This reinforces the importance of action research and our role as academics in these big, complex urban problems" (Murray 2020). Our interest moves beyond a PhD candidate being part of a Department cohort or topical research group,[2] or the now common industry-partner PhD model (Department of Education 2014; Group of Eight 2013). We focus on operationalising PhD research by embedding them in transdisciplinary action-research projects.

Four PhDs Embedded in a Live Project

This chapter takes as a case study a group of PhDs embedded in one such project titled RISE (Revitalising Informal Settlements and their Environments), undertaken in the Monash Informal Cities Lab at Monash University. Now, almost three years into the PhD's candidature, we see an opportunity for reflection on our experiences as supervisors and PhDs engaged in a live project.[3] We have done this through a dialogical process and iterative cycles of dialogue and reflection, surfacing and exploring opportunities and challenges—a series of back and forth reflections between us—the PhD candidates and supervisory team.

We first sought reflective personal written responses from the PhDs, responding to a series of factors that the supervisory team had identified to be formative stages

[2] In which researchers meet and participate in events like seminars and discussion forums, or occasionally contribute to collaborative projects where their interests overlap with others.

[3] Live project, refer to Dodd et al. (2012) and Mitchell and Tang (2015).

in the PhD. We followed this with group discussions reflecting together on these experiences. The PhD reflections and transcribed discussions were then coded and analysed. We traced the relationship between PhD experiences and RISE project development, trying to capture how project dynamics transformed PhD projects relative to our lab mission, and the RISE project itself. We then mapped the development of PhD focus areas, structure and methodology over time against RISE, as well as competencies that emerged to enable candidates to persevere and progress effectively. In so doing, a range of enabling factors and a research ecosystem composed of a number of nested elements have emerged.

While PhD experiences were also shaped by other, more typical challenges associated with action-researchers undertaking research in a context other than their own (Scott et al. 2006), we focused closely on the PhD entanglements with the RISE project. From their reflections, we noticed trends that captured in different ways the limitations and constraints particularly in relation to the RISE method, project timelines of the PhD and project and the important separation between RISE research activities and delivery of sanitation infrastructure. In order to understand the dynamics of this entanglement, we first need to understand the RISE project.

The RISE Project and Its Methodology

Involving over 1200 households and 7000 people, RISE explores how to improve water and sanitation, by implementing a novel approach to settlement upgrading in 24 urban informal settlements in Makassar, Indonesia and Suva, Fiji (Ramirez-Lovering et al. 2018). Working alongside communities, governments, local leaders and partner institutions, RISE will implement a series of integrated water sensitive urban design (WSUD) solutions to deliver low-impact, cost-effective health and environmental improvements. The approach includes drainage, water supply and sanitation improvements, with new or renovated toilets, and connection to a decentralised treatment system of septic tanks and constructed wetlands or bio-filtration systems. Underpinned by the emerging discipline of Planetary Health, RISE's success will be measured by the health and wellbeing of residents—particularly children under five years of age—and ecological health of the surrounding environment.

RISE's focus on human health combines quantitative and qualitative approaches and is structured as a randomised control trial (RCT). Of these 24 urban informal settlement neighbourhoods, six from each country are randomly selected to receive the intervention in the first round (see Fig. 4.1). Following a period of baseline assessment monitoring health, wellbeing, policy, and environment (water, soil, temperature, floods and morphology), the project engages each community in a participatory, co-design process to develop and implement the intervention. After construction is complete, post-intervention assessment begins, continuing to monitor communities against the six non-intervention communities in each country, the control group. Through this RCT, RISE seeks to produce empirical evidence of the impact of this approach to informal settlement revitalisation on human and environmental health.

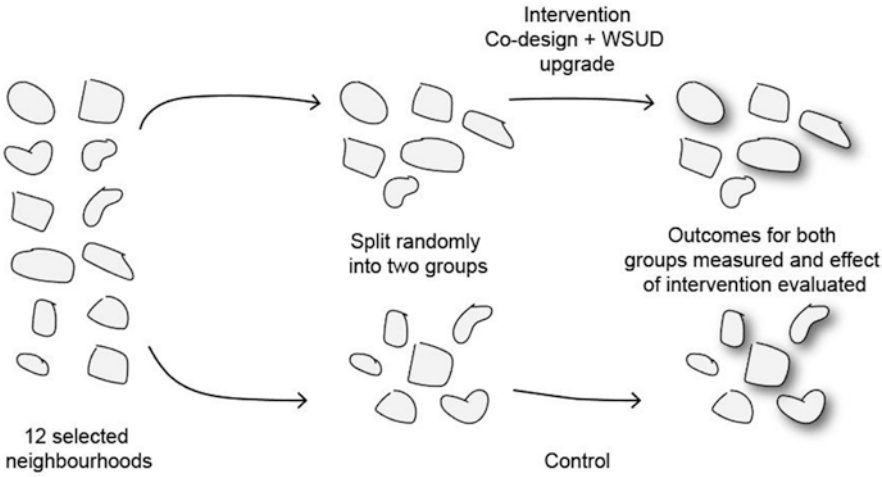

Fig. 4.1 Diagram showing the structure of the RCT and the relationship between intervention and non-intervention neighbourhoods in each country

RISE is structured into teams of interdisciplinary researchers: Design and Engagement; Ecology and Environment; Human Health; Wellbeing; Policy and scaling-up; and two country teams based in Makassar and Suva. The researchers—around 70 in total—have significant expertise in the range of fields required for project delivery, including engineering, ecology, hydrology, architecture, landscape architecture, community engagement, public health, epidemiology, statistics, economics, and IT. The country teams—approximately 30 staff in each—bring local expertise in community development, public health and environmental sciences, essential to project delivery. Not least, the project is also supported by a diverse stakeholder group, including funders,[4] government agencies, industry partners, and the study communities.

Research Ecosystem and PhD Integration

We seek to develop an alternative model that shifts from PhD researchers embarking on isolated projects, to team-based structures integrated in live projects that contribute to a common mission—an embedded PhD model. The embedded PhD model development and successful operation relies on a range of enabling factors and a research ecosystem composed of a number of nested elements (see Fig. 4.2). This is described in the following paragraphs.

[4] The project research is supported by the Wellcome Trust, while the infrastructure implementation is supported by the Asian Development Bank (ADB), New Zealand Ministry of Foreign Affairs and Trade (MFAT) and the Government of Fiji.

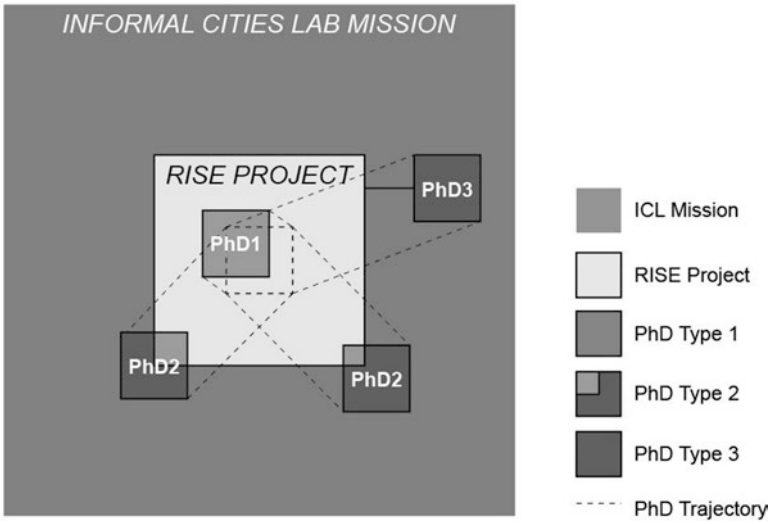

Fig. 4.2 Embedded PhD model ecosystem and different PhD typologies of integration

The Lab Mission and the Project

The Informal Cities Lab is the platform for the embedded research ecosystem. The lab is focused on the collaborative transformation of urban informal settlements in the Asia-Pacific through a transdisciplinary, community-centred approach, which in turn contributes to high-impact multi-stakeholder research projects. Conviction in this mission—its conceptual agenda and modus operandi—is central to creating an environment that is able to hold the passionate engagement required of PhD candidates undertaking the embedded PhD model. The mission provides direction for guiding the lab candidates, at a high level, through the uncertainties and dynamic environments that characterise these complex, multi-stakeholder engagements (Mazzucato 2018). Importantly, the lab also brings a network of partners and scholarship base, allowing candidates to select the ingredients that will best support their investigations. It is important that the mission is sufficiently broad to allow for different engagements but also coherent—clearly and specifically articulated to connect to varying PhD directions. As the next element in the embedded research ecosystem (see Fig. 4.1), the RISE project provides a thematic diversity to allow for different PhD directions. The project is also central in providing the research infrastructure.

The PhD Team

The establishment of a PhD cohort proved to be an essential component for the embedded model, as candidates enrolled concurrently and moved through the PhD program together. At the start of the project four competitive scholarships were advertised which described the project and PhD frameworks—team-based

engagements with a diversity of stakeholders, interdisciplinary teams and in-country governments and communities. Through broadcasting the mission, we sought to draw sympathetic candidates to RISE and its model of research training. While broad PhD subject areas were initially described, applicants were asked to identify their own specific questions to extend or complement the project aims or broader lab mission.

We were looking for a diverse PhD team and the four successful candidates were selected, among other things, based on educational backgrounds which include architecture, urban planning and social sciences, urban design, and engineering. Their motivations for joining the project ranged from disciplinary and methodological curiosities, such as the opportunity to unite professional and academic interests, or to link research from different fields, or develop and explore transdisciplinary team-based and hybrid research practices; to practical aspirations to explore real-world problems from empirical and theoretical standpoints, and to undertake impact-driven research that would enact "meaningful change" in the world. The candidature began three months after the RISE project kick-off and a few weeks after the initial community engagement activities in the Demonstration Sites[5] in Suva and Makassar. In these early months of the RISE project, the diverse team of researchers and industry experts were still defining the research scope and implementation agenda.

Three Typologies of Integration

Reflection and analysis on the PhD experiences have revealed three distinct typologies of PhD integration within RISE: PhD type 1—embedded internal, type 2—embedded hybrid and type 3—embedded external (see Fig. 4.1). While one candidate, Daša, actively embedded her research and contributed across the range of project parameters (type 1)—methodological, structural and temporal—Erich and Mahsa focused their research contributions on specific project components, for example community-led flood monitoring or an investigation into land tenure and its impact on infrastructure upgrades (type 2). Brendan developed an aligned topic that, while using the RISE project as an embedded case study, was not directly integrated in core RISE activities. Brendan's research, an investigation into the morphological transformation of informal settlement environments over time, is however fundamental to the overall lab mission (type 3) and contributed to RISE in its later stages.

The three PhD typologies reflect, in various combinations, the spectrum of interplay between core project aims and more direct and connected PhD studies (type 1) to parallel and affiliate studies that may not directly integrate into core project research but deliver on important aspects, nevertheless (types 2 and 3). Each of

[5] Required by the infrastructure funders to demonstrate the scope of the intervention and the socio-technical infrastructure it comprised—largely untested in the informal settlement context— "in action".

these PhD typologies plays an important role with diverse and parallel contributions to project and lab missions alike and is essential to a productive and resilient research ecosystem.

Reflections from the Inside

The embedded model has influenced PhD project trajectories in different ways, drawing out an exciting but often-uncomfortable interplay between the PhD's, RISE and the lab. Table 4.1 summarises the manner in which the different project elements—methodology, structure, timing, impact research, infrastructure and data—affected the three PhD typologies.

Research Methodology

Engaging in transdisciplinary research often involves complex and compound project frameworks and methodologies. These will variously affect embedded PhD structure and development. For example, while the PhD projects were not structured around the RCT approach, this context presented limitations and constraints that had profound impacts on all PhD project in different ways depending on the type. Following the RCT structure, PhD projects were initially planned to relate to the pre-and post-intervention state of communities, and the intervention design and engagement process that drove the broader team's focus. While all candidates had to be conversant in, and abide by the RCT's scientific objectives and structures, their level of alignment to the RCT structure, and the candidates' embeddedness in the research ecosystem, shaped their research in significant ways. For example, Daša, a type 1 PhD, whose research focused on participatory design workshops, found that her direct engagement in the project forced her to undertake workshops only with intervention communities and prevented additional fieldwork to be conducted in control communities to enable comparison. While close alignment was incredibly productive for her research, allowing combined data collection for her PhD with project activities, the inability to engage with control communities detracted from her research.

On the other hand, for Mahsa and Erich—type 2 PhDs, and Brendan—type 3, the nature of the research meant that they were less hampered by the RCT structure and allowed them to look across both intervention and control communities and compare different conditions. Erich's community-led flood monitoring was developed in conjunction with baseline activities across intervention and control communities and allowed him an expanded breadth of analysis. However, while these PhD

Table 4.1 Summary of the manner in which the different project elements affected the three PhD typologies

RISE project elements	PhD type 1—embedded internal (*Daša)	PhD type 2—embedded hybrid (*Erich and Mahsa)	PhD type 3—embedded external (*Brendan)
Methodology Compound, qualitative and quantitative methodologies of RISE allow for different alignments and engagements	Alignment to project methodology can be incredibly productive for both project and PhD but can limit scope of PhD research	More flexibility in research and activity design	
		Still need to accommodate project activities/structure in their planning	
Structure RISE implementation and research objectives allow for different types of involvement and focus	Need to manage PhD's progression alongside project, for example data analysis and research publications	Important to maintain connection to project's specific objectives and lab mission	
Timing Most difficult to achieve for close alignment of PhD with the project. Project delays can significantly impact the PhD. It is important to align PhD commencement with end of project establishment	Important that the student is part of discussions relating to project timing	Sequencing of activities is an important consideration to align to project data, milestones, and so on	Relatively detached from project timing
	PhD research question integral to resilience and rigor of the PhD study		
Impact research Connection of PhD to project influences the ability of the candidate to affect the work on the ground. If PhD motivation relates to action this should be discussed early on	Need to manage burden on PhD as a result of direct connection to project	PhD contribution/involvement in project limited by project elements.	
		Data/outcomes produced in PhD may be useful for implementation further along the timeline	
Infrastructure Project infrastructure provides a significant and valuable enabling environment to the PhD research	Project infrastructure supported PhD fieldwork		
	Transdisciplinary setting supported the development and enriched work		
Data Intellectual property and data confidentiality should be transparent and communicated early on	Need to manage burden on PhD as a result of direct connection to project	Good synchronicity with project can lead to productive contributions	Close relationship to mission may result in unplanned productive contributions
		Poor synchronicity or limited flexibility can lead to PhD challenges	

typologies were not "internal" in the research ecosystem, they needed to accommodate the project when planning their own research. Brendan reflected that one of the most fundamental impacts on the direction of his individual research project, sited in the midst of a larger transdisciplinary research project, was the "constant back-and-forth negotiation" required to navigate the project, its research methodologies, access to research sites and data, amidst his own and other candidates' research interests.

RISE's large scale had multiple researchers working across the project—engaging with the same vulnerable communities—requiring negotiation of PhD scope and activities to reduce overburdening communities, meet individual requirements and team objectives. For Mahsa, these constraints extended through her project engagement, for example limiting her ability to attend community engagement sessions undertaken to co-design the infrastructure. These restrictions shaped her research approach, leading her to "consider alternative and complementary data collection activities" in order to be resilient to unpredictable project shifts and conditions.

Research Structure

Tensions Between Implementation and Discovery Research

From the outset, candidates were immersed in RISE, taking part in numerous project activities including intervention infrastructure design and development, community engagement, data collection, whole of project meetings and activities. Through this intensive immersion, candidates developed individual research agendas and projects aligned with issues identified throughout their involvement (see Fig. 4.4). The PhD projects were structured to engage in a series of investigative loops. Framed as focused studies or sub-projects, these would vary in overlap with RISE and make project contributions at key moments. As the candidates progressed, and their research became clearer and more specific, their degree of direct involvement in the project would diminish.

At the start, we wanted candidates to work closely on project implementation, namely the design of the intervention and frameworks for designing with communities. We hoped this would lead to a strong and productive connection between PhD projects and delivery. The Department's practice-based PhD model—the "PhD by project"—supports this approach, in which, "the argument is made through both design (including analytical and observational drawings, as well as other manifestations of design) as well as discursive text" (Department of Architecture 2019). PhDs developed close knowledge of RISE through their involvement, participating in Demonstration Site design and documentation for Makassar and Suva, such as the production of drawing sets and assisting with the development of initial community consultation materials and strategies. This involvement with implementation was supported by the PhD-by-project mode, however led to unclear distinctions between

PhD and project, roles and responsibilities, which became more pronounced as time progressed. Brendan observed that "Occupying this in-between space of researcher/student/employee revealed some opportunities for research, however due to a focus on implementing and 'actioning' research, many gaps in the process appeared".

The different levels of PhD integration in RISE activities shaped candidates' research, and over time they gravitated towards different levels of integration (see Fig. 4.3). Daša (type 1) remained directly involved for the longest period, reducing only after mid-candidature; while Erich, Mahsa and Brendan (type 2 and type 3) reduced their direct involvement after confirmation, remaining connected to the project's specific objectives and lab mission. From Brendan's perspective, although this experience was valuable and provided insight to the project's structure and context, "the practical realities of delivering PhD material while simultaneously documenting infrastructure designs became untenable". It quickly became apparent that the project delivery requirements couldn't be fulfilled by the research team alone and the work was impeding candidates from maintaining the University's progress expectations and developing their projects.

Following confirmation (see Fig. 4.3), distance was established to protect both PhD research and the project, and at this point the different degrees of integration started to emerge. Additional delivery-focused professional staff were employed to drive the progress of the RISE project intervention, enabling the PhD candidates to focus on their research. The candidates needed to readjust expectations of their involvement in RISE, and their project's relationship with it. Tensions remained for Daša, whose project remained closely intertwined with the project delivery, focused on community engagement and the integration of local knowledge and practices with infrastructure design. Maintaining a connection to the project while progressing the PhD was time consuming, and the separation of research and implementation teams and agendas led to a communication gap, and unclear responsibilities

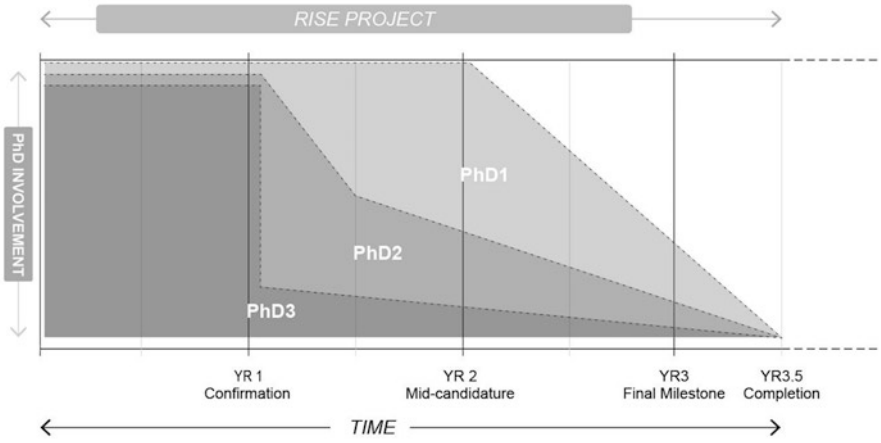

Fig. 4.3 The PhD research varied in overlap with the project and contributions over time. This was reflected across the different typologies of integration

and boundaries between the PhD project and RISE. Daša reflected that "in order to stay connected with the implementation and the real impact of RISE, I was in constant and direct contact with both research and implementation teams and looking into the design of the effective interaction with local communities". Although she acknowledges this provided "an incredible opportunity for exploration", on the other hand it was plagued by a complicated matrix of responsibilities and communication channels. Daša observes, "This is probably more evident because the research is embedded within the PhD-by-project and design-led research, where these boundaries are blurred". However, it made making a productive contribution to, and engagement with, the project difficult. This has resulted in a greater separation from the project than anticipated.

Research Timelines

Engaging with a live project involves adapting to events and related timelines that are driven by the project's real-world contexts. The RISE timeline was impacted by events outside the project's control, significantly altering delivery scheduling across both countries. For example, in-country laboratory and team establishment delays meant that baseline sampling started late, causing randomisation to be delayed 12 months. Furthermore, instead of the planned synchronised randomisation in both countries, funding changes for the civil works for the Suva arm of the study caused a six-month delay in randomisation (see Fig. 4.4). These changes had knock-on effects, pushing post-construction assessment of RISE's intervention communities

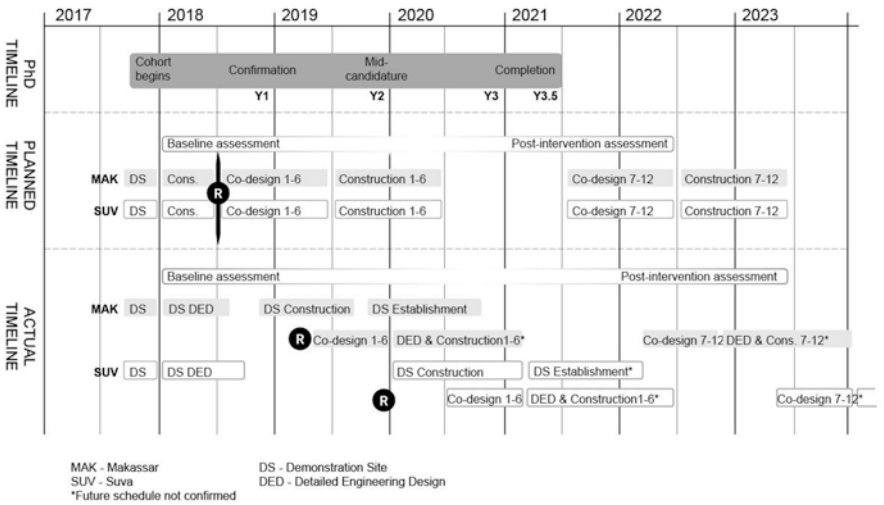

Fig. 4.4 Diagram of the PhD timeline, mapped against the planned RISE project timeline and the actual delayed timeline, as influenced by internal and external factors

outside the PhD timeline. While this did not affect the characterisation of the different PhD typologies per se, Erich and Mahsa who had originally planned to focus on Suva shifted their attention to Makassar. They were coincidentally both identified later as type 2. Preliminary fieldwork and contextual research undertaken in Suva was set aside as the candidates refocused on Makassar to maximise the overlap of the PhD with RISE. Reflecting on the shift, Mahsa observed, "While this has limited the opportunity for cross-country comparison which may help further exploration of the scalability of the RISE project, the Makassar case provided a more diverse range of land-related challenges (tenure, conflict, space), and this consequently has enriched the analysis". It became apparent that sequencing of activities would be an important consideration, in order for the type 2—embedded hybrid candidates to remain in contact with the project and coordinate their activities to facilitate productive research contributions.

For Daša and Brendan (types 1 and 3) who planned to undertake post-occupancy studies of intervention communities, the delay meant that the first six interventions would not be delivered in time for diachronic comparison across datasets. The decoupling would also limit immediate cross-country comparison, since the countries would not experience the project synchronously, between rates of morphological change, and the impacts of participatory design activities and construction activities on communities, among other aspects. Daša's research continued to progress alongside RISE, with her research closely tied to the project objectives, structure and outcomes. She found that the focus of her research question was contingent to the study being able to adjust to changing conditions and maintaining rigour. Contrastingly, Brendan's research shifted here into what has been identified as a type 3—embedded external PhD, becoming more detached from the project timing, while retaining connection to the project's specific objectives, structure and lab mission. This gave him more flexibility to define his research scope and activities.

Research Impact on Communities

The RISE project's built intervention seeks to respond to real-world problems, such as the health and environmental challenges of inadequately serviced neighbourhoods. The project engages with participating communities through a process of co-design to identify and target significant water and sanitation gaps that can be addressed through the intervention. Engaging in RISE through an action research methodology also influenced the PhD candidates' perspectives on RISE and development of their research.

Type 2 and 3 candidates felt that, in some instances, the project limited potential for their research to produce meaningful and useful outcomes for the project or communities as some of their research activities or aspirations were not in line with, or requisite for project implementation. Data produced by the PhD research was in some cases directly useful for project implementation. However, there is potential for the contribution or involvement of type 2 and 3 PhDs to be negatively affected

by the project itself. Since the PhD projects are ongoing it is expected that they will have promising outcomes and contributions to the project in the future.

Operating through the type 3 mode, Brendan felt that the complexity of RISE and its RCT structure prevented him from undertaking certain activities that involved communities in his research. This was in direct contradiction to his personal view, "…that in the contexts in which RISE is situated there is a great need for the collaborative generation of knowledge". This fuelled an internal conflict around "conducting research in a real-world context in which vulnerable populations provide data… [Which] directly affected and shaped my research focus, my research methods, and the theoretical framework from which I operate". The tension between research activities and lived experiences during fieldwork was observed by Erich as well. He observed that theoretical frameworks he was identifying through his literature review on water level fluctuations in informal settlements were not appropriate to these communities, even seeming "limited, misleading, or derogatory". This reinforced the importance of undertaking fieldwork and having ongoing engagement between project and PhD to support the relevance and rigour of the research.

For Daša, working through type 1—embedded internal mode, the close manner in which her research was intertwined with the project led to feelings of responsibility towards the communities, as well as challenges shifting into later research phases including data analysis and writing up. Daša, reflected that, "through my year-long fieldwork I became very close to the RISE communities. This added another layer of responsibility to my research. After my fieldwork finished, the project implementation continued. I had to distance myself from all teams and communities in order to look at the data and make conclusions that are in line with what the academic discipline demands for quality research".

Research Infrastructure

For many action-research PhD projects much of the first year is spent establishing research infrastructures like networks and support frameworks, to align the PhD project to a relevant real-world situation. For this PhD cohort, structural aspects of RISE established after its launch in 2017—such as international—and in-country research environments and networks—provided significant opportunities for the candidates. Although integral to the delivery of RISE, the transdisciplinary setting of partners, expert academics and practitioners provided a strong foundation for the development and enrichment of the PhD's work. For example, PhDs had the opportunity to participate in RISE's monthly interdisciplinary cross-team meetings of early career researchers and country coordinators, as well as annual workshops bringing project teams together to report and share ideas. This offered potential for collaboration and discussion on work and, in some cases, led to innovation, greater integration of the PhD project, or publications.

The candidates also took on teaching work in our Department. This included leading courses related to, and funded by the lab and its mission, such as a

month-long overseas unit engaging undergraduate students in project contexts and enabling candidates to travel during the first year of their candidature before confirmation. Their later fieldwork travel and accommodation was also covered by project funds. They found valuable support in the country offices. The local staff acted as informants, translators, mediated interactions with stakeholders from communities to institutions, NGOs and government agencies, and invited them into their homes. Brendan reflected on the value of this infrastructure, that there was this "existing network that we could use which was, is really valuable, and is continuing to be". Erich also observed the advantage that this served in establishing and undertaking the PhD project, where relationships with communities were already established by the project.

PhDs across all typologies observed significant benefits from these project infrastructures, which provided a transdisciplinary setting of academic and practitioner experts for the development and enrichment of their work, and supported them to undertake travel to familiarise themselves with the research context.

Data

In an embedded PhD mode, it is critical that intellectual property and data confidentiality are transparent and communicated early on. Candidates across the three PhD types had different experiences relating to data collection and sharing. For Daša, her close involvement in the project delivery involved her in reporting requirements. Meanwhile, for type 2 PhDs, we observed that good synchronicity with the project could lead to productive contributions, such as a critical dataset which provided opportunities for them to contribute and collaborate with others in RISE. Through his research, Erich participated in the development and implementation of a community-based flood monitoring project. The project engaged members of the community in reporting daily changes in water levels, against gauges installed close to their home. The monitoring project produced directly beneficial data on seasonal changes to water levels in RISE neighbourhoods which could be used to understand influencing factors on community exposure during these periods, and to inform the relative levels of critical infrastructure that had particular flood tolerances.

In comparison, where PhD activities were less synchronised with the project timeline, or the PhD has very specific requirements, we observed that issues could be experienced around data availability. This would delay, or require adaptations to the PhD project, such as supplementary data collection. For example, the project documentation and reporting requirements did not always match the timelines and level of detail that type 2 candidates required and were already difficult to fulfil with the available resources. In addition, the nature of implementing the project on the ground meant that the delivery teams (based in Australia and in Makassar and Suva) needed autonomy to act and respond to on-the-ground needs as required. This fluidity affected candidates' ability to access information "as it happened" and, for example, limited Mahsa's ability to understand the impacts of governance and land

tenure, as they related to project implementation since “conversations, negotiations and meetings with the local and central government …often happen spontaneously, and the meeting minutes are not well-documented or accessible promptly”.

From Brendan’s (type 3) experience, we observed unplanned productive contributions that emerged over time as a result of the close tie-in of the project topic overall. These less centrally located typologies were still able to return on project investment, giving back to the project and overall mission of the lab. For example, Brendan’s morphological studies, which included quarterly documentation of built environment changes in neighbourhoods including new builds and renovations, self-built infrastructure (such as drains) and other spatial changes within sites. This work contributed more directly to lab’s mission to better understand the built environment dynamics of informal settlements, and as a result better working within them. The work was able to be correlated with other data collected in RISE, such as information on inward and outward movements of households in communities and tied into other implementation and research work in RISE.

Candidates’ Background, Competencies and Proclivities

Through the candidates’ interplay with the forces of the live project, we observed certain competencies among the PhD candidates that allowed them to persevere and progress.

The RISE project required candidates to be flexible and adaptable in order to navigate the changing timeframes and ongoing refinement of the project scope. This was echoed through the reflections via phrases such as “negotiation and adjustment”, a need for “emergent-” or “iterative-” “development”, and “adaptability and opportunism”. While all candidates’ projects adapted and developed over time, for Erich and Mahsa (type 2 PhDs), the desire to remain relevant to the project required particular flexibility relating to the challenges they faced. Erich found negotiating the research design and frameworks with reality particularly challenging. Meanwhile, Mahsa observed that the “emergence” of the research activities and plans over time, meant that the challenges and uncertainties of the project could inform the research methods and actionable outcomes. This project experience also instigated transdisciplinary explorations and an opportunity to develop skills in “interdisciplinary understanding and communication”. For Erich relating to risk management—as an engineer conducting research on floods within a primarily architectural research group, and for Mahsa relating to urban governance and policy—as an urban designer conducting research on implementation and scaling-up. This required them to work and communicate across disciplines and with a range of project stakeholders.

The project conditions brought forward not only “opportunistic” research endeavours but also “creative thinking and innovation” in light of working around the project’s constraints, and a need for “independence”. Brendan (type 3), aligned primarily to the mission, found that directing his research into gaps that he

identified in the project and working "externaly" to RISE required a "mindset of adaptability and opportunism" while presenting benefits and opportunities. Mahsa (type 2) reflected that although project constraints affected the "duration and depth" of her research activities, these facilitated creative thinking and grounded research outcomes. In hindsight, this creativity also maintained the PhD's ongoing relevance to the project. Meanwhile, Daša (type 1) reflected that the significant project administration undertaken by the supervisory team forced the candidates to take a proactive approach to their own development. "This was an opportunity to grow into an independent thinker, but it was also a source of insecurity and future uncertainty".

Conclusion

As we enter into the final year of the PhD candidature, it has been useful to engage in a process of dialogical reflection between candidates and supervisors. It is evident that, while full of potential, the model of operationalising PhD research within live research projects like RISE, is fraught with difficulty and uncertainty. However, as we make strides towards new projects which engage in these difficult contexts and continue the mission of the lab, it is clear that new embedded PhDs will form an increasingly important part of the research ecosystem. There is a confluence of aspirations as a new wave of prospective PhD candidates are increasingly valuing projects that, like the lab, "promote academic opportunities with international networks and participation in research projects" (Patricio and Santos 2019).

In order for a resilient research ecosystem to thrive within the research contexts described here, we look towards bringing together a number of key ingredients to the model. A clearly articulated, mission-based research program (the lab), a multi-year, transdisciplinary impact research project and a spectrum of embedded PhDs. In our reflection of the three typologies of embedded PhD, type 1—embedded internal, type 2—embedded hybrid and type 3—embedded external, the most productive aspects of the model were the result of a set of principles which we consider to be essential ingredients for meaningful engagements.

1. *Establishing a cohort*. Moving away from the lone PhD student and, for each project engagement establishing a PhD cohort. Ideally the cohort would begin at the same time and move through the process together.
2. *Diversity of engagements*. As it is difficult to predict the course of live projects from the outset because of the many variables at play, the PhD cohort should have representation across the typological spectrum—from those that are completely intertwined with the project to those who operate towards the broader mission but are not delivering core project research. This diversity will bring resilience to the PhD cohort and to the lab.
3. *Staging*. The typological direction may only become evident over time and as the project develops and variable become clearer, candidates can transition to different pathways. Refer to Fig. 4.3, which describes this transition. In our experience

it is key for embedded PhDs to begin their studies, in their first year, closely entwined with the project. This allows for deeper engagements and a meaningful knowledge of project teams, contexts and project infrastructure. In this model, the confirmation milestone at the end of the first year marks an important moment in the model. The first year is pivotal in determining which direction the candidature will take, and which typology is best suited to the candidate's aspirations and proclivities as well as best supporting the project research ecosystem. In this example, after confirmation, PhD's types 2 and 3 veer in different degrees away from core project research towards contributing in a broader manner to the lab mission. PhD type 1 remains deeply entwined with project operations and contributing to core research up to mid-candidature at the end of year two. After this, similarly, they move away from core project research.

4. *Fieldwork*. Many PhD programs do not allow fieldwork until after the first year and the candidate has been successfully confirmed. In international development projects where PhD's are expected to make significant contributions, a meaningful understanding of the context is critical in order to ground the project in reality. Travel to the project location(s) is highly encouraged in the first year.

The articulation of this embedded research ecosystem—involving the lab research mission, the research project and the three typologies of PhD's, we hope will offer guidance to future project structures in being more deliberate and productive. Charting different PhD pathways and articulating the roles and responsibilities of multiple types of engagements may also guide prospective students and supervisors in assembling the most productive and fulfilling arrangement. This framework may also offer utility in allaying some of the concerns and fears of engaging in such a model. Being explicit about this framework from the outset provides not only choice but also direction and certainty for candidates and supervisors alike.

We have explored through this dialogue the difficulties and challenges associated with deep project integration (see Table 4.1). In type 1, the greatest level of integration requires that the PhD topic and structure align in an entwined way with the project but that it is able to sway and adapt as the project inevitably changes over time. This dynamic environment can be stressful and uncertain, requiring the PhD researcher to have a certain appetite for chaos- to be nimble, flexible and open to the uncertainties of inevitable project deviations. In type 2, the hybrid mode remains connected to the project while establishing its own research direction with contributions at key moments. Less influenced by project dynamics than the first, this typology needs to retain clear communication in order to remain synchronised. In type 3, the PhD topic and structure shift away from the project but remain aligned to the lab mission granting the greatest degree of researcher autonomy. This detachment means that the typology may have greater difficulty engaging in impactful research however this can be managed through close alignment to the lab mission.

Although the PhD types were not so much a "choice", but rather emerged as project and candidature developed, the lab mission provided a space for PhD projects to be impactful outside the project and added resilience to the research ecosystem. From our collective reflection, this is one of the core characteristics that

separates the "embedded" approach from the "traditional" approach. For prospective supervisors hoping to establish a similar operative model of PhD research, it is important that directors/managers of prospective projects are able to identify the areas where PhDs will operate and a research direction for each "type" based on the project's unique requirements. This direction will assist future PhDs and be especially useful to supervisors in structuring and navigating transdisciplinary research ecosystems to more effectively contribute to on-the-ground, impact-driven endeavours.

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Part II
Earthing the PhD Curriculum

Chapter 5
Postformal Learning for Postnormal Times

Susan D. Porter

Abstract It is said that we live in 'postnormal' times, characterized by heightened interconnectivity, complexity, chaos, and contradictions, and perhaps most acutely exemplified by the current climate crisis. A reliance on the 'normal' ways of thinking, being, and working are largely responsible for the state we are in, and a reorientation and expansion of our ways is essential if we are to mitigate the upcoming catastrophes and move towards a more life-affirming future. We will need our graduates to manifest greater capacities for holistic, multi-perspectival, flexible, creative, and empathic understanding; they will need to be able to know in different ways, and be effective change agents in a diversity of settings. This chapter describes possibilities for and models of doctoral education that revisit its purposes and priorities towards these ends. In particular, it is argued that the parameters of dissertation research—the core component of student learning—should be broad enough to allow students to develop these attributes and that more student-centric, transformative, approaches to doctoral education are necessary. Initiatives at the University of British Columbia that promote and support these ideals have demonstrated their viability across most disciplines, and similar goals are broadly supported by a vast majority of surveyed graduate schools across the country.

> The reductionist, analytical world-view which divides systems into ever smaller elements, studied by ever more esoteric specialties, is being replaced by a systemic, synthetic and humanistic approach. The old dichotomies of facts and values, and of knowledge and ignorance, are being transcended...The science appropriate to this new condition [postnormal science] will be based on the assumptions of unpredictability, incomplete control, and a plurality of legitimate perspectives. (Funtowicz and Ravetz 1995)

I am not an environmental scientist, nor a social scientist or philosopher. I am writing as a practitioner of graduate education administration (and former molecular geneticist) who cares deeply about the future of the world, the future of the

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academy, and the futures of our graduates. I and my colleagues thus represent key contributors to the 'plurality of perspectives' required to navigate this very messy but urgent topic of how doctoral education and research can help heal and transform our world, mitigate our upcoming catastrophe(s), and redefine the interrelationships of all living things.

The climate crisis, the changing geopolitical landscape, our increasing global inequalities, and the COVID-19 pandemic are all emblematic of what has been called our 'postnormal' time, characterized by uncertainty, interconnectivity, complexity, chaos, and the prevalence of contradictory perspectives and values (Sardar 2010, 2015). The assumptions, conventions, and rules modern society has relied upon in life, in politics, and in science and scholarship of the past decades are in many ways inadequate to understand or cope with the uncertainties and complexities inherent in the increasingly urgent problems of our globalized, industrial world. In fact, as many have noted, it is these conventional scientific and societal worldviews and practices—responsible for the successes of technology, medicine, wealth production, and colonial expansion—that have in many ways caused or contributed to the catastrophes of our day. We are in an in-between period, Ziauddin Sardar has said, where 'old orthodoxies are dying, new ones have yet to be born, and very few things seem to make sense' (Sardar 2010).

The single lenses of reductive, disciplinary sciences and their underlying 'taken for granted logics', including binary cause-and-effect reasoning, context-independent generalizations, and formal, linear thinking (even if these are not always subconsciously adhered to) continue to be fruitful approaches for many questions. Using only these to the exclusion of other modes of thought, however, is wholly inadequate in addressing the profoundly complex and interdependent dimensions of much of our twenty-first-century world. First described in the 1990s, an emerging 'postnormal science' is a response to this gap (Funtowicz and Ravetz 1995). This approach to scholarship relies on 'the recognition of different legitimate perspectives and ways of knowing…more akin to the workings of a democratic society, characterized by extensive participation and…diversity' (Funtowicz and Ravetz 1995, p. 160). Here, an 'extended peer community' is essential for quality assurance—quality not only of the products of research, but of its processes, people, and purposes. The diverse perspectives need to stem from inclusion of those from outside the usual domain of sciences and the academy and to encompass both the head and the heart in much broader capacities than those traditionally acceptable in the academy. This is not an argument for wholesale dismissal of enlightenment-inspired values, but rather an abandonment and 'unlearning' of some of its 'fundamentalist' notions (Elkana 2000) and a learning of more capacious approaches to understanding.

This expanded view of contemporary scholarship has some parallels with many aspects of 'Mode 2' research and knowledge mobilization (Gibbons et al. 1994), increasingly practised in the academy, and typified by a wide range of actors inside and outside the academy working collaboratively and iteratively on problems in their context. Such contextualization allows a shift from solely scientifically 'reliable' knowledge to knowledge that is also 'socially robust', the validity of which is determined by a wide community of users and contributors (Nowotny et al. 2003).

Uncertainty, complexity, and volatility are not limited to grand, wicked problems. Massive interconnectivity, a key underlying characteristic and cause of postnormal environments is just as prevalent in and relevant to institutions and organizations (Anderson and Jefferson 2019; Sargut and McGrath 2011), governance (Serra 2019), and societal patterns, including those of the evolving landscape of work (Ramanathan 2017). PhD graduates, wherever their careers take them, will need the ability to wisely and productively navigate complexity, uncertainty, and volatility. These issues are also linked to individual wellbeing, clearly a twenty-first-century concern for doctoral students and graduates. An uncertain and volatile world can generate anxiety, feelings of powerlessness and insecurity (Sardar 2010); moving beyond binary thinking and assumptions of order and logic in life can support resilience, and provide the confidence to cope with chaos, complexity and contradiction in life as much as in work and research (Gidley 2010; Scott-Janda and Karakok 2016).

Postformal Thinking and Wisdom

Personal abilities and attributes enabling us to navigate our way through the challenges of postnormal times have been proposed by many and are remarkably consistent (e.g., Gidley 2010; Olvitt 2017; OECD 2018; National Academies of Sciences, Engineering, and Medicine 2018; Winter-Simat et al. 2017; Partnership for 21st Century Skills 2008). Perhaps most fundamentally, we need flexibility in ways of thinking and knowing, and the motivation and ability to seek, understand and integrate the required plurality of perspectives. We need a better ability to understand and contextualize our work, and, especially for the future of our planet, 'a deep reflexivity of [the Earth's] inhabitants finally learning where they inhabit' (Latour forthcoming). We need various higher order thinking abilities that may be categorized as 'postformal' (for review, see Gidley 2016a). This term references Jean Piaget's proposed last stage of human cognitive development, 'formal operational' thinking, which enables thinkers to reason well within a formal, structured system. In these postnormal times, the necessary thinking processes also include ones that are more creative, reflexive, intuitive, relativistic, systems-oriented, and dialectical (in which issues are approached from multiple perspectives or logics). These thinking processes have also been conceptualized as a 'higher order of consciousness that involves changes in epistemology and ways of making meaning more inclusive, integrative, and complex' (Stevens-Long et al. 2012) and are frequently aligned with the concept of wisdom (e.g. Arlin 1999; Sinnott 1998; Sterling 2003; Sternberg 2001).

The epistemic plurality required of today's scholars is especially important in advancing reconciliation between Indigenous and settler peoples, and in reversing the assimilation and cognitive injustice perpetrated through the privileging of Western epistemologies in our broader scholarship (Kuokkanen 2007; Santos 2007). Crucially, the academy as a whole is also impoverished when it marginalizes the legitimacy of Indigenous ways of knowing:

> As long as the academy remains ignorant or dismissive of epistemes that differ from dominant Western ones, Indigenous people will be voiceless – in the sense that their words will be misunderstood or ignored – and furthermore, the epistemological foundations of the academy will continue to be constrained as well as exclusionary. As long as the academy sanctions epistemic ignorance, it will be unable to profess its multiple truths…It is not simply what the academy can do for Indigenous peoples; it is also what the academy needs to do for itself. (Kuokkanen 2007, p. 5)

These types of thinking could also be described (in a perhaps reductive fashion, ironically) as 'whole-brained' approaches to experiencing and understanding the world. As comprehensively described by Iain McGilchrist (2009) from a wealth of evidence, our two brain hemispheres attend to and represent the world in different ways, both of which are necessary. The left hemisphere relies on sharp focus and a narrow perception of things as decontextualized, static, abstract, mechanical, and fragmentary. It prioritizes theory over experience and creates a model of the world that 'aims' towards certainty and allows prediction. It is unaware of its limitations. The right hemisphere, on the other hand, attends to the world holistically, relies more on tacit understanding, and is more open and uncommitted to what it may find. Meaning beyond language is understood, ambiguity is accepted, and the world represented is a 'live, complex, embodied, world of individual, unique beings, forever in flux, a net of interdependencies, forming and reforming wholes, a world with which we are deeply connected' (McGilchrist 2011). A link with these 'right-brained' concepts of thinking and feeling has frequently been made with the development of sustainability mindsets (Haines 2017; Rimanoczy 2013; Livingstone 2018) and to wisdom.

As our graduates advance understanding in all forms of work, they will also need a 'bias toward action' and a design-thinking frame of mind (e.g., Buchanan 1992; Carroll 2015) if their work is to have impact. 'Normal' notions of scholarly objectivity and detachment in many fields, while necessary to address structured, scientific problems, are insufficient for innovative solution-finding that also relies on abductive reasoning, creativity, empathy, and divergent thinking.

Our Current State and Potential for Improvement

Doctoral research and related coursework in many areas can engage students in these more complex, cross-boundary, and epistemologically diverse cognitive processes; however, neither most disciplinary graduate programs and research projects provide the opportunity to do so nor are students usually assessed for these abilities. Robert Sternberg's (2001) notions of multiple intelligences encompass at least a subset of these postformal abilities, including creativity, the ability to hold multiple perspectives in mind, and intuitive, or practical, wisdom (Gidley 2016b). In broad surveys of faculty members' views of these broader intelligences in doctoral students, Barbara Lovitts found that few students were perceived as exhibiting these in

a profound way, and few dissertations reflected those qualities (Lovitts 2007, 2008). While we are unaware of research more directly assessing the prevalence of postformal thinking abilities among doctoral students, it has been estimated that fewer than 0.05% of the American population has these abilities at the third of four proposed levels (Commons and Ross 2008).

Over the past decade, employers of recent PhD graduates have fairly consistently noted that new hires often struggle to work effectively with those from diverse cultural or disciplinary backgrounds, may be confounded by 'real-world' problems or situations, and are not as flexible as they need to be (Borrell-Damian et al. 2015; EURAXIND 2016; Porter 2017). 'Broad literacy' across diverse disciplines has been specifically cited as an attribute that needed better inculcation in doctoral students to address the increasingly complex problems that employers are engaged in (NASEM 2018).

While many of these abilities are often subsumed under the category of 'soft skills' or even 'non-cognitive skills', they have very significant cognitive dimensions, in addition to affective and conative (motivational) ones. They impact not only practical performance in a work environment, but how individuals approach significant, intellectually demanding challenges, and how motivated and effective they are at leadership and eliciting meaningful change.

Learning postformal thinking patterns and ways of being is by definition a holistic endeavour, entailing growth in emotional domains, interpersonal competencies, creativity, and personal attributes such as empathy and humility (Baxter Magolda 2007; Griffin et al. 2009; Scott Janda and Karakok 2016; Sinnott 2002; Stevens-Long et al. 2012). They cannot be learned through 'normal' educational paradigms that value independence and fragmentation, but require transformative learning approaches (Illeris 2014; Mezirow 1991; Taylor et al. 2012) that incorporate experience, disorientation, dialogue, and reflection, ultimately causing a 'deep structural shift in the basic premises of thought, feelings and actions' (Centre for Transformative Learning, University of Toronto n.d.). Learning to *become* a scholar for postnormal times requires *doing* such scholarship.

There are obvious obstacles to this in doctoral education, a primary one—in the sciences—being the apprenticeship paradigm, that relies on students as labour on faculty research projects. While postnormal forms of research are increasingly prevalent in some areas, they are still rare in others, and students do not widely have the opportunity to explore this mode. Across all disciplines, there are perhaps equally problematic cultural barriers of faculty and student research reward systems, that value independence, clear conclusions, traditional academic modes of communication, and disciplinary advancement, and that depend exclusively on 'expert' peer communities for assessment of quality. Among still other barriers are the issues of program completion times—postnormal science is slow (Stengers 2018)—and concerns about academic career trajectories for students who have veered off the traditional paths of scholarly work.

University of British Columbia Experiment: The Public Scholars Initiative

Despite (or because of) these hurdles, the University of British Columbia (UBC) embarked on an ambitious experiment in 2013 to 'reimagine' the potential of the PhD in light of the complexity and urgency of the world's problems, in the diversity of doctoral career pathways, and in the evolving relationship of the university with society (Porter and Phelps 2014; Peker et al. 2017). While extracurricular professional development opportunities, including internships, had been offered to doctoral students for over a decade, the time had come, we believed, to also explore more integral changes across all disciplines and to rethink and re-articulate the purpose(s) of a PhD, facilitating an expansion of the ways students think, act, feel, and learn through their scholarship.

Drawing from the work and language of the Carnegie Initiative on the Doctorate (Walker et al. 2008), we proposed that doctoral education should entail the 'formation of scholars who make a positive difference in the world'. 'Formation' is seen as close to the German ideal of 'bildung', which aims towards the development and harmonization of the mind and heart—one's humanity—towards personal maturity and contribution to and transformation of one's society. As described in Walker et al. (2008), 'scholar' also has a broad meaning, extending beyond the academician to all those relying on specialized knowledge and a 'larger set of obligations and commitments that are not only intellectual but moral' (p. 4). The work of the scholar writ large, then, entails all of the domains of academic scholarship the American educator Ernest Boyer (1990) termed as discovery, application, and integration of knowledge, and its transmission through teaching and learning.

Many doctoral graduates will need to transform knowledge into action and change through numerous avenues that include policy, entrepreneurship, communication, and institutional and societal change; many will need to integrate information and ideas from diverse sources to serve causes or stakeholders; many will be teachers in a variety of contexts; and most will need postformal ways of thinking and being. We explicitly challenged the assumption that such ways of doing scholarly work were inappropriately included in doctoral learning objectives and assessment (a sentiment more prevalent in some disciplines than others), and argued that such broader abilities and mindsets can be learned best, or only, through transformational approaches *integral* to students' primary intellectual development. The development of such abilities should not be seen as an 'add-on' to doctoral education, but as necessary to the formation of graduates in the twenty-first century and therefore assessed as part of the degree.

The first initiative from the central graduate school, launched in 2015, was an 'experiment' to determine whether a larger conception of doctoral research and scholarship beyond most academic and disciplinary norms was feasible in the academy, and whether faculty were willing to accept and assess corresponding dissertations that may be broadened in content and/or format. The goals of the pilot were to facilitate the development of students who were able to make a purposeful, 'positive difference in the world' through effective scholarly work in diverse contexts,

through engaging a plurality of perspectives and partners, through approaching messy questions or problems with wisdom, through knowing and communicating in different ways, and through competence in creating diverse forms of scholarly products essential to the work of the scholarship. We also wanted students to gain experience in and awareness of potential career pathways. The intention was for students to expand their dissertation research in more postformal ways, outside the norms of their discipline, and for the work to be included in their dissertation.

The resulting 'Public Scholars Initiative', or PSI, is now in its sixth year (University of British Columbia n.d.-a). The program invites applications from PhD students in all disciplines, with the support of their supervisors and research partners as applicable, to describe their proposed dissertation work that meets the goals of 'explicitly linking doctoral work to an arena of public benefit and integrating broader and more career-relevant forms of scholarship' into their doctoral education. Successful applicants are provided up to $20,000 over two years as a research allowance and/or stipend. The initiative also includes programmatic elements such as panel discussions and workshops on areas of interest and relevance, a required presentation to the broader public, opportunities for interdisciplinary peer engagement and community-building, and mentorship and support on academic issues. Students are profiled on the PSI website, and through this and other means, are frequently invited to speak or be interviewed by parties within and outside the university.

From more than 400 individual applicants over five years (approximately 8% of the university's eligible doctoral student population, that is those in years 1–4), 184 students have been selected to participate, studying in all major disciplines at the university, including the humanities, sciences, applied sciences, health sciences, and social sciences. They are collaborating, or have collaborated, with over 100 partners in all sectors in more than 40 countries. More than 40 have graduated, and are working in diverse careers throughout the academy, and in the public, private, and nonprofit sectors.

The following two stories of PSI scholars and their dissertation work illustrate the incorporation of both postformal forms of thinking (including multiperspectivality, contextualization, creativity, systems theory, and tacit reasoning) and extended peer collaborative communities with contradictory perspectives and values:

- Having worked in the area of childbirth support, interdisciplinary studies student Sarah Munro sought to understand the reasons for, and help reduce the rates of, unnecessary caesarean section births for women who had previously delivered through C-sections (Munro 2016). Findings from interviews of the various stakeholder groups (expectant women, clinicians, and hospital administrators), interpreted through complex adaptive systems theory, showed disparities in perspectives, needs, values, instincts, and knowledge bases between the groups, which contributed to sub-optimal decision making. Using an integrated knowledge translation approach, she collaborated with the groups and the provincial government to facilitate improved mutual understanding among them and to devise policies to improve future practices. A jointly written policy brief and a

scholarly description of its development were included in the dissertation. Most of the recommendations in the brief have since been implemented by the collaborating health authority.

- Driven by a concern about the fraught and contradictory discourse in humanitarian disaster recovery, an area in which he had previously worked, educational studies student Omer Aijazi engaged with residents in Northern Pakistan and Kashmir along with local organizations to understand the 'micro processes' through which the residents recover and flourish after natural disasters. As he engaged with the residents, he described 'throwing out' his interview questions and 'discarding' his carefully honed research proposal as the conversations revealed a much greater complexity of residents' experience than he had anticipated, one characterized by a profound interconnectedness with multiple forms of violence (including epistemic harms) beyond that of natural disasters. He decided to center his dissertation on a series of 'scenes' interspersed by images and poetry, which he described as an 'experiment with form *and* content to adequately accommodate complexity, nonlinearity, ambiguity, and the openness of life.' (Aijazi 2018). He has contributed substantially, both before and after his PhD, to international policy development and public dissemination in addition to the scholarly literature.

For some students participating in the PSI, the supported work was already planned or considered; PSI funding either provided needed resources or allowed a slight pivoting of the research towards the goals of the PSI. For others, it provided resources to mobilize the research or to expand the range of or degree of interaction with collaborators. For others, it was an entirely new approach to the dissertation research question or to the general area of study. This latter group included an English student studying writing who worked collaboratively to create a related interactive computer program; a botanist who included as a chapter in his dissertation a scholarly reflection and proposal related to what he saw as a misalignment of his discipline's current directions with the urgent needs of the planet (based in part on his PSI-funded work with the provincial government); a biomedical scientist who is collaborating with patient groups and clinicians to assess their concerns about and willingness to use novel therapeutics that he helped develop; and a zoologist and botanist who included in their respective science-based dissertations a chapter on the development and assessment of undergraduate teaching methodologies in their areas of study.

Identity, Legitimization, Successes, and Failures

For us, one of the most surprising findings from the initiative was how deeply meaningful the legitimization of students' identities and work was for many. If a defining feature of Millennials is 'pragmatic idealism' (Burstein 2013), this has certainly born true with the PSI scholars, most of whom fall in this demographic. Through

conversations and an annual survey,[1] many expressed a disappointment with the academic milieu which they felt seemed to devalue their expertise, creativity, passions, and orientation as change agents, and in which they felt restricted in their research questions and approaches by the unquestioned epistemic norms of their disciplines, including detachment and decontextualization. Some said they had finally found an academic 'home' or a 'life-line' in the PSI, and were in fact re-invigorated to pursue an academic career, knowing what may be possible in the academy ('Before [being in the PSI], I could not see myself as an academic, and now I see a path that motivates me to continue my studies'; 'it has helped me take ownership over an academic identity that I already had, but was shy or reluctant to admit, previously'). It was massive relief to many to discover that their boundary-pushing and solution-oriented approaches to research questions can be fully endorsed by the academy.

Among those who hadn't necessarily viewed themselves as public scholars, the PSI-enabled work awakened many to this new possibility, and unexpectedly helped shape their growing identities. Over 85% of all surveyed students agreed with the statement that the PSI 'significantly impacted [their] formation and identity as a scholar':

- 'It gave me an opportunity to even begin to imagine that my research might have impacts outside of the walls of academia'.
- 'I began to frame my work as public work, and to understand the role of my work in pushing forward public knowledge and practices'.
- 'It has made me think more critically about my responsibilities as a researcher'.
- 'Largely because of PSI, I will continue to pursue avenues to research for the public good'.

Although students' supervisors were supportive of the work itself (it is a PSI application requirement) many, particularly in the earlier days of the initiative, did not agree that the 'PSI component', as some thought of it, was appropriate dissertation material. It was sometimes viewed as improperly outside the disciplinary norms or as not scholarly; or it was considered perhaps worthy but impossible to be assessed. It was frequently up to students to persuade their supervisors or committees of its legitimacy, and they had variable degrees of success in doing so.

- 'Despite the fact that I have changed policy in the government over the course of my degree, it will be unlikely to end up in my dissertation (as I come from a hard-core empirical-based discipline; thus, policy changes are irrelevant)'.
- 'To go beyond these 'traditional' pieces of scholarship involves additional education and pushing to your advisors and to your committee -- this can be very difficult to juggle while simultaneously navigating the demands of your idiosyncratic advisors, research projects, and job market'.

[1] An online, anonymous survey is conducted at the end of every cohort's first year, with an approximately 74% response rate (109 responses over four years). Faculty supervisors (50 responses) and external collaborators (80 responses) are also surveyed non-anonymously.

- 'The expectations of my program are such that an overhaul of the dissertation to the level that I feel is appropriate would simply not be permitted. Any changes are seen as 'detracting' from the quality of the thesis, and a reduction of scholarly rigor'.
- 'It's frustrating being in the PSI and seeing what's possible, while feeling that some fields are prevented from fully participating. My field is often held back by narrow ontologies, but we are rarely taught to discuss them, let alone engage and interact with them'.

Improved Research and Impact, Deeper Student Understanding

While formal assessments of PSI-supported research have not been conducted, 95% of the 40 partner organizations, individuals, or communities surveyed agreed that the PSI-students 'work has contributed or is expected to make a significant positive social contribution'. Students and external dissertation examiners have frequently noted that their new or expanded approaches have resulted in findings that were validated because of their contextualized collaborations and extended peer communities, and in research that generated tangible impacts through context-specific and 'whole-brained' inquiry and collaborative action. Perhaps most importantly, students and their supervisors frequently note students' expanded understanding and appreciation of what their research is 'about'.

- Student: 'Finally, after 4 years picking around the edges of the policy side of my topic, I was able to really understand what was going on'.
- Student: 'It has created opportunities for timely and meaningful knowledge exchange that is directly impacting policy'.
- Partner: 'The work is contributing to changes in practice as well as in changes in the way services will be delivered in the future - it will benefit youth and families greatly'.
- Partner: 'The outcome of [the student-led] study of the ways in which people navigate the challenges and opportunities of environmental change…cannot be underestimated'.
- External examiner: the dissertation and embedded artefact (an art installation) 'enable people to engage directly with the research, providing it a much wider audience than one composed simply of academic readers…It is polyphonic and multi-modal in a carefully crafted manner, like nothing I have encountered before'.

Canadian Consultations

If non-traditional/postnormal scholarship is to be a growing trend for doctoral students, it is important to understand the broader academic community's perceptions and facility with these forms of scholarship within the members' own disciplines, and its willingness to value these in the greater sphere of academic work. Accordingly, through a task force of the Canadian Association for Graduate Studies (CAGS), we conducted a two-year consultation with faculty, graduate administrators, and students across the country using a 'green paper' to ground and standardize the questions (Canadian Association of Graduate Studies 2016). The resulting Canadian Association of Graduate Studies (2018) report described a 'nervous excitement' among the national community. Nervousness stemmed from a number of concerns including the potential for a reduced depth of research, academic career or dissertation examination risks to students, and a perceived 'dumbing down' of the PhD. At the same time, people were excited about its potential for increased relevance of doctoral research to the world and to graduates' careers, its association with an expansion of the ways of knowing and communicating given privileged status in the academy, and its promotion of creativity and broader understanding. CAGS has since created a set of webpages devoted to the topic and has continued the conversation through a number of avenues. A 2019 survey of 24 graduate deans across the country revealed that 95% were supportive of the concepts, and over 80% had one or more programs, policies, or activities devoted to promoting the ideals of broadened dissertation scholarship, or were wishing to implement such initiatives.

Other Current and Future Avenues

We recognize that not all graduate students want to or are able to conduct broadened forms of research in the ways described earlier. Other promising approaches to facilitate transformative learning in postformal ways of thought include coursework that includes collaborative and/or experiential work on complex problems (e.g. Levkoe et al. 2014; Neuhauser and Pohl 2015), especially those providing guidance in systems and design thinking. Pedagogical approaches, generally, that promote reflexivity, perspective transformation, and integrative learning can be effective in helping students develop the twenty-first-century competencies discussed (Baxter Magolda 2007). In alignment with these goals, we at UBC developed an annual competition for faculty to mount a transdisciplinary graduate-level course, 'Killam Connection' (University of British Columbia n.d.-b), focused on a complex theme of scholarly and public interest and importance that includes a translational component and guests from both outside and inside academia providing class lectures and public talks. All courses have been highly rated by students, and have led to a number of further interdisciplinary activities, including the planning of a 'collaborative

PhD' cohort (described below) by faculty responsible for the first course, 'Leading the Way Toward a Low-Carbon Future' (University of British Columbia n.d.-c).

Still in the early stages of planning, the 'collaborative PhD' at UBC is being investigated as a means of providing doctoral students the opportunity to conduct collaborative, transdisciplinary—postnormal—research on significant problems, leading to collaborative dissertation components and artefacts. The range of disciplines and partners involved on projects is anticipated to be very broad (e.g. from humanities and engineering to social and natural sciences; partners may include NGOs, communities, industry). It is clear that curriculum focused on *how* to think and work in postformal ways will be necessary, perhaps as much for faculty as for students.

While no policy changes were necessary to implement the PSI or other initiatives (although additional wording in dissertation guidelines and in external examiner letters was incorporated), we have relaxed the interpretation of the criteria for, and in fact promoted the inclusion of, non-academic members on supervisory committees. We are also investigating the inclusion of non-academic 'assessors' of dissertations to provide feedback on those portions or perspectives of dissertations the required expertise for which may not be common among academic examiners.

Many faculty participants in the early days of the conversations leading to these pilot projects felt that it would be more prudent to wait for broader changes in faculty perceptions and academic culture, rather than lead through students' ambitions for change. While we believe that the successes of the initiatives speak to the validity of this approach, it is clear that general acceptance and wholehearted support does not yet exist in the academy, which continues to hinder wider awareness and uptake of the ideas. As recommended in the CAGS report, key focuses going forward need to include broadened definitions of scholarly excellence in faculty hiring and reward decisions, in research grant funding criteria, and at all educational and administrative levels of the university. As Yehuda Elkana expressed fourteen years ago, 'It is not enough to rethink the doctorate. We have to rethink the faculty' (Elkana 2006).

Conclusion

Postnormal times demand an unlearning of many of our cherished scholarly norms, a revisitation of our long-held assumptions, and an expansion of our ways of thinking and knowing. May we continue to reimagine doctoral education in alignment with these commitments, enabling the next generation of doctorate holders to address the planet's and our society's most urgent needs with greater courage, imagination, humility, and wisdom.

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Chapter 6
How Might the (Social Sciences) PhD Play a Role in Addressing Global Challenges?

Lynn McAlpine

Abstract Increasingly, the PhD is perceived as needing change. Yet, a review of efforts at such 'reform' suggests limited impact. This realization led me to seek a novel way to rethink the PhD. So, I addressed what to me is particularly challenging—what practice(s) could actually realize a re-visioned PhD. I created a structured thought experiment to tackle a global challenge, the climate crisis, which I did alone and then with others. Being a social scientist, I started with the factors influencing effective response to this crisis, as representative of efforts at social/societal change more broadly. After reflecting on the outcomes of the exercise which proved productive, I argue that if we, as researchers, want to reform the PhD, we would benefit from thinking more broadly about the nature of social science research, in fact, conceive of the PhD and our own work as encompassing solution-oriented inquiry. We would also expand and deepen our interactions with those beyond our own disciplinary colleagues: not just researchers in other disciplines, but those in other labour sectors and civil society—this whether the research/PhD goal is to address the climate crisis, other sustainability issues, or other meaningful goals.

Introduction

Refugee migration, climate change, online data regulation and protection: These are just three of the global challenges[1] facing society today that will impact all our futures. To hope to address such problems, collaboration is needed across labour sec-

[1] The Covid-19 pandemic, also a global challenge, was not even a thought in my mind when this was written December 2019.

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tors, civil society and academia to integrate knowledge and expertise in creative ways. Calls for this sort of action can be seen in, for instance, the EU initiative for responsible research in and for society, premised on the need for research to address the well-being of society (van Oudheusden 2014), as well as for us to be more inclusive, responsive, and reflexive researchers. In other words, (inter)national policies are calling for highly skilled knowledge workers, particularly PhD graduates, to be prepared to engage in research to help meet global challenges. What does/might this actually mean as regards the PhD curriculum? What are the drivers and constraints that would make it possible for the PhD to address societal/global challenges? By engaging in a thought experiment[2] focused on this question, my hope is to open up new possibilities for the PhD for those of us who value its potential in the world, and see the need to reconsider its nature. So, this chapter is constructed as follows: after some background, I describe the thought experiment process (including background reading) so that you can engage in the thought experiment yourself, then a few examples from those who had the chance to begin the thought experiment, ending with some reflections on the value of a thought experiment, the importance of effective communication in social change, and the nature of social science research.

A Bit About Me

My relatively privileged worldview is situated in a particular time and place. Born in the post-WW II 40s, I am an older white female social scientist from Canada who first worked for 20 years in the public sector, before becoming an academic. In academia, I was initially involved in indigenous teacher education in the Canadian Arctic and sub-Arctic, then academic development with pre-tenure and tenured academics—before focusing on PhD and post-PhD life and career trajectories for the past 15 years. During these 15 years, I have lived and worked in Canada and the UK and done research in these and other countries, particularly Europe, on doctoral and post-PhD experience—and have seen the PhD change dramatically. It is from this set of experiences that the following account emerges.

Lessons from Previous Efforts at Changing the PhD[3]

Increasingly, the PhD is perceived as needing change by a range of stakeholders—academic organizations, labour sectors and governments. Each has made efforts to change different aspects of the PhD from their own perspectives. So, these efforts

[2] The aim of a thought experiment is to address a specific question about a non-imaginary situation within a clearly articulated but imagined scenario.

[3] I do not address the history and purpose of the PhD as it is dealt with by Ronald Barnett, Søren Bengtsen, Robyn Barnacle and Denise Cuthbert.

have been largely independent and piecemeal with different foci, for example reduced time to completion, graduates with generic skills training, and interdisciplinary research. There has rarely been talk across stakeholders or sectors in any meaningful way. I am reminded of the blindfolded individuals each touching a part of the same elephant and perceiving a different problem—but not considering how to combine their knowledge and expertise to come to some joint assessment. This lack of joined-up thinking suggests we need greater attention to meaningful communication across stakeholders in order to (a) more clearly focus efforts towards a shared purpose and (b) integrate sufficient breadth of knowledge and expertise to bring about change.

Another lesson is that especially with policies, we see the principle of subsidiarity operating. So institutional or national policies are expected to be actualized at the local level in order to attend to specific structures, individuals, and so on. However, the complexity and diversity of the specific contexts may not have been taken into consideration by those creating the policies. As well, in many cases, these efforts for change are agreed by individuals representing different groups or organizations, for example an academic representing his/her department on a university committee. Yet, such individuals may have limited levers to bring about change in their own work contexts, particularly if there are powerful or many resisters to change. Thus, another constraint may be a lack of sense of personal agency to move forward.

Overall, what is evident is the failure to address the interaction of the structural and individual factors that can impede or facilitate successful social/societal change, which ultimately requires long-term consistent changes in thinking, action, shared practices, and so on. We need to work collectively, while mindful of structural factors, if we are to rethink the nature and purpose of the PhD.

So I've Wondered

What single purpose might grab our *collective* attention enough to seriously rethink the PhD-for-the-future? This led me to the question: How might the PhD address the global challenges we are facing? And from there to my 'thought experiment' which I chose to situate in the social sciences given my background.

Global/Societal Challenges

Refugee migration, the climate crisis, online data regulation and protection are just three of the global challenges impacting all our futures. Working towards solutions requires collective action, in fact, collaboration, across labour sectors, civil society, and governments, to use our shared knowledge in creative ways.

In the year 2019, what is increasingly referred to as the climate crisis was constantly in the news. It was impossible to pick up a newspaper, read online headlines

or listen to the news and not read or hear about floods, forest and bush fires, melting permafrost, and so on—as well as varied responses by multiple stakeholders. (See box for some examples.)

London will have Barcelona's weather by 2050. The lead author of the paper said it was trying to convey concrete examples of what warming might feel like. 'It is hard to envision how 2C of warming …might impact daily life.' (July 10 2019, L. Hook, Financial Times) https://www.ft.com/content/4e27d34e-a2fd-11e9-974c-ad1c6ab5efd1

Roughly a quarter of the 348 million tons of annual plastic production worldwide now goes into packaging … making it the single biggest use of the material ahead of buildings, textiles or transportation. (October 31 2019, L. Aboud, Financial Times) https://www.ft.com/content/27cf9734-faa7-11e9-98fd-4d6c20050229

Globally, public awareness has improved in recent months … even the business community is starting to talk about doing its part. There is growing pressure on central banks to engage with climate change … But talk of eco-friendly policies does not always translate into action. (Nov 6 2019, Editorial Board, Financial Times.) https://www.ft.com/content/e99d9b56-f0d2-11e9-ad1e-4367d8281195

Apocalypse got you down? Searching for a cure for my climate crisis grief …asking people around me didn't help. I heard that it was too late anyway. November 19 2019, C. Buckley, New York Times International Edition) https://www.nytimes.com/2019/11/15/sunday-review/depression-climate-change.html

A (YouGov) survey of 28 countries … found the US the most skeptical country in the world on anthropomorphic climate change, with 15% believing there was no change or humans were not responsible. Further, those in western countries were more likely than those in eastern countries to believe it would not have a big impact on their lives. As well, less than 50% of individuals in 17 of the countries felt they could do more personally to address climate change. Individuals are placing the major responsibility on international/national governments or business. https://today.yougov.com/topics/science/articles-reports/2019/09/16/global-climate-change-poll (31.12.2019)

In a time of climate crisis, what do rich countries owe to the poor? Climate apartheid, as the UN calls the disparity between the experiences of rich countries and poor ones is …intangible, at least for those who live in the west. Climate apartheid …is a scenario where the wealthy pay to escape overheating, hunger and conflict while the rest of the world is left to suffer. (September 21 2019, E. Renzetti, Globe and Mail) https://www.theglobeandmail.com/opinion/article-what-debt-do-rich-countries-owe-the-ones-thatll-get-shafted-by-the/

Even this small selection of reports highlights the complexity of the issue: dire future predictions of warming and their impact on our lives, the damage we have already done, individuals' awareness of and belief (or not) in their ability to act effectively, the global north's responsibility to the south. So how might the PhD do at least some small thing?

Thought Experiment

The question for this thought experiment is this: How might the social science[4] PhD play a role in addressing global challenges? Since thought experiments are in the mind, we need to (a) extrapolate from the present situation as we know it, (b) apply that within an imagined scenario to open up possibilities, (c) have a structure to engage meaningfully in completing the task, in order to (d) consider at the end what might be do-able in the present situation. The process I designed involves nine steps (see Appendix 1) and would take 3+ hours in total. However, here I will only deal with the first two and last steps: (a) key ideas about societal change as background; (b) situating the context, the role play; and (c) returning to reality.

The Thought Experiment: Tools to Design a PhD Programme to Address the Climate Crisis

Key Ideas About Societal Change as Background

Two themes are central to engaging in the thought experiment: one the nature of social/societal change and how research, evidence and knowledge are understood by different stakeholders.

Conceptualizing Society: The Nature of Social/Societal Change

We first need to consider the relation between individuals' experiences and motivations and the nested micro-, meso- and macro-contexts in which they live (McAlpine and Amundsen 2018), that is think systemically even while we can only act locally and individually.

Micro-institutional factors include the local work climate (positive through negative), supervisory/managerial expectations, practices, and support for change. At the

[4] While I focus on the social science PhD, I believe the argument and exercise apply equally across humanities and sciences fields.

meso-level, institutional structural factors include organizational structure and mission which can range from profit to social good. Regarding the latter, the alignment or not between institutional purposes and desired societal change will have a profound impact on investment in such change. Macro-level factors bring in national policies such as strategic funding initiatives which expect bigger, more global research consortia and use of big data; funding council initiatives to re-tool PhD programmes; and funding incentives to hire PhDs. And, finally, there are global policies, such as the UN sustainability goals designed to address global challenges.

Within these nested contexts, individual factors embrace, for instance, individuals' life goals, desires to align work with their personal values, and the nature and satisfaction they draw from their work and the rest of their lives. In thinking about addressing the climate crisis, it has been argued that for the public, the issue is 'no more than background noise' (Rogers and Norgaard 2011). While you may not agree with this statement, it is important to recognize that even if individuals are convinced of the reality of the climate crisis, not all will believe that individual action is worthwhile given the scope of the problem (note earlier YouGov report). They may instead experience helplessness alongside guilt. In other words, intentional change of any kind, even individually, is not necessarily easy or fast since the change builds on, especially for adults, values, beliefs, knowledge and behaviours developed throughout prior life histories alongside a willingness to invest in undertaking change which will create disruptions in one's life (Tough 1979)—at the same time, navigating the range of drivers and constraints in the nested contexts in which they live and work.

Thus, in conceiving the complexity of the task of addressing the climate crisis in any fashion, one can imagine successive levels of readiness and commitment as regards the nested contexts and those within them: (a) the individual worker/student, (b) the employer/manager/supervisor who has a unit leadership role, (c) the organization's leadership, (d) regional networks—both cross-organization and cross-sector, (e) national cultures and policies, and (f) transnational policies.

Further, what is also necessary to advance the process is new and shared knowledge/expertise about the science of the climate crisis and the social processes of large-scale change. This calls for expanded networks that cut across disciplinary, organizational and labour sector lines. This combined knowledge *may* alter beliefs and values and lead to efforts to implement new actions/behaviours—individually, organizationally and beyond. And, if enough of these efforts are congruent and successful, the greater the potential to actually change social and economic structures and create socially and environmentally sustainable societies.

So, to sum up, the possibility of success in addressing societal change (successful interaction and change across nested contexts), emerges from a series of tenuous links, tenuous in that if any one of them does not succeed, other links are at risk. Thus, while addressing climate change requires global action, in fact, any change has to begin with congruent and shared individual efforts—starting by working locally since drivers and constraints will more likely be shared and it will be easier to act collectively locally given that misunderstandings and conflicts are often easier to resolve face-to-face. I return to this theme after the thought experiment.

How Research, Evidence, and Knowledge Are Understood

I hope I have clearly established the challenge of success in any intentional societal change given varied degrees of readiness. In doing so, I raised the need for new and shared knowledge, which brings me to the second theme: how research, evidence (and thus knowledge) are understood across stakeholders. We can see some of this range of views of research in, for instance, citizen science, in research and development units in private sector firms, in programme evaluations in the para-public sector, and in higher-education work with other sectors in what is variously called intervention studies, participatory action research, and action research. These varied views of research are premised on different perspectives as to what constitutes evidence. For instance, (Tseng 2012) reported that individuals influential in school boards/systems accepted social science research as evidence, but also considered as evidence what some researchers might not: personal experiences, the experiences of parent and constituent feedback. I return to this point after the thought experiment since these varied meanings of research and the increasing expectation for researchers to advance the knowledge economy (Hancock et al. 2015) and societal well-being (EU 'Science with and for society') raise political issues about power, authority, and values (van Oudheusden 2014).

So for this thought experiment, the goal is to create partnerships, mutually advantageous conjunctions of participants, resources, and efforts from different sectors, to design social science PhD programmes to address the climate crisis. This involves changing our own ways of thinking and seeking out potential collaborators—while recognizing that apathy, dis-belief, insufficient motivation, as well as differences in institutional/sectoral purposes and pressures may be key issues to deal with.

Role Play

After introducing a group of academics, PhD students, and graduates[5] to the themes given earlier, I divided them into small groups of four or five and gave the groups the following role play.

> You are the (a) Head of Department, (b) Research Director, and/or (c) PhD program Director in your department. Your Rector/Vice-Rector has announced that the mission of the university is to lead the way in finding 'solutions' to the climate crisis. S/he offers resources (HR, funding) for those taking up the challenge – particularly for those in the social sciences. So, you, a social scientist, get together with colleagues to think about what might be done to create a PhD program that addresses climate change comprehensively, e.g., societal need, academic research contribution, PhD graduate employment. Your goal is to design a program in which PhD students engage *locally/regionally* in research that addresses the climate crisis, contributes to academic research, and graduates are highly skilled solution-oriented and motivated researchers. Don't let constraints get in the way (addressing the constraints was a later step in the process). You have about 30 minutes to *define the possible program focus and partners*

[5] Not all knew each other, so they began with brief introductions.

At this point, you might want to try the experiment yourself before reading the examples.

Examples from Those Who Did This

I have included two group examples here plus my own.

#1: This mostly social science group focused on the theme 'Creating water for the future'. This was a situated, local, real problem since locally there was a geographical lack of water and also a drought. They believed their work, if successful, had the potential to have national impact. Their goal: to find ways to ensure future water for the community using (re) imagination—with those involved climate warriors. The focus of the PhD and related research was local water recycling, essential in the context of local politics where there was no appetite for new dams but the potential to do something around storm water run-off and storage. External partners were: aboriginal groups, farmers' organizations, news media, banks, municipal councils, civil society, the water company and large local industry that needed water for its processing. Internal partners were a team from science, engineering, education, arts, economics, and agriculture. Strategies to engage others in defining new solutions included: encourage divergent thinking and the imaginary, provoke outside ideas, and create an aesthetic (as well as psychological) emergency—with a kick-back to globalization.	#2: This group, mostly educationalists, focused on the theme: 'Recycled(ing)/not recycled(ing)'. Their focus was developing local eco-friendly play environments for pre-school age children which both modelled the effective use of recycled materials and also educated about recycling. Thus, the outcomes would be education of those using the play area (children and adults), product designs which others could emulate, and publicity about the value of cross-sector collaboration. The local external partners were: individuals normally involved in playground design, local engineering companies, the city councils, the regional parks division, and the national education department. Internal stakeholders included supervisors and students of education, engineering design, communication and marketing. They also proposed that there be external PhD co-supervisors.	#3: My own thought experiment suffered from being done by only me but produced these initial thoughts. The theme was 'Co-creating solutions'. The idea was to draw on the fact that there are many in my department involved in vocational education, workplace learning, and organizational change. The intent was to work with colleagues from the sciences to seek local organizations wanting to address the climate crisis and work cooperatively with them to explore appropriate science-based solutions and create the social science-based change processes for the planned organizational change, both in relation to internal and external practices, for example with clients/customers. The external partners were: municipal/county government, NGOs, research institutes, that is mostly public, para-public organizations. The internal ones: others in the department, master's and PhD students; colleagues in environmental sciences; Vice-Rector's office.

Returning to Reality

When the groups had done these initial steps of the experiment and reported, I asked them to leap to the end of the process—returning to reality. I asked them to consider whether any of the ideas they had generated could be used/useful in their PhD programmes already. They immediately saw some possibilities as did I for my experiment, for instance, including external stakeholders on the programme board to inform us as to the nature of PhD graduates they would be interested in hiring, and exploring co-supervision with external stakeholders—already done by some science PhD programmes. I want to step back now and reflect on what can be learned from undertaking this practice-based thought experiment.

Reflections: Factors Influencing Social/Societal Change

I would argue four points are worth exploring: (a) the role of a thought experiment; (b) disruptors in any organizational social change process; (c) organizational, disciplinary, and individual constraints in designing a new PhD; and (d) the purpose(s) and conduct of social science research.

The Role of a Thought Experiment

A structured thought experiment can help us step out of the everyday—and, in this case, see ways in which change in the PhD could support individual and collective efforts to address the climate crisis. The final step of the experiment, considering what might be done within one's present programme, also suggests that it is feasible for such experiments to have practical immediate applications, given that thought experiments, though imaginary, are created in response to a real situation.

Further, while PhD programmes need to be globally oriented academically, they can be locally situated—as in the thought experiment, and involve a range of non-traditional stakeholders. Wiek and Kay (2015) describe an undergraduate curriculum doing just that. In what they call solution-oriented sustainability learning,[6] students directly contribute to the sustainability-oriented transformations of cities, businesses, or government organizations, while building their proficiency in sustainability problem-solving. The programme goal is for students to develop a range of ways of thinking: systems-thinking, future-thinking, values-thinking, strategic-thinking, interpersonal competence, and integrated problem-solving. If this can be achieved in an undergraduate programme, it suggests interesting possibilities for a PhD programme!

[6] These types of problems range from climate change to childhood obesity and violent conflicts.

Disruptors in Any Organizational Social Change Process

While the initial steps in a thought experiment about social change open up possibilities, important next steps include exploring the affordances and constraints that any actual change would entail. In other words, subsequent steps in this thought experiment make concrete the fact that undertaking any complex social change requires addressing the interaction among a range of individual and structural factors. In the thought experiment as I set it up, there was institutional support and reward for undertaking change. However, these were rather ideal circumstances.

In fact, intentional change is difficult when trying to achieve systemic organizational change (Sannino and Engeström 2017). Organizational readiness for change, for collective behaviour change, requires a shared psychological state in which members feel committed to implementing the organizational change and confident in their collective abilities to do so (Weiner 2009). Further and often overlooked is the variation in individual's readiness and ability to change. In other words, individuals will change their patterns of thinking and acting in different ways and to different degrees (Billett 2001). Thus, Weiner (2009) notes organizational readiness to change encompasses members' perceptions of a (a) shared commitment to implement change and (b) shared belief in their collective capability to do so; but this readiness depends on the individuals' perceptions of organizational structures and resources (and constraints). In other words, attending to the interaction of structural and individual factors is essential. And, of course, change at the societal level is even more daunting. Yet, 'ultimately it will be societal processes that drive much of the required change, so it is important to understand them better' (Fankhauser September 9 2019: https://pcancities.org.uk/news/uk-contribution-social-science-research-climate-change-significant).

Even if there is a shared commitment, other structural constraints might emerge for this or similar kinds of change, for instance:

(a) Any institutional change creates countless small disruptions to institutional systems and there may be inherent pushback against the change.
(b) Change often requires additional investments in time, so what can be put aside?
(c) Any change in formal leadership during the process could lead to loss of momentum, resources and focus.

And, of course, any systemic efforts at societal change multiply the difficulties since this involves interaction within and across organizations and sectors.

But perhaps the two biggest challenges that confront any efforts at change exist within ourselves as (social science) researchers: (a) our ability to effectively communicate across disciplines, institutions, and sectors; and (b) the need to rethink the nature of research—and then to convince others, like university administrators and funding councils. So, it is to these two I turn next.

Designing a Different Type of PhD: Organizational, Disciplinary, and Individual Constraints

Consider the university as a particular microcosm of the organizational challenges of bringing about PhD change. The organizational 'loose coupling' of units and notions of subsidiarity in many universities creates challenges in advancing systemic change (Berdahl and Malloy 2019). For instance, they reported that chairs/heads of departments generally saw the graduate faculty as responsible for PhD professional development and felt constrained in considering any departmental involvement due to lack of knowledge about where PhD graduates work; what non-academic employers want; and what skills PhDs should develop. They also reported a lack of resources and concern that involvement could mean downloading university responsibility. Of course, similar issues are present within other organizations; highly complex problems with required interdependence are more difficult to achieve than simple tasks given the need for effective information sharing (Marlow et al. 2017).

Moving now to disciplinary challenges, I argued earlier that the social sciences are key to addressing the climate crisis (and other societal issues)—yet insufficient on their own since the climate crisis is also intimately tied to the sciences. This poses a challenge since most of us are largely embedded within our disciplinary silos and our perspective on the conduct of research results from our 'disciplinary' culture (Gardner 2013).

So, working with colleagues from other social sciences and from science, technology, engineering, mathematics and medicine (STEMM) fields will likely be daunting in that while we may share common cause, we do not share a common language or framework—and differences in paradigms across (and within) those cultures will affect how collaboration is engaged. Notably STEMM fields tend to greater consensus than the social sciences (Watts 2017), so clarifying and naming our own stance(s) and others' understanding of it is critical to ensuring effective communication across disciplines. And, such differences, if dealt with effectively, can be an asset (Deeks 2004).

So, to achieve the goal of a PhD focused on societal change, in this case, the climate crisis, we need to start by acknowledging the extreme complexity of the task, and that achieving it requires effective information sharing (Marlow et al. 2017), in other words, a deep investment in the micro-processes required for effective communication and decision making. Thankfully, there is some research here to guide us. First, to communicate effectively in mixed groups, we need to first accept that individual differences (Brew et al. 2013) can be potential barriers that however, if fully explored, can become facilitators. So, we need to be attentive to differences in culture/language (Payumo et al. 2019), in epistemology (Lebeau and Papatsiba 2016), and in degree of trust (Leibowitz et al. 2014). And, we need to plan an initial investment of time, some discomfort and reflexivity (Curry et al. 2012) for this to be achieved.

Social Science Research: What Is Its Purpose? Do We Need/ Want to Change/Broaden Our Thinking?

So far, I have argued that the social sciences are key to addressing the climate crisis and that we need to engage in effective communication with colleagues from STEMM fields as well as external stakeholders. But, I haven't yet addressed the knotty issue of 'research': its purpose, its uses, its relation to practice, and so on.

As academics, we have been rewarded for conducting significant disciplinary research that contributes to our own field, for instance, though research grants, peer-reviewed publications. This Mode 1 perspective on research has increasingly been challenged by societal changes (Gibbons et al. 1994) with greater expectation of demonstrating Mode 2 knowledge claims—while still maintaining Mode 1 forms of academic communication. Mode 2 knowledge has been characterized (Nowotny et al. 2003) as valuing application, flexibility, and responding to external demand (as in the EU call for research in and for society). It is trans-disciplinary, occurs in more diverse sites, produces more varied types of knowledge, and requires a dialogic process to sustain quality since peers cannot be reliably identified given the range of forms of knowledge that may be engaged. Thus, Mode 2 knowledge requires that besides being good researchers, we can act as team leaders, managers, and marketing experts (Melin and Janson 2006).

The sciences have adapted to this shift more than the social sciences and humanities, for instance, through patents, licenses, start-ups, and other kinds of knowledge 'transfer'. In the social sciences and humanities, the visible focus has been more on, for instance, case impact studies to demonstrate societal engagement. We have yet to substantially explore the ways in which Mode 2 thinking might influence how we approach research. Such exploration need not mean giving up our present focus on basic research, but rather broadening the scope of what is seen as research (Watts 2017). He suggests that by 'seek[ing] to advance theory specifically in the service of solving real-world problems' (p.1), we can use this engagement in real problems to improve the coherency of social science given the many collectively incoherent theories to explain one phenomenon. Western (2019) concurs: we can provide meaningful solutions to societal problems while still advancing our scholarly fields. Further, if we focus more extensively on solution-oriented social science, we will increase the reach of the social sciences, and create social science that is exciting, meaningful and transformative.

Gredig and Sommerfeld (2008) also argue for solution-oriented social science and solution-oriented knowledge, suggesting that the traditional view of the relationship between scientific knowledge and its use in society is of a 'transfer' of knowledge to practice. They suggest that for scientific knowledge and empirical evidence to really play an effective role in action, we need to focus where processes of generating knowledge for action take shape: to engage in cooperative knowledge-making rather than 'transfer' from academy to practice. Tseng (2012) argues the same point: we push out knowledge, a 'one-way' street, rather than engage with stakeholders, a 'two-way' street, in order to learn their different views of what

constitutes research and research evidence, how to interpret evidence—and perhaps most important the drivers and constraints they view as influencing their use of research.

So, what might we gain by incorporating solution-oriented research into our research repertoire? In the longer term, such efforts might lead to an expanded view of research, greater coherence of social science theories, greater public recognition of our contribution to society, and perhaps access to more funding. In the shorter term, it will influence how we build teams and collaborate, and what methods and tools we use (Western 2019)—and in my view would change how we design PhD programmes, supervise, and teach.

Conclusion

Given the relative lack of success of previous efforts at PhD reform, I chose in this chapter to address how in practice to realize a re-visioned PhD. I asked the question: *Can the PhD play a role in addressing global challenges?* I chose the global challenge of the climate crisis for a structured thought experiment. On the basis of the experiment, I would say the answer to the question is: *Yes, it can*. That needn't mean that every programme should be focused solely on the climate crisis as there are many other challenges, global through more local, to which we could bring a solution-oriented research approach. More broadly, the thought experiment was useful in opening up my mind, at least, to some key elements that we need to consider in any re-design or new design of today's PhD. In other words, just as I would argue that addressing the climate crisis requires thinking globally, and acting locally, I would also argue the same is true for other kinds of social change which demand we think and act differently. The question you might is: *Is the effort required worth the outcome?* This is an important question since it speaks to our ability to sustain a purpose and motivation over a lengthy period of time when the constraints may seem overwhelming and the drivers limited. But, *only you can answer it!*

Appendix 1. Structured Thought Experiment

Key Ideas About Societal Change as Background
See earlier text on two themes.

Situating the Context, the Role Play
Your Rector/Vice-Rector has announced that the mission of the university is to lead the way in finding 'solutions' to climate crisis. She/he offers resources (HR, funding) for those taking up the challenge—particularly for those in the social sciences. So, you, a social scientist, get together with colleagues to think about what might be done to create a PhD programme that addresses climate change comprehensively,

for example societal need, academic research contribution, PhD graduate employment.

Your role: You are (a) Head of Department, (b) Department Research Director, or (c) PhD Programme Director.

Your task: Design a social science PhD programme in which students engage in research that addresses the climate crisis in some way, contributes to academic research, and graduates are highly skilled solution-oriented researchers and motivated knowledge workers.

Defining the Possible Programme Focus and Partners

You have 5–7 minutes for each step below to address this goal: What would your programme look like?

1. Given your specialization, *brainstorm* aspects of CC your programme could address (C.1 below).
2. Then, *brainstorm* a list of potential stakeholders (C.2):
   (a) *Internal* (across the university—who/what that you might want to pull in)
   (b) *Local/regional external* (mission related to public good) partners for your initiative, that is create a mutually beneficial conjunction of individuals, resources and efforts
3. In light of 1 and 2, narrow down your focus (C.3) to which aspect(s) of CC you want to focus on.

Brainstorm: Aspects of CC your program could address	Brainstorm: Internal/external partners	Decide: Which aspect of CC you will focus on

Imagining a Possible Programme

1. How would you and your partners be involved (C.1)?
2. *Brainstorm* a list of the kinds of things you could imagine making up the programme (C.2).
3. Ignoring potential constraints, what constellation of these (C.3) would best meet your goal?

Decide: How will you and your partners be involved?	Brainstorm: Possible elements of the program	Decide: What is the best constellation?

Creating a Rough Timeline

1. Map out the timeline for the programme elements in light of the goal: students engage in research that addresses the societal challenges of CC in some way (and contributes to academic research); the goal is that they graduate as highly skilled and motivated non-academic knowledge workers.

Year 1	Year 2	Year 3	Year 4

Establishing 'Needed' Resources

1. Now, consider the resources you could draw on, for example Vice-Rector's leadership and incentives.
2. You might first brainstorm a list and then divide into 'for sure' and 'less sure' possibilities.

Assessing Constraints

1. Now, consider the constraints.
2. You might want to do a SWOT analysis or a GAP analysis or a combination of the two,

(a) SWOT: strengths, weaknesses, opportunities, threats
(b) GAP: current state, future state, gap, to do

Finalizing Your Vision

1. Return to your plan and see if there is anything that needs adjusting in light of the resources and constraints.

Returning to Reality

1. Review all your notes and make a list of the things you could begin to do now.

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Chapter 7
A Public and Persuasive PhD: Reforming Doctoral Education in the Outreach-Focused University

Denise Cuthbert and Robyn Barnacle

Abstract This chapter, written in the confluence of two global crises, that of the environment and the COVID-19 pandemic, considers how doctoral education should respond. Taking Latour's idea of the reformulation of the mission of university around outreach as the key organising principle, we argue for reform of doctoral education to produce graduates who are proponents of public and persuasive science. Our model for public science is drawn from that of public health, that aggregation of specialisations which is able to propel public policy, as evinced in the management of the pandemic, by bridging the gap between science and policy. We respond to Latour's provocations for the re-orientation of the university with some specific considerations pertaining to doctoral education and curricula; and the relationship between STEM-M and HASS fields and capabilities in the outreach focused university. Our proposals include the need to shift from involuted models of doctoral education as preparing 'stewards of the discipline' to an idea of doctoral education as a different kind of worldly stewardship and a challenge to positivity and a plea for normativity. We call for a public and persuasive PhD: programs which produce graduates who have advanced capacities in communication, in reason-based argument, in persuasion, and who can deal adeptly with the demands of academic debate and the rigours of public discourse.

Introduction

In planning this chapter, we intended to make our starting point Bruno Latour's neo-Humboldtian vision of the university and the re-ordering of university priorities recommended by him for survival in the 'world in ruins' (Chap. 2, this volume).

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We were keen to explore how the doctorate might be re-shaped and re-oriented to address the compounding challenges of the climate emergency and the crisis in public confidence in the authority of evidence-based science as a basis for political, social and personal action. As we worked on our arguments, we were interrupted by COVID-19 and its fallout—as were many of the contributors to this volume. In fact, the volume conceptualised in the throes of one global emergency was brought to completion in the midst of another. The nexus between science, governance, social and personal action in the political management of the pandemic in Australia provided us with new insights into Latour's ideas and challenged some of our own thinking. This chapter, written in the confluence of these two global crises, considers how doctoral education 'at the end of the world' should respond.

Setting the Scene

In January 2020, as bushfires consumed 100,000 km^2, or 24.7 million acres, of the country across Australia, following hard on catastrophic wildfires in the Americas and other extreme weather events in 2019, a UK-based climate scientist confronted Australian parliamentarian and serial climate-change denier Craig Kelly over his 'blatant misrepresentation' of her bushfire research. Professor Sandy Harrison explained: 'I am a working scientist and I do not routinely engage in arguments on social media, but I do not think the misuse of scientific analyses should be allowed to go unchallenged' (Redfearn 2020.). As Harrison put it to Kelly, the respective roles and responsibilities of scientist and politician are clear: 'As a scientist, my job is to tell you the facts. Your job is to act on them'.

This deceptively simple statement neatly captures numerous complex issues around which this chapter pivots, the fulcrum being the challenge of communication. Why don't governments act on what scientists are telling them? More specifically, why aren't 'the facts' persuasive enough to galvanise action? Of course, part of the explanation is that neither 'the facts', nor what action should spring from them, are straightforward or self-evident. Facts don't speak for themselves; they need to be interpreted and communicated. The contestation of facts, concepts and theories largely occurs within the academic disciplines in which they are generated, as is appropriate. The issue that Harrison's statement raises regarding the respective roles of scientist and politician is what happens as facts, or, more specifically, consensus positions regarding the interpretation of these facts (Cook and Jacobs 2014) are released into the public domain. Putting aside the numerous issues raised for public policy, governance, democratic institutions and functions, here our considerations focus on the issue of the role of PhD in the communication of science or knowledge. What can be learnt from the current and prolonged stand-off between politics and science on the climate for research education and the communication of science and knowledge?

The paragraph above was drafted in early 2020 when the escalating emergency of global climate politics and the gulf between scientific consensus on the climate emergency, the urgent need for action to address this and the political will to do so, appeared unbridgeable. In Australia, whose cities were choking with smoke and where vast

regions were enduring apocalyptic fire and destruction, the disjuncture between the very palpable sense of the end of the world and the persistence of climate change denialism in public discourse became intolerable. There seemed no way to bridge the gulf between science and politics on climate issues; no way to ensure evidence-based research might meaningfully inform public policy. No way for us to avert the disaster that scientific experts proclaimed as imminent. Then came COVID-19.

As some fires still burned, the Australian public witnessed a *volte-face* in the government's relationship with scientific expertise in the handling of COVID-19, after a faltering initial response. Far from ignoring or trading blows with scientific experts as they had done in the lead up to the outbreak of the first fires in late 2019, which were themselves a consequence of the lack of scientifically informed action on climate over decades, the Prime Minister and senior cabinet readily, although not immediately, fell into lockstep with the Chief Medical Officer and public health experts. In the management of the pandemic, politics in Australia did what had previously seemed impossible and deferred to expert advice. Evidence-based science informed the public policy response to COVID-19 in a way that it had failed to do on environmental issues—notwithstanding decades of scientific consensus on the scale of the problem, its causes and its remedies (IPCC n.d.).

This *volte-face* occasioned comment in the media and from public intellectuals (Evanson 2020; Galbraith and Otto 2020; Goldie et al. 2020; Rouhad 2020). If the Australian government was persuaded to listen to experts on public health, why not on the climate? This question has been repeated in Australia by commentators in the first six months of 2020 (Currell et al. 2020). Further, witnessing the ways in which Australians and others around the world changed behaviour, ways of living and working, almost overnight in response to directives informed by science provided one answer to a question hovering over all climate change remediation discussions. That is, could and would people change the way they lived in order to avert disaster? What occurred in Australia (and in many other parts of the world) in 2020—with the overnight transformation of life and work as people locked down to stem the spread of the virus—answered this question. It is possible to change behaviour; it is possible to live differently and deliberately in response to an emergency. Within weeks, lifestyle changes previously toyed with or considered unimaginable were realised, such as remote working, online education at scale, and fully subsidised childcare. With some notable exceptions where national leadership ignored or slighted expert advice, including most shockingly both the USA and UK, the multi-layered, cross-jurisdictional mobilisation in response to COVID-19 provided a partial correction to views expounding the impossibility of concerted action on climate. For example, bleak futurist Roy Scranton concludes that there exists 'no mechanism for uniting the entire human species to move together in one direction' (Scranton 2016). At the same time, we continue to witness in horrific detail—including unthinkable images of mass graves in advanced economies such as the USA—the perils of ignoring expert advice.

The measures taken to stem the pandemic had other surprising effects. In a paradoxical phenomenon experienced globally, COVID-19 restrictions led to massive reductions in carbon emissions. While no-doubt temporary, this is surely one of the most perverse and paradoxical outcomes for those campaigning for decades for real action to curb emissions. While there is much to be learned about the imbricated

relationship between the rise of global pandemics of zoonotic origins and the environmental damage of carbonisation (Arora and Mishra 2020; Pimental et al. 2007), we now see how the cessation of normalised, carbonised activities leads to an immediate reduction in carbon and other toxic emissions. Skies over many Chinese cities, and mega-cities such as Los Angeles, Tokyo, and London were clear and blue. Wildlife returned to cities whose empty streets saw deer, boar, mountain lions, foxes, kangaroos and other creatures venture into the newly vacated spaces. Imagery poignantly refused pathetic fallacy: bright blue skies in China, Italy and Spain and, more recently, Florida and other USA cities, were the backdrop to mass death, challenging the perverse norm of skies choked with particulates signalling booming economies.

Fear of the pandemic, and the need to contain its spread, has caused governments and communities worldwide to stop the very activities previously considered unstoppable. Action taken to limit the ravages of COVID-19 has provided a glimpse, therefore, into a de-carbonised world and life lived differently. Leaving to the side the disastrous individual, social and economic impact of this shutdown, it has provided significant pause for thought about different ways of living and the potential to pursue different economic models as economic activity resumes (e.g. the World Economic Forum's report, *The Future of Nature and Business*, 2020). For us, these questions and the relationships between science and government in the management of COVID-19 and the climate emergency resonate in rich and surprising ways. What insights can be gleaned from these perverse events for doctoral education and how could these be brought to bear on our original interest in the outreach-focused university, as theorised by Latour?

What follows is a series of ruminations arising from the jostling together of the two, and not un-related, end-time crises of COVID-19 and the climate emergency. Our proposals for changing the way in which we might educate doctoral candidates draws on Latour's 'hints' at a radical re-orienting of universities (Chap. 2, this volume) and our own observations and reflections. We've framed this loosely in what follows according to three themes: the re-prioritisation of outreach in universities; the need for new communication literacies, and; the new disciplinary formations required to pivot the university earthward. We acknowledge that the following discussion raises as many questions as it seeks to answer. We acknowledge, also, that what we propose will not be easily achieved but it seems to us that we now stand on the brink of anything being possible. Or nothing at all.

The Power of Public Science and the Need for Outreach Universities

Latour's first proposal for the radical re-orientation of the university to address the climate emergency is to prioritise outreach. This resonates strongly with our observations of the management of COVID-19. For Latour, a salient failure of the modern university—particularly as exemplified by the American research university—is the promotion of research and education at the expense of outreach. This has led, among other things, to the dangerous co-incidence in the USA, in

particular, of a world-class university system, alarmingly high levels of ignorance and misinformation in the general population, and concerted attacks on the value of science by many in the political classes. Elsewhere we have written on the crisis in expertise and the risks that it poses to higher education and doctoral education (Barnacle et al. 2018). The power of Latour's explanatory model is that it reveals the connection between failures in higher education delivering on its promise as a public good and the destructive politics of climate change. Latour sees the abandoning of outreach and public pedagogy in favour of the narrow conception of research that is competitively enacted in our universities as a potent analogy to the failure of trickle-down economics in assuring the just distribution of wealth. World-class university systems do not assure wide-spread educational benefits for the communities in which they are located. Nor do they equip these communities with the critical literacies required to discern between scientific evidence and politically motivated arguments countering science, and which may masquerade as science. This results in the highly politicised controversies on climate and other scientific issues, such as vaccination, which we note has also flared up during COVID-19, including the emergence of new and repurposed conspiracy theories intended to debunk COVID-19 as a hoax. Take, for example, the assertion of the rights of the sovereign self over and above public health imperatives on such issues as the wearing of face masks (Manavis 2020; McGowan 2020).

To counter this gulf between the university and the communities it is supposed to serve, Latour advocates numerous reforms. Notably, a neo-Humboldtian university would prioritise outreach as its paramount mission and organising principle. The work of universities—especially the findings of science (broadly framed to include the humanities, arts and social sciences or HASS and science, technology, engineering, mathematics and medicine or STEM-M) on issues of public importance—stands to be better supported and better received by a literate and educated population. Herein are imperatives for both enhanced outreach and wider access to higher education. A university sector which commits itself to outreach—a commitment to the public good—is more likely to enhance the potential for the knowledge it produces to be translated into effective political action and policy responses to pressing global problems. A commitment to outreach would also prioritise equitable access, community engagement, and career paths for academics which reward public engagement as well as scholarly attainment.

Multi-disciplinary Aggregations

What would a reformed, outreach-oriented university look like? In other words, what would a truly *public* science look like, again, with science broadly conceived to include STEM-M and HASS? Thinking along these lines requires reframing the largely and persistently discipline-based education and research activity in universities into outreach-oriented endeavours. For the explanatory and analytical tools provided by disciplinary knowledge to be brought to bear on significant global problems, expertise would be drawn from the disciplines *but not bound by them*.

Such problems include the reactivation of world economies without acceleration of carbonisation, and sustainable ways of living with a view to both the health of the climate and our capacity to withstand new and virulent disease. This latter necessarily entails a social justice dimension, a focus on equity and combatting disadvantage, as the health of society and the economies which support it are necessarily undermined by inequity. Both climate change and the pandemic have cruelly exposed gross inequity at a global and local level. These include, for example, the threats to the livelihoods and survival of those who live in marginal lands subject to rising sea levels and the threats exposed by precarious workers, those who need to work, even when ill, due to the lack of paid sick leave or the absence of other social security protections. With reference to one curiously persistent characterisation of doctoral education as the production of 'stewards of the disciplines' (Golde and Walker 2006), this orientation in doctoral education would fashion 'stewards of the earth' or perhaps 'stewards of life on earth' with a significant shift in emphasis. In other words, advancing disciplinary knowledge would not be the aim of research and education, but a by-product of the outreach mission.

The multidisciplinary aggregation of public health provides an interesting exemplar of the kind of disciplinary aggregations we are thinking of. Combining medical research, public policy, public outreach and education capabilities, such aggregations are proving effective, notable exceptions aside, in guiding both government policy decisions and public behaviour in the response to and management of COVID-19. The support of public science by advanced capabilities in communications, including compelling data visualisation, also provide insight into the skills, capabilities and literacies with which doctoral graduates might be provided in a reshaped and reoriented PhD. A public health modelled PhD would routinely pursue trajectories which enable diagnosis, investigation, description, analysis, discovery, theorisation *and*—with the requisite attention to the additional skills and capabilities required for this—action, remediation, solutions and redress.

Of course, there are myriad examples of this work being done or attempted—often by exception, extension or in specialist programs—in formations such as problem-based learning in undergraduate programs, and interdisciplinary programs at undergraduate and graduate levels including, notably, in the field of environmental science. In this volume, Susan Porter provides an example of a purposeful attempt to do this at a doctoral level in the Public Scholars Initiative at the University of British Columbia (see University of British Columbia, n.d.). A further example is Lund University's PhD program, Agenda 2030, designed around the Sustainability Development Goals (Myklebust 2020).

While these are promising developments, to grow this sort of endeavour at scale and beyond specialist or niche programs will require significant re-orientation in the conceptualisation and modalities of academic work. All of us working in higher education recognise the extrinsic and intrinsic challenges entailed in growing this sort of work at scale and making it, as per Latour's formulation, the organising principle of universities. A significant challenge to be overcome in such reform is that academic disciplines persist in exerting restraints on this sort of development. To mention a few of these, constraints are expressed through the structural determinism of disciplines on the organisation and funding flows of universities; as

well as their continued influence over the organisation of research journals and publishing, professional and scholarly societies, academic recruitment and career progression, and global rankings. Notably, the inclusion of impact and sustainability measures in some global ranking schemes will assist in driving engagement and outreach—as for example, the Leiden ranking produced by the Centre for Science and Technology Studies at this university (see CWTS Leiden Ranking 2020).

There is a further deep inhibition to the sort of outreach-focused university advocated by Latour and the trajectory from *research to action* which we propose. That is the deep academic bias towards positivity and the disciplined resistance, in many cases, to normativity. The need to shift from a positivist paradigm in reforming higher education and the 'massive effort' required to do so are also commented on by Deane Neubauer and Susan Porter (Chaps. 5 and 8, this volume). The trajectory of academic endeavour we propose, which commences in the positivist domain (diagnosis, investigation, description, discovery, and theorisation) would need to transition—based on evidence—to the normative domain (action, remediation, solutions and redress). This would entail a significant shift from a commitment to understanding the world as *it is* to a commitment to making the world *as it could be*. A commitment to research in this paradigm will likely see a repositioning of action research models from the periphery to a more central position, as Ramirez et al. explore (Chap. 4, this volume). Thus, the *outreach* of the outreach university would need to be expressed not only structurally (in the organisation and collocation of disciplines, the orientation of programs of study, and the career paths of academics) abut also epistemologically and philosophically, or in terms of how these new, restructured or aggregated disciplines view their core business and its relationships, not primarily with the discipline, but the world.

Pathways to Impactful PhDs

Doctoral education is a prime candidate for such reform. On the most recent available data, the aggregated global research capacity encompassed in doctoral programs amounts to a staggering 400,000 graduates annually (Barnacle et al. 2019a, b; Gu et al. 2017; OECD. Stat 2019). If the principles of outreach, understood as a commitment to public pedagogy or public science, were routinely included in doctoral curricula, the potential to develop public science and to launch substantive outreach activities can be readily seen. As indicated, this would necessitate the development of new and different skills. This does not represent a departure from, but instead a return to, capabilities originally envisaged in the degree which, as Ross Gibson (Chap. 12, this volume) reminds us, derives its title from the Latin *docere*: to teach, to instruct. We also see the notions of public outreach and persuasion in the concept 'candidate'. From the Latin *candidatus*, meaning 'white-robed', candidate refers to the eye-catching togas worn by those vying for the votes of Roman citizens, and we still use it today to refer to politicians running for office. Being able to influence, to persuade and teach, therefore, are at the heart of the concept of a doctorate and what it means to be a doctoral candidate.

While there is a range of capabilities which would need to be formally developed through PhD curricula to enable this, particularly those centred on communication and data literacy, there is also the need to educate doctoral candidates in the concepts of impact and pathways to impact in the conceptualisation and design of research. That is, questions of how the proposed research might be applied or translated should assume as central a position in our evaluations of the potential value of the research as questions about its potential to contribute to knowledge. Pedagogically, this could be enabled through the prominent positioning of education on pathways to impact (of which there are several available models see e.g. CSIRO n.d.) for all doctoral candidates. This would involve doctoral curricula to orient candidates—from the outset of their research—into thinking concretely about issues such as: the ways in which their research might be designed with and communicated to audiences beyond the academy; how to articulate potential applications of their work, thus enabling the knowledge and other outcomes to be translated into changes in policy and practice, and; a range of other impact pathways, beyond the narrowly conceived research commercialisation pathway.

As with Lynn McAlpine's thought experiments for reformed doctoral curricula (Chap. 6, this volume), which challenge us to posit an applied dimension to doctoral work (we would insist at the outset and not as an afterthought), we consider it both timely and necessary for doctoral educators and examiners to give serious consideration to expectations that work at a doctoral level will not only display robust research methods (to assure positivist requirements) but also articulate pathways to impact, translation or outreach, whether to be pursued by the researcher in further work, or others.

Enhancing Outreach Capability: The Key Role of Communication Literacies

To leverage the capabilities of doctoral research to address the climate emergency and the array of social, political and economic as well as scientific and technical challenges it presents, the topics selected for study by doctoral candidates would need to be informed by these worldly—as distinct from purely academic—concerns from the outset: '[Outreach] is no longer an afterthought, added once basic research has been completed; it is that toward which basic research is directed' (Latour, Chap. 2, this volume). To support outreach, Latour proposes a second radical orientation for universities towards a cluster of specific capabilities. This will require the considered addition of capabilities to the doctoral repertoire. For instance, advanced students, such as those undertaking the PhD, could be better served by a grounding in the political economy of knowledge and science and in a range of communication skills and strategies. Addressing survival in the Anthropocene, which by necessity entails surviving and countering the politics of the Anthropocene to assure a pathway for sound policy and government, advanced communication literacies will be required. Latour also highlights design,

performance and other political arts, and digital literacy, including advanced capabilities to work with and communicate, including visualising, big data.

For us, especially considering what we have observed during the COVID-19 emergency, the case for a re-orientation is compelling. The prolonged standoff between science and politics in the hyper-politicised climate debate should provoke a rethink in all of us engaged in research and research education about data and communication. When data upon data are stacked towards a resounding consensus, the stalemate in which we are stuck is not necessarily going to be broken by more or better science. This is not to say that more science is not needed, but it is not needed for evidential purposes. The reliance on rigorous research, evidence-based and reasoned argument alone—the very disciplines and techniques in which we train our PhD candidates—are effective in producing researchers who can contribute to knowledge and diagnose problems. They have proved less effective, however, in producing researchers who can shape public opinion and public policy. Recalling the derivation of the doctor in *docere* (to teach), our current mode of doctoral education has not proved as efficacious as it needs to be in producing individuals who can engage with the wider public. A better educated public might be more inclined to demand sound public policy and have the skills necessary to exercise critical judgements to discern hoax or pseudoscience from the real thing.

This is neither a retreat from facts nor an argument for their absorption into opinions. On the contrary, it's incumbent on well-trained researchers to understand precisely this distinction: where facts end, and interpretation begins; and where scientific evidence requires a dedicated communication science to assure its translation into effective policy. To return to an earlier line of thought, we might also add: where positivist inquiry and argument ends, and where it provides grounds for normative proposals and actions. We agree with Latour that the education of scientists has not served them well in being '…able to sustain the violent controversies that their science will necessary trigger' (Chap. 2, this volume). Nor does it help them to understand the complex politics which drive these controversies. Scientists, publishing in peer-reviewed and difficult to access scientific journals, are not necessarily or assuredly equipped through their education to deal with the lies and misinformation spun by highly effective communicators and promulgated on an industrial scale by bots and through various digital platforms which either misrepresent their work or produce pseudoscience refutations.

There is a need for high-level training in communication for all researchers to accompany their domain expertise. There is also a further need for the development of new, hybrid fields of expertise in effective scientific and political communication on questions of science and public policy, and possibly also social psychology and sociology. As argued compellingly by Pidgeon and Fischhoff (2011, p.38) '…public understanding of climate science deserves the strongest possible communications science to convey the practical implications of large, complex, uncertain physical, biological and social processes'. Communication, as a field in its own right, and as a core component of all doctoral programs, is crucial to the outreach mission and connects with it in several ways. As argued by Wynne (2006, 2007) and Gauchat et al. (2017), effective science communication is legitimate outreach and offers the

potential for scientists to rebuild public credibility in those communities which are critical or sceptical of science on issues such as the climate. Effective communication has the potential to depolarise opinion. For Wynne, the public needs to hear from scientists who can communicate effectively, and not only science communicators or other surrogates.

Rethinking Disciplinary Arrangements Towards an 'Earthly' University

So far, we have outlined some considerations in response to the call for the principle of outreach as that which organises all activities within the university. Our conceptualisation of public science—and the public and persuasive PhD—calls for fundamental shifts in academic practice. This includes the shift from positivity to the initiation of pathways from positivity to normativity, and the repositioning of the primacy of disciplines to the primacy of problems to which disciplinary expertise is brought. We also argue for high-level training in communication for all researchers to accompany their domain expertise to enable community engagement and inform appropriate policy actions. Next, we address what this means for the way in which disciplinary knowledge is organised towards serving the earth and its preservation.

At the time of writing, the Australian Government has proposed university funding measures aimed at suppressing demand for HASS courses and increasing demand for STEM-M, claiming the latter's employability and economic advantages (see Australian Government 2020). While the intention of such a measure has nothing to do with attempting to ameliorate the climate crisis, STEM-M fields have an obvious role to play in climate research by understanding the impacts of fossil fuel-based economies on our planet and the means of its remediation. What role, however, HASS?

The problem here is reminiscent of that raised by Heidegger (1971) in his essay 'Building, Dwelling, Thinking'. Writing at the time of the massive re-building task in Germany following the second world war, surely an apt precedent for learning how to live in the world in ruins, he reflects on the folly of a preoccupation with housing without a deeper examination of what it means to dwell. The perennial question of how we should live is perhaps more vexed now than ever. How should societies and economies re-organise to address the climate crisis? These questions are not those the natural or physical sciences alone can answer. Collectively, however, universities can produce the cross-disciplinary conditions in which these questions can be answered, particularly by actively facilitating places where multiple disciplines create knowledge and jostle and interact with other sectors and the community. Interdisciplinarity and non-university engagement is, of course, a recognisable element of widely established Mode 2 models of knowledge production intended to dismantle silos and orient researchers towards public engagement (Gibbons et al. 1994). Latour, however, takes this thinking one step further.

In Latour's third proposal for the radical re-orientation of the university, he questions current disciplinary arrangements and pivots the entire enterprise towards the earth and the task of 'becoming earthly'. In this model, the focus of the natural sciences, on natural processes and systems, is complemented by a reconceptualised model of the non-natural sciences, or HASS, as 'earthly sciences'. HASS as an earthly science is concerned with the world we inhabit: *phusis* or Gaia, what Latour calls the 'critical zone'. Whereas natural processes and systems are the proper focus of the natural sciences, the non-natural sciences are concerned with 'gaia-ology': the contested sphere in which the study of the earth we inhabit, the lived-world, takes centre stage.

In this model, HASS and STEM-M are complementary but the earthly re-orientation of the former is more transformative than the latter. For Latour, in becoming earthly, the former is mobilised towards the interpretation and translation of the data, or facts, which is the preoccupation of the latter. Echoing the earlier discussion about facts and their interpretation, the critical zone occupied by HASS in Latour's model is the contested sphere dominated by public policy and other debates concerning how facts should be interpreted and acted on, if at all. It is not that Latour is suggesting the natural sciences are without debate, rather, that the focus of their debates is in the establishment of facts. The critical zone, inhabited by HASS, is far more slippery. In Latour's words: '…contrary to the natural sciences, the earthly sciences cannot ignore that they are engaged in controversies for the production, interpretation, and application of data'. To put this in the context of Harrison's comment, above, about the respective roles and responsibilities of scientist and politician, if it is the role of STEM-M to uncover the facts, and politicians are to act on the facts, then it is the role of HASS to translate between the two.

Doctoral Curriculum in the Earthly University

Latour's earthly re-orientation of the university foregrounds public engagement; design, performance and data visualisation, and; the mobilisation of the earthly sciences (non-natural sciences) to 'gaia-ology'. How might this earthly orientation inform doctoral education? We have already touched on some of the numerous ways universities might re-orient to address public extension/outreach to address the survival and flourishing of life on earth. Adoption of these measures are likely to influence the research topics that are promoted and adopted by PhD candidates. For example, obvious measures in PhD programs include strategic allocation of scholarships and alignment of institutional research objectives/funding mechanisms with the United Nations' Sustainable Development Goals. External incentives are already in place for the latter in the form of the impact ranking systems, such as the Times Higher Education impact rankings (THE n.d.), and we are already seeing many universities world-wide adopting at least in-principle support for the SDGs—including our own.

Drilling down into opportunities in the co-curriculum, how might the new forms of collectivity that Latour's framework encourages mobilise the complementary disciplinary expertise of HASS and STEM-M? A feature of Latour's model is that both HASS and STEM-M have key, substantive roles. HASS, for example, is not simply there to provide the so called 'soft' generic and transferable skills, such as critical and creative thinking, to which it is as all too often reduced (Søaalen et al. 2020). Interdisciplinarity, to borrow from science and technology scholar Radin (2019) recognises, '…the complex forms of collectivity and politics that go into making reliable knowledge'. A model of the university that foregrounds interdisciplinarity, therefore, recognises the collective role of a range of disciplines in the production and communication of reliable knowledge and translating between science and social action.

Large scale, successful precedents for cross-disciplinary and cross-institutional innovations in the PhD co-curriculum are already available. The worldwide, Three Minute Thesis competition is one such example, in which PhD candidates are challenged to describe the significance of their research in three minutes (University of Queensland n.d.). A limitation of this model, however, is that the largely expository presentations do not allow for interrogation and discussion. Nor does it provide an opportunity for interdisciplinary or inter-sector interrogation, explication or dialogue. Building on this precedent, however, a dialogic, debate-oriented model is imaginable. For example, PhD candidates could collaborate in interdisciplinary teams, critically interrogating and communicating data sets with community stakeholders. Interdisciplinary dialogue of this sort would support, in Latour's words '…people in entirely different disciplines being pushed to compare their data sets no matter where they come from'. This would create interdisciplinary opportunities to share, discuss, interpret and visualise data with the aim of building data interrogation and communication skills and non-university engagement.

As discussed earlier, additional changes would be required to PhD programs—either to the core or to the co-curriculum—to support these activities and address key capabilities, such as critical communication, design, data analysis and visualisation. Essential to advanced communication, for example, is the need critically to understand and appropriately adopt techniques of persuasion. This has a theoretical element, based-on epistemology and the philosophy of science, in addition to an applied element drawing on models of debate and rhetoric. Ancient precepts regarding the arts of rhetoric and persuasion have long been considered the foundations of higher learning and are equally relevant now. For example, Aristotle's three proofs: ethos, the trustworthiness or credibility of the speaker and claim; pathos, the ability to draw-in the intended audience through identification and experience, and; logos, or argumentation and the effectiveness of supporting evidence. Whilst communication skills have long been recognised as essential components of PhD training, Latour's framework also highlights the need for design, data analysis and visualisation capabilities. Unlike Aristotle's time, techniques of persuasion are now heavily reliant on visual media and the ability to communicate data graphically. While recognising that some, particularly HASS, disciplines may specialise in this area, the development of appropriate co-curricular learning resources will be necessary across the disciplines, including opportunities for cross-disciplinary discussion.

As science communicator Nick Pyenson (2020) states, 'it's clear that facts aren't always enough to capture interest or sway public opinion. Something more is needed. In our view, this something more can be encapsulated in the concept of persuasion; hence our characterisation of the PhD needed for our future as one that is publicly oriented and persuasive.

Conclusion

The need for a different kind of research which demands a different kind of research training feels very pressing—especially given the opening provided by COVID-19 for active consideration of the so called 'new normal' and the steps needed for humans to learn how to live—and dwell, as in Heidegger's formulation—in a world made more perilous through deteriorating climatic conditions and mass pandemic. This task appears to us very urgent and it is salutary to consider how much brainpower could be harnessed towards solving some of these critical problems. For example, if universities worldwide directed a small proportion of all doctoral research—say 10% on current numbers as cited above—this would yield around 40,000 research projects directed to how we might live in the world, especially if these researchers conceived of their mission as the stewardship of life (in all its dimensions, including the social, political and economic) on earth and its sustainability.

In this chapter, we argue for a reformulation of doctoral education in the context of the re-organisation of universities around outreach and engagements as core principles. We identify the need for some inclusions in doctoral curricula to enable this—guidance in the concept of pathways to impact, more concerted focus on communication both within doctoral programs in all fields and as a field in its own right, an expanded range of literacies including data literacy and literacy in policy and political processes, and an ethos directed to the stewardship of life on earth in the place of the narrower, involuted stewardship of the disciplines. We draw on the model of public health to advance the idea of public science of which doctoral graduates would be highly skilled proponents.

We recall that the conferring of the doctoral degree is the conferral of authority to teach, to instruct and persuade, and envisage graduates capable of this important function both within the university and beyond. We are not oblivious to the challenges entailed in this re-orientation—the persistence of the disciplines in the structure of institutions and the career paths of academics remains an inhibition to change, as does the bias against normativity in many disciplines and the marginalisation of action-research models. Closely tied to our vision for a public PhD is our vision for a persuasive PhD: programs which produce graduates who have advanced capacities in communication, in reason-based argument, in persuasion, who can deal adeptly with the demands of academic debate and the rigours of public discourse. As indicated earlier in this chapter, we feel that the need for change is pressing. If not now, when?

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Chapter 8
Remaking the PhD in US Higher Education: An Assessment

Deane E. Neubauer

Abstract The United States stands athwart a widening gap in PhD education with respect to effective consideration of the role of this degree in reference to the global climate crisis. Where a small number of research universities have begun to reconsider the role of the degree in the face of this crisis, most have not. In point of fact, within most US higher education institutions, the degree is framed and conducted as it has been for decades with little or no attention paid to its particular role within the crisis. The chapter seeks to place the current status of the PhD in American higher education in the context of Bruno Latour's analysis of the global response to the changing global climate.

Introduction

In his provocative essay on the politics of the "new climate regime" (2017) Bruno Latour seeks to organize the discourse that was arising within the twenty-first-century period of "mature globalization" by positing a set of "attractors"—foci of both discourse and behaviour that had come to predominate in the first two decades of the century—a discourse that had also come to be framed as the tensions existing between globalization and the "new nationalism". In providing the analytical framework for "up-dating" much of politics and discourse of the past two centuries, Latour has sought to conceptually re-frame the impacts being imposed on these phenomena by the "realities" of the steady movement toward the impending climate crisis. In his historical summary leading up to the "just-past" period of globalization, he highlights the tensions between the "local" and the "global"—which many commentators over the past decade had placed within the framework of the steadily emergent tensions between a globalization regime embodied by the forces of global

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capitalism, their instrumentalities of global firms, and their financial, production and distribution modalities. In his analysis, Latour terms these respectively, "Attractors" 1 and 2. The core of his theoretical contribution is to posit the emergence of an "Attractor 3", constituted of and embodied by what he terms "the Terrestrial", the movement toward all the combined and complex phenomena that constitute the existential climate crisis in which the world finds itself.

With one notable exception—the emergence of yet another "direction" which he terms "Attractor 4: Out-of-This-World". This distinctive attractor is constituted of the phenomena resulting from Donald Trump's election as US President, which has created "a political innovation of a rare sort that needs to be taken seriously (p. 34)". He goes on to frame this attractor in terms that clearly differentiate it from the other distinctive conceptual and theoretical constructions that constitute his analysis:

> It is as though Trump has managed to identify a *fourth attractor.* This one is easy to name: It is the *Out-of-This-World*…the horizon of people who no longer belong to the realities of an earth that would react to their actions. For the first time, climate change denial defines the orientation of the public life of a nation. (Latour 2017, 34–5)

And taking the "logic" of this position further:

> In a sense, Trump's election confirms, for the rest of the world, the end of a politics oriented toward an identifiable goal. Trumpian politics is not 'post-truth', it is post-politics—that is, literally, a politics *with no object*, since it rejects the world that it claims to inhabit. (Latour 2017, 38)

Addressing these phenomena in the Summer of 2020 as the COVID 19 pandemic continues to spread across the world, one can only urge a post-script to what Latour had framed in 2017 as the prevailing politics of the United States, inasmuch as the Trump administration has brought to the "conduct" of the pandemic an irrationality and a politics of the "idiosyncratic" that one would be hard pressed to find replicated in the behaviour of any modern national state that professes to be both "developed" and "democratic". What transpired in the first months of the pandemic in the United States simultaneously represented the greatest "dislocations" of the society and economy, at least since the combined impacts of the Flu pandemic in 1917–1921, the Great Depression, and WW II. Overall, in many ways the current pandemic may be the greatest dislocation ever, with one significant impact situated firmly within the education system of the country at all levels. None of which, it must be emphasized, was predictable at the end of 2019.

However, almost from the beginning of the Trump administration, the world was faced with a central feature of that administration, and a primary source of Latour's characterization: climate denial. "Within a nonce", as it were, those throughout the world accustomed to viewing the United States as its most economically advanced country, and who had come to regard that accomplishment as largely inseparable from the nature and contributions of its "science establishment", were confronted with the spectacle of that country's president's continued denial of the very reality of climate change, terming it yet another "hoax". Such pronouncements were made even in the face of powerful negative evidence such as a January 2019 report of the US Department of Defense that emphasized the "significant vulnerabilities" the US military faced from "climate-related events" (De La Garza 2019). Daunting as such

a stance is in the context of what the "rest of the world" holds to be true (and what was recently true of the United States as well as signified by its role in the creation and support of the Paris Climate Accords) the Trump administration has "pushed on" to make its position a matter of clear government policy including reducing governmental financial support for climate science research. Consistent with this position, at the time of this writing, the Trump Administration's proposed 2021 federal budget cuts funding for climate-related science including funds available for climate research conducted by American higher education institutions (Beitsch 2020).

Embracing the framing proposed by Latour creates a conundrum for those within the United States context seeking to follow the wisdom of his argument within their own currently tortured frames of reference. On the one hand, given the historical framing of his argument, it is clear that the emergence of the Third Attractor is, from any sensible macro point of view, an important and perhaps even essential framing for developing sensible understandings of the challenges facing all of the earth's societies within the emergent climate crisis. Five years ago the vast majority of American scholars and commentators would join some aspect of discourse being framed by the tensions between what was then seen as "emergent nationalism" and a "run-away" globalization that had at the very least provided for the most astonishing increase in wealth inequality of the modern era. Those "facts" alone provided the basis for the underlying tensions that Latour has so well captured. And, importantly, the insight provided by the realization of these emergent tensions "fitted" surprisingly well the continued directions of American higher education and its related research establishments.

The over-riding issue created by the "Trump-reality" within which the country finds itself is whether this will prove to be an anomalous "side-track" along a pathway being mapped by the tensions between Latour's Attractors One and Two, holding open the possibility that a "post-Trump" government could bring the country "back in line" with a generalized movement toward the Terrestrial, *or* whether this "detour" will prove enduring: taking what is currently the largest economy in the world in a direction in which its fossil-fueled structure *demands* legitimation from the rest of the world, irrespective of consequences.[1]

This is the over-riding tension that undergirds American higher education in 2020, *irrespective* of the additional unknown, but potentially equally transformative, effects of the current COVID 19 pandemic. And, whereas these are for the most part unknowable at the time of this writing and the publication of this volume, some early data and estimations of possible effects are worth noting. As a case in point, early in the course of the pandemic, and inseparable from the extraordinary mismanagement of its onset and course by the Trump administration, the Spring semester of US higher education was in full session, having begun in almost all instances in January. And, as is well-known, the epicentre of the pandemic was

[1] And, it deserves to be pointed out, the longerterm effects of the Trump administration, even should it prove to be one-term event of 4-years duration, will be substantial, nevertheless. As this is being written, that administration is in the process of repealing over 100 environmental-oriented regulations that were governing the US economy. Again, even if the task comes down to rebuilding this structure after a one-term presidency, the amount of climate damage wrought during this period will be substantial (Popovich et al. 2020).

New York City, which geographically and institutionally stands as close to the centre of US higher education as exists, given that within the northeastern states a large number of its oldest, best known and highest regarded institutions are located. Furthermore, the other major early epicentres of the virus were the West Coast and the states of Washington, Oregon and California, wherein are located another tier of the most established and highly regarded institutions.

By early March, it had become clear that continuing face-to-face education in such institutions was impossible, and these institutions were rapidly shut down to students, dormitories were closed, and to the extent that the research and service missions were allowed to continue, these institutions embarked on creating novel ways to "work from home" for faculty. In some cases, the semester was simply abandoned, whereas in others, teaching by distance was instituted in an effort to save at least some of the semester. Overall, as will be recalled, much of the country and its 330 million plus inhabitants were "shut down" for most of April and May.

One important consequence of this has been early estimations of the number of US higher education institutions that may simply not survive the effects of the pandemic. Richard Vedder, a long-time analyst of higher education finance, to cite one view, has estimated that the pandemic will "kill" 500–1000 colleges, noting that many of these were in marginal financial condition before the onset, and even with any available governmental support, they will be unable to continue as viable higher education institutions (Vedder 2020).

The basic point to be made here is that the overall "fate" of American higher education at this moment and within this framing is simply unknown, especially as the society as a whole prepares for a "second wave" of the pandemic, and as other instances of social unrest such as urban riots and demonstrations, having their origin in racial issues, have spread across the country. Even as the country seeks to "re-open" and moderate the extraordinary extent of damage to the economy suffered,[2] it is profoundly uncertain how higher education institutions will change in response to the challenges of making campuses operational once again. At the very least, the existing situation will provide increased incentives to introduce a range of technologies into the teaching process, and in doing so accelerate the degree to which existing instructional modalities are transformed.

The Doctorate in Contemporary US Higher Education

With very few exceptions, the PhD in American higher education has been viewed as a pinnacle degree, initially giving rights and status to teach and conduct research within universities. Recently, however, as Michael Jones has noted, the degree is increasingly being re-conceptualized and re-examined.

[2] In April 2020, the unemployment rate was 14.7% which translates into a total of 23.1 million unemployed.

This re-examination has come about for a number of reasons:

> (1) employment options within the academe are no longer as abundant or secure as they once were; (2) employers have become more discerning; they are looking for specific skills and qualifications which are absent from the traditional PhD; (3) government and society are demanding a research degree that is more relevant to the needs of business and the growth of the economy; and (4) universities are seeing the economic value of increasing student numbers, and creating better alignments with industry (Jones 2019).

Within this changing structure, the PhD has come predominantly to signify a course of study culminating in a major research undertaking, one rendering the holder a perceived expert in the subject matter of the dissertation. However, increasing numbers of "doctoral degrees" have emerged in recent years, often carrying a certification that distinguishes their course of study from that of the PhD and with the designation of being earned within professional programmes, such as law (JD), education (EdD) and engineering (DEng/DESc/DES). Such degrees are further differentiated from other increasingly popular professional degrees. These are meant to signify accomplishment in either endeavours outside the traditional fields of the academy (e.g. Doctor of Acupuncture, Doctor of Professional Counseling and Doctor of Podiatric Medicine), or those conducted within conventional academic structures but closely aligned with their practice environments outside higher education (e.g. Doctor of Optometry, Doctor of Management, Juris Doctor/Doctor of Jurisprudence) (Wikipedia 2020).

In this transitional higher education climate in the United States, addressing the question of how the "doctorate" may develop/evolve/emerge as a designed frame for disciplined academic discourse—even in the absence of the critical issues of how climate change may impact higher education—becomes extraordinarily complex. And to this set of circumstances must be added the reality of how higher education as a national "structure" is "organized" or "un-organized", such that seeking to make generalizations about these phenomena is always fraught with the reality of there being no national "centre" to American higher education and no governmental ministry at the national level to make, coordinate and enforce policy. In place of this, and as a result of over a century of developments within this model, there exists an extended complex of regulation and oversight consisting of state departments of education, boards of regents and trustees, and professional associations—including those focused on quality assurance and the maintenance of professional standards—all overseen by a national Department of Health, Education and Welfare whose role in the actual governance and regulation of higher education is limited by the federal structure of government.

The overall result is that the dynamics that underlie and propel such questions as the nature, role and future of the PhD, in all of the frames provided by the preceding analytical chapters of this volume, not to mention the more radical and complex analysis of Latour, are quite unique within the American experience.

Climate Change Engagement Within US Higher Education

Whereas the reality and critical importance of climate change have been recognized and addressed within US higher education since shortly after the turn of the century, and not discounting the fact that a relatively large number of universities have supported voluntary organizations to pursue the goal of climate mitigation, specific focus on the role of the PhD in that endeavour has, on the whole, been pursued within the context of the individual institutions themselves, most notably through a large coalition structure known as Second Nature.[3] In 2017 a number of the most important universities pursuing climate research (and to a significant degree highly dependent on grant funding from science-focused governmental departments) were faced with the reality of the United States withdrawing from the Paris Accords, following yet another of the nationalist commitments of the Trump Administration. One entailment of that was the formation of the University Climate Change Coalition (UC3) representing some of the top US research universities (and representatives from both Canada and Mexico).[4] The focus of both these large institutional coalitions embraces the full range of activity from basic science to applied science, to policy structures, and the analysis of effects. To that extent they seek to gain "buy in" across the whole of contemporary higher education structures including, importantly, the social sciences and the humanities as well as the natural sciences. Overall, this continued, transforming focus has not (yet) affected the overall structure of how the PhD is conceptualized or actualized within the majority of universities. In the vast number of cases the degree is located within existing disciplinary structures and doctoral students are charged with demonstrating their overall knowledge of "the field" (as defined by those structures) while making a distinctive and (hopefully) original contribution to it. Numerically, what one might consider "interdisciplinary" PhD's are far and away, a minority contribution to overall research and knowledge structures.

[3] At the overall "cooperative" level, perhaps the key action has been the creation of Second Nature, an organization dating from 2009 of over 600 signatories representing university presidents and chancellors. Their climate leadership statement reads: "We, the undersigned presidents and chancellors of colleges and universities, believe firmly in the power, potential, and imperative of higher education's key role in shaping a sustainable society. Not only are we deeply concerned about the increasing pace and intensity of global climate change and the potential for unprecedented detrimental impacts, but we also understand that technology, infrastructure, global interconnectedness, and our greatest asset—engaged, committed and smart students, allow us to explore bold and innovative solutions and to lead in climate action and sustainable solutions" (Second Nature 2020).

[4] Among the perhaps better-known institutions are Caltech, Arizona State University, the University of Washington, the University of Michigan, The Ohio State University, Boston University and the University of California.

Interpreting the US PhD Through Latour

One way to engage Latour's climate argument in the context of US doctoral education and research orientations is to see his interpretation of modern history as a staged movement from a "generalized force" of a socially useful "power" source that multiplies human labour, dating from the advent of the steam engine, into and through successive waves of technologies capable of powering and advancing industry and the historical sequences of continued organization and reorganizing of such capabilities. Over the last four decades, these forces have culminated in the current predominant stage characterized by the globalization attractor (Latour, cf. pp. 25–38). By extension, he argues that the movement of individual societies and cumulatively, the world as a whole, toward the world-changing event of climate change constitutes in effect fundamental interruption of this entire process. This transition involves moving away from the seemingly endless proliferation and aggregation of the "specializations" in virtually every endeavour that has defined technology, industries, economies, societies and so on back toward an encompassing "general" force—that of the terrestrial. The underlying logic of this aggregate process has been a continuous sequence of extensions of the "specific" that had been defined and captured successively by all such technologies and their endless applications. Collectively, they embody "ways of being". The emergent reversal of this dynamic involves movement away from such highly distributed and differentiated "ways of being" toward the new "general" imperative. Importantly (critically important!) is the premise that such a movement is constituted such that it is incapable of being "escaped from". This is the climate dynamic that Latour frames as Attractor 3 (the Terrestrial) and the ultimate resolution of the dynamic and tension between Attractor 1 (the Local) and Attractor 2 (Globalization), a dynamic that exists despite the futile efforts of the Trump Attractor 4 to create an alternative that denies it.

By extension, and operating within the terms of this argument, it is necessary to view the past century and a half of US higher education and its research elements, which included the development of the PhD as its premiere degree, within this emergent transformation as well. Historically, higher education research structures in general have led to the degree having a privileged social status, which entails creating access to critical resources in institutional roles and settings that operate to reward ever-greater knowledge accumulations within more narrow and specific knowledge specializations. It is useful, in the overall context of the Latour argument, to hypothesize that these research structures will also be asked/forced to yield to the imperatives of the emergent climate change objective contained within the Third Attractor. In this circumstance the graduate degree representing the "highest levels of higher education achievement" will be forced to focus on the vast multitude of changes taking place in the movement from the Global Attractor to that of the Terrestrial and its inseparable and constitutive climate objectives. In effect, Latour is suggesting that "all of knowledge" needs to shift toward this objective to have continued meaning for a surviving humanity, and it makes sense, given the logic of this argument, that the doctoral degree may/will become the framework for this shift within the academy as well.

Direct Implications

Assuming for the sake of this argument that such transformations do emerge, we can speculate on how the PhD may be transformed within the overall context of American higher education. Doing so, it is also useful to emphasize the rising awareness already occurring within higher education commentary concerning the impacts of artificial intelligence (the Fourth Industrial Revolution) on all of higher education, in a time frame that often begins with the articulations of the annual meeting of the World Economic Forum in 2016 and its focus on "Mastering the Fourth Industrial Revolution" (Schwab 2016). Increasingly, higher education institutions throughout the world are being impacted by various aspects of what is also termed 4AI and the varied extents to which it is beginning to transform the relationships between higher education institutions and the societies within which they reside. (For a brief accounting see C. N. Davidson 2017; Doucet et al. 2018.) Even without an intervening event such as the COVID 19 pandemic, projections about the future of higher education within an AI regime presage various fundamental restructurings. One seemingly common conclusion is that over the coming decade, most higher education graduates will be entering into a radically transformed social reality of altered expectations. Daniel Susskind, for one, has predicted that within the next decade (and even perhaps sooner), as many as 40% of existing jobs are likely to disappear as a result of AI-induced social change (Susskind 2020). These dynamics alone, this literature suggests, will create a "new reality" for all higher education graduates, with perhaps those holding advanced degrees being affected the most.

Within this emergent view of higher education, it takes little effort to locate a growing chorus of expert commentators offering projections of how these emergent dynamics will be radically hastened and given effect by the COVID 19 pandemic. Consider in this regard the prognostications of Yuval Noah Harai in March 2020 in which he argues that *all* of education will be confronted with the new and radical emergent framings of online education.

> Many short-term emergency measures will become a fixture of life. That is the nature of emergencies. They fast-forward historical processes. Decisions that in normal times could take years of deliberation are passed in a matter of hours. Immature and even dangerous technologies are pressed into service, because the risks of doing nothing are bigger. Entire countries serve as guinea-pigs in large-scale social experiments. What happens when everybody works from home and communicates only at a distance? What happens when entire schools and universities go online? In normal times, governments, businesses and educational boards would never agree to conduct such experiments. But these aren't normal times. (Harai 2020)

In the American case, it seems clear that an effort to identify and sort through the macro forces situating the transformation of the PhD within its universities now forces us to engage not only the reality of Latour's Attractor Four—Trump's world and its uncertain duration and after-affects—but also the overall structural impacts of the pandemic simultaneously taking place within the transformative processes of the Fourth Industrial Revolution. It is this novel and continuously changing context that frames any effort to assess and predict the status of the PhD in US higher education with respect to the inescapable imperatives of climate change.

As indicated earlier, the overall salience of the climate change narrative within US higher education is itself limited. On the one hand, formal recognition exists at a senior level, evidence of which is Second Nature, yet the translation of such symbolic commitments into extensive higher education organizational processes is limited. For example, a recent World University Rankings report on climate change ranks only two American universities among the top 31 as globally distinguished by their efforts to engage climate change. Where climate research and instruction do have an independent focus, they are characteristically situated within designated research centres and institutes that are themselves located within larger complex university structures. Such emphases typically are not located within the core "academic" units into which students are recruited and provided their primary instruction, units which overwhelmingly continue to be structured and recognized as "traditional" departments and related academic units. Two useful contrasting examples of how such very distinguished climate-focused entities do operate are the University of Hawaii, Manoa, and the University of Maine.

In the former, climate research has been ongoing for years as a key element of its research on ocean temperatures affected by climate change (conducted primarily within its School of Ocean and Earth Science and Technology-SOEST). Within the School, the doctorate is a combined endeavour of the disciplines that contribute to the organization and structure of the School itself, but as a motive force within the overall university processes, the structure of this particular PhD has had little overall effect, given that each school or college offering the doctorate does so within its own framing, as dictated by its predominant knowledge paradigm and traditions, and most frequently providing certification at the departmental level (over which a separate Graduate Division provides coordination and oversees standards). At the University of Maine, climate science is organized into an interdisciplinary school covering a wide range of research endeavours[5] which do not, however, reach into the kinds of implications and analyses for societal impact that are more usual to the social sciences and humanities.

Returning to the terms generated by Latour's analysis, it is the overwhelming case that in virtually all American universities, the PhD (and with the above caveats to differentiate it from other professional terminal degrees) is first and foremost perceived of and structured as a terminal degree in an established and accepted field of study with minority provision existing for the development of "new" fields of research and scholarship. With respect to the impending climate change crisis, and the movement toward Latour's Third attractor, it would seem that three fundamental and far-reaching changes would need to take place to give the degree essential salience in the face of the nature and scale of social needs.

First, and foremost, would be a reconceptualization of the degree within university hierarchies that allows for a transition from its historic role as a research signifier within the context of its "culmination of the (a) discipline focus", and as such, bound by the many structures that reinforce existing disciplinary-focused activity and organization.

[5] Including: glaciology, sedimentology, plate tectonics, paleoclimatology, structural geology, glacial geology, sea-level change, hydrogeology, environmental geochemistry, petrology, mineralogy and marine geology.

Moving away from its current and predominant role as labeling (both explicitly and by inference) of the degree holder as "expert" within a defined, accepted and "legitimated" disciplinary field, the degree would need to be reframed in terms that extend the knowledge holder's capabilities beyond most currently constituted academic disciplines. Rather than signifying the holder as expert (and presumably with an expert-knowledge capability unmatched by virtually all "others" in society) in a "subject field", the degree would come to indicate the holder's distinguished capability to frame, describe and conduct analyses on and across a range of human occurrences that transcend existing modes of inquiry *and* to engage, with both creativity and intensity, inquiries into "the novel", "the unexpected", and the "never previously experienced".[6]

Among current US doctoral programmes, that which most closely approaches this model may be Prescott College, a private institution located in Prescott Arizona. Its PhD descriptor reads: "The Ph.D. program strives to contribute to equitable educational change and building a more just future: through a socially and environmentally oriented lens" (Prescott College 2020). Were one to find an analogue for this model within existing higher education, it is probably within the varied forms of Future Studies[7] in which much of the intellectual and analytical burdens fall on giving framing and a sense of substance to issues, structures and behaviours that at best are only emergent within existing categories of description and analysis.

A second major transformation that would be required to align PhD programmes with the needs of the climate crisis would be a fundamental restructuring of programmes within the social sciences and humanities. Here the effort would be to focus them beyond their existing complex descriptions and analyses of how societies and cultures are created, organized and operated and with what outcomes and consequences. In their revised form and mission, they might be re-conceptualized to render them increasingly relevant to the emergent crisis and to the full range of consequences emerging from such powerful new forces as AI and climate change.

In short, a massive effort would be needed to shift them away from the positivist and analytical paradigm that has dominated these disciplines within higher education for the past several decades, into a normative framework in which their intellectual energies and capabilities would be directed toward the social challenges already taking place and emergent in the dynamics and consequences of climate change. In specific, the disciplines currently embraced by the social sciences and humanities would increasingly be charged with seeking both to analyse and to account for the "new worlds" being created by the synchronistic forces of artificial intelligence and climate change, including the nature, range and implications of their disruptions. In a manner that is currently difficult to imagine given the frames within which current PhD programmes operate, these degree programmes would be

[6] In this regard, such a conceptual approach would resemble Tim Morton's notion of "hyperobjects", namely a problem or phenomenon that not only seems to defy our control, but our very understanding of what it "is" (Morton 2013).

[7] Cathy Dawson, seeking to identify Futurist resources throughout the globe that seemingly possessed such capabilities in 2019, found one such program in the United States offering a Ph.D., located at the University of Hawaii, Manoa, having been established by Professor James Dator over two decades ago (Dawson 2020).

charged with the dual task of exploring how current inhabitants of existing societies are impacted by and respond to these extraordinary changes, while also gaining a sense of new modalities of "the possible", including new visions of social life and organization, emergent within such dynamics of change.

It seems to follow that where PhD programmes to embark upon a course in which such new ways of thinking become central to their revised mission(s), novel modalities of recruitment would soon develop within universities. That which is regarded as "novelty" and "creativity" would (conceivably) rapidly change, as would "ways of thinking" within higher education structures. Much of the existing burden placed upon "individuals" to display their capabilities could, conceivably, be fundamentally modified by new ways of producing and organizing "intelligence" for those asked to operate within new higher education structures—again, a process that is likely to be much framed and influenced by the developments and progression of artificial intelligence. The prevailing presumption that holders of the PhD do so in part as the result of a demonstration of their capability for both analysis and creativity could find, conceivably, that the burden of their intellectual demonstrations was increasingly shifted in the direction of their ability to think creatively about the transforming nature of society within never before experienced social realities and the consequences that may flow from that.

And finally and importantly, to fully appreciate the current structure and "operation" of the PhD system within American higher education, one needs to take into consideration the extraordinary degree to which it is funded by research grants, largely from governments at all levels, but also through the extensive structure of private-sector spending, by both foundations and corporations (Mervis 2017). Such funding structures, as they have in the past, perform the dual role of creating new agendas for research into which PhD cohorts are introduced, educated and graduated, and also operate as powerful forces to institutionalize and maintain the status quo. Within the policies of the Trump administration, it is simply unrealistic to see government funding leading to any significant support of research that would impact in a novel and positive way, the overall role of doctoral research focused on climate change. By contrast the commitment of private foundations to support research on climate change is substantial and continues to grow (Wendelbo 2018). The critical question here is whether in this regard higher education policies and structures may, in effect, get "caught in the middle" of these two possibly contending agendas.

Conclusion

Working with Latour's framework provides American students of its higher education structure an opportunity to attempt a difficult task: namely, employing his categories and insights to confront the transformative dynamics of climate change and gain the benefits of the insights produced, even while appreciating how theoretically and analytically isolating the prevailing American perspective is becoming within the Trump presidency. Confronted by the onrushing challenges to its structures, pedagogies, intellectual orientations and financial underpinnings embodied in the unprecedented combination of the COVID 19 pandemic, the rapidly emergent

Artificial Intelligence Revolution, *and* climate change, American higher education must face fundamental questions about its basic purposes, capabilities and desired outcomes. From every perspective, it is apparent that the country's higher education structure is unlikely to produce acceptable outcomes without fundamental changes. One of these can be, and should be, re-conceptualizing the PhD to focus it in various novel forms toward addressing these unprecedented national and global challenges.[8]

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[8] I am grateful for the consultation of both Krista Hiser and Matthew Lynch for various ideas embodied in this draft. Neither are in any way responsible for its contents.

Part III
Earthing Beyond the PhD

Chapter 9
"I'm Sorry, but It's Kind of Business." Crisis, Critique and Care in and Beyond the PhD

Ruth Müller

Abstract In this chapter I explore the notion of crisis in academia as a form of mismatch between researchers' expectations of which values *should* govern academic work and their experiences of which values govern academic work *in practice*. I do so through the lens of postdoctoral life scientists' accounts of working and living in academia. I propose that postdocs' accounts offer particularly rich narratives about the values that guide academic work today and that their experiences mirror larger transformations of academic work that intimately affect PhD education. Foregrounding three moments of crisis – a crisis in collaboration, a crisis in education and a crisis in academic subjectivation – I argue that in order to improve and reorient contemporary PhD education, systemic change pertaining to the values, assessment procedures and incentive structures that govern academic work across career stages and, increasingly, across disciplines is needed.

Introduction: Unpacking the Notion of Crisis

The contributions in this volume start from the observation that the university as an institution, and PhD education in particular, finds itself in a state of crisis, an observation that is both widely shared and criticized in academia. Some argue that contemporary universities are finally heading in the right direction, leaving the ivory tower behind, becoming more accessible and accountable to a range of societal stakeholders, exhibiting a more competitive spirit and focusing on fields of research and training that can yield measurable public impact and increase student employability. Others argue that this is exactly the wrong direction to head in: they argue that universities need to remain institutions of independent knowledge production, educate

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students to become critical thinkers not employees, focus on basic research and promote collective thinking and problem-solving in order to respond well to the multiple social and ecological challenges that planet Earth is facing right now. Both of these positions of course operate with idealized notions of the university and its past, present and possible future. Both also focus on aspects of the university that have always existed to different degrees in different fields, institutions and national contexts. The struggle today, therefore, might be more about balance than about principle.

It is from this vantage point of thinking about balance that I start my interrogation of a possible crisis in academia. A crisis emerges when a system is no longer able to integrate or compensate for certain developments; a body, for example, experiences crisis when it lacks nourishment or is strained too much. A state of crisis can only be maintained for so long before it results in lasting damage. If the strains are not attended to or integrated in some way, a body eventually becomes sick or burns out.

Recent years have seen an uptick in literature in which academics describe just such an experience of crisis: a sense that everyday work in contemporary universities results in a myriad of "hidden injuries" (Gill 2010) that strain and overstrain the bodies and the minds of academics. This sense of crisis, I argue in this piece, is chiefly rooted in a mismatch between the values that are supposed to govern academic work in principle and those that govern academic work in practice. I arrive at this conclusion based on my interview-based research, which explores the work cultures of researchers in the life sciences and the environmental sciences. The notion of crisis that I am working with in this chapter is thus not a temporal one: I do not assume that there was a "golden age" (Holden 2015) of academia when things were good and that now they are not anymore. Talking to researchers at different career stages reveals that indeed each time period in academia had its own challenges and, sometimes, what was intended as a solution to a problem in the past has now become a problem itself. For example, in interviews, senior life scientists recount how, when they were starting out their careers, they argued *for* the use of performance metrics for hiring and promotion procedures in order to break up feudal and nepotist structures at universities. Today, many feel that in doing so they have assisted in the creation of a new system of oppression and exclusion, a novel "monster" that replaced the old one and that now governs their own research agendas and the careers of their students, and that limits epistemic and human diversity in academia.

Rather than a decay over time, I thus understand the current sense of crisis as a mismatch between ideals and experiences in the present. Ideals that, among other things, include the notions that science is a public good with the primary aim of expanding knowledge, not profit; that science is collaborative and communitarian; that educating students is an important and rewarding academic activity and that the scientific community would stand up to defend these values if they were threatened. Academics, particularly younger academics, often assume that these values at some point governed academic work in practice (a question that, in my view, is open to historical-empirical investigation) – why else would these values be so central to the mission statements and recruitment pitches of universities, research funders and related government agencies? Yet, as Ylijoki points out, this nostalgic view of the

past that we often encounter when academics speak about current problems might say more about the present than it does about the past. In her analysis of academic nostalgia, Ylijoki (2005) argues:

> The reference point of the story of nostalgia is not the past but the present. Thus the nostalgic past should not be interpreted as an objective description but as a selective idealization and simplification (Gabriel, 1993). The nostalgic yearning for the lost golden age reveals current tensions and dilemmas through which the idealized past is then socially constructed. (561) […] Nostalgia concerns the moral order of academic work: what is academic work all about, what is its purpose, who determines its content, which duties form the core of the profession, to whom it is directed, and which commitments and assumptions are the most fundamental. (570)

Ylijoki reminds us that nostalgia, which literally means "homesickness," is more often indicative of feelings regarding a mismatch of ideals and experiences in the present than of the existence of an actual golden past. In her study, nostalgia is often related to the perception that something is different from how it should be; it conveys feelings of loss and lostness, of anomie, distrust and confusion. Nostalgia is connected to what Ylijoki calls an academic "identity crisis" (2005, 571): a moment in which the values that have been perceived to be at the core of academic work do not figure prominently enough in practice to uphold the sense that they are really guiding its processes. Whether they have ever been key is debatable and, to me, not the most fruitful or urgent of questions. In my view, it lends neither less nor more authority to a problem if it is a new or an old one; rather, its consequences in the world are decisive.

My use of the word crisis is nostalgic in this sense: while not necessarily assuming the de facto existence of a better past that preceded the crisis (Alas, what does better mean? Better for whom? In which respect? For whom not?), it aims at honoring a *feeling* of decay that permeates many interviews – a decay that is first and foremost a social one that runs contrary to the expansion of campuses, PhD programs and funding programs in fields such as the life and environmental sciences. In what follows, I sketch three, as I believe, important aspects of this crisis, particularly with regard to the ability of academic science to respond well to the multiple social and ecological crises of our time. These aspects concern the value of (1) collaboration and (2) education in contemporary science, as well as (3) the formation of academic subjectivities. In conclusion, I discuss what this analysis of crisis might imply for rethinking PhD education "at the end of the world."

Viewpoint: Postdocs and the "Postdoctoralization" of Academia

I explore these moments of crisis from the perspective of postdocs in the life sciences, through material gathered in interviews over a period of more than 10 years in a range of projects. It might be surprising to find a chapter that specifically draws on the experiences of postdoctoral researchers in a volume dedicated to PhD

education. I believe, however, that postdocs offer a particularly valuable vantage point from which to explore the guiding values of contemporary academic work. Postdocs work at the "bottleneck" of academic careers; particularly in fields like the life sciences, the number of PhD holders who aspire to an academic career far exceeds the number of available long-term positions, such as group leader or staff researcher positions. The postdoctoral period is hence a time of intense competition, and postdocs are often keen observers of the values and norms that govern academic success. No longer students and not yet – or ever – established scholars, their take on academic life and its rules tends to be astute and unfiltered.

Yet, it would be a mistake to assume that their accounts of academic life only have relevance for the postdoctoral period: I understand the postdoctoral period as a model of a type of anxiousness, precarity and a specific value-orientation that is currently expanding into ever more periods of academic life. Ever more senior positions are time-limited, non-tenured or non-tenure-track; ever more PhD students have the sense that they need to be immensely successful and productive during their PhD years in order to stand a chance in the fierce competition that comes thereafter. Even master's students in the sciences report that they feel the pressure to arrive at publishable results by the end of their 6-month thesis period. The pressure is mounting all around, and the postdoctoral period offers insights into how these pressures might affect researchers' decision-making processes in their academic work practices.

Additionally, of course, postdocs also serve as important role models, mentors and supervisors to PhD students in everyday research life. While often not officially acknowledged, their impact on PhD students is significant. In the life sciences, for example, they are usually the most experienced researchers at the bench, with group leaders usually removed from everyday laboratory work. For all these reasons, I believe it is more than appropriate to dedicate a chapter in this volume to postdocs and to what we can learn from their experiences about the contemporary transformation of academic work in general and about PhD education in particular.

A Crisis in Collaboration

Scientific collaboration is one of the big buzzwords of contemporary science and science policy: it is through collaboration that researchers are supposed to address and overcome the challenges and crises of today. Yet, in my work, collaboration emerged as a practice that postdocs struggled with (Müller 2012; Müller and de Rijcke 2017). In their narratives, it became apparent that considerations of (first) authorship often led postdocs to shy away from rather than embrace collaboration. For advancing their careers, postdocs considered publications, and especially first authorships on publications, absolutely vital. This high career value assigned to publications in general, and first-authored publications in particular, shapes how postdocs prefer to organize their work within research groups. It decreases their interest in collaboration with peers in order to avoid authorship conflicts and the

potential loss of vital first authorships and increases their preference for working individually.

Group leaders are generally aware of the career needs of their younger group members, and most try to ensure that each member of the group, starting at the PhD or even master's level, can work on a clearly delimited project in order to keep the number of authorship conflicts low. Hence, the basic socio-epistemic organization of life science labs – and, increasingly, of groups in other research fields – is based on individualized working structures that serve individual-focused career rationales.

This is not to say that, within the basic structure of individualized projects, group member scientists do not cooperate; indeed, they systematically and significantly assist each other with their individualized projects. Yet, they try to avoid having to accredit help through co-authorship, as the value of a paper is perceived to decrease with the number of authors. Thus, even these informal forms of working together are constantly assessed with an eye to the potential danger of having to share authorship and hence entail a significant amount of self-monitoring: the task is to give enough to others in the group to be able to ask for help, while avoiding giving or especially receiving help that becomes so substantial that it needs to be formally accredited with co-authorships. Thus, career considerations substantially shape and govern processes of (not) working together in life science research groups.

Calling it a *moment of crisis* if postdocs prefer to work individually rather than collaboratively might seem to require the normative assumption that collaboration is something beneficial in and of itself. Shrum (2010) argues that it is an analytic weakness of numerous studies of collaboration to implicitly make this assumption without further reflection. This is certainly an important observation. Yet, this is not the assumption behind my argument here. In fact, I do not argue that all collaboration is inherently beneficial. Rather, I argue in favor of *socio-epistemic conditions that allow for collaboration when it is needed* – when the research problem and the real-world problem behind it are better solved collaboratively. Hence, what I am concerned with is that current academic career rationales in the life sciences limit the *possibilities for collaboration*. They tend to make collaboration unattractive even if, epistemically, collaboration would be the best way to go. Since criteria for assessment and employment focus on individual achievements, they limit how much and which kinds of collaboration life scientists can afford. This goes beyond the entity of the young competing postdoc researcher who does not want colleagues involved in his or her work for authorship reasons: it affects the structure of learning processes and opportunities during the PhD as much as it affects the behavior of group leaders, who, for example, recount shying away from collaboration within the same institution because a collaborative paper will only count half in publication numbers and impact points for each group in the annual institutional performance evaluations.[1]

[1] Economist of science Paula Stephan (2012) has published similar findings with regard to interdisciplinary collaboration.

Someone might interject that this cannot be true, as formal collaborations are becoming more frequent – often, achieving funding is not even possible without collaboration. Through these creative constraints,[2] scientists come together in novel and unexpected constellations, sharing their expertise and devising new research questions and approaches. However, at times, these collaborations are just that: means of achieving funding. Accounts of how scientists try to ensure a competitive advantage over other collaborators within these large-scale collaborations (e.g. by not sharing their most promising data) are not unusual. Subjected to the primacy of individualized career rationales, collaboration can only thrive where it assures a competitive edge over others and improves one's position within the academic system. Competition structures collaboration, giving room only for some forms of collaboration and not others. Yet, what about those forms of collaboration that would address a problem very well but would be lengthy, complicated and unorthodox? Where do they fit in? It is these forms of collaboration that I am concerned about. How do we need to refigure academic career and incentive systems to allow them to thrive, too?

A Crisis in PhD Education

Not all collaboration is beneficial, nor is all collaboration elective. Shrum reminds us that the term collaboration itself has historical affinities with practices of betrayal by invoking its "World War II roots as a traitorous relationship with an enemy" (2010, 247). While Shrum clearly invokes this drastic historical meaning of collaboration to counteract what he perceives to be an overly uncritical embrace of collaboration as an inherently positive and well-meaning practice, it is worth exploring under which conditions collaboration can become part of practices of exploitation and betrayal. The second moment of crisis I attend to has to do with such instances in which a collaborative relationship might entail treacherous aspects. It focuses on how postdoctoral life scientists engage in supervision work of PhD students (Müller 2014).

Social science studies of the increasingly dominant neoliberal model of the university indicate that its rise goes hand in hand with shifts regarding which kind of work is rewarded in terms of career development and job security (Macfarlane 2005; Brown 2002). While an increasing focus is put on evaluating research performance, less reward is attached to excellent performance in supervising and teaching students. Postdocs carry out significant amounts of supervision work within life science research groups (Delamont and Atkinson 2001). Yet, this work hardly counts towards their career development. Here, research performance metrics such as publication numbers and journal impact factors are key. Hence, within the

[2] See Stengers (2010) for how constraints are, while limiting, always also creative as they lend specificity to practices.

competitive environment of academic life science careers, postdocs feel that they need to dedicate as much time as possible to working on publishable results. Supervision work takes time away from publication work. Still, postdocs are often overburdened with supervision duties handed down to them by their group leaders, who are also overburdened by an increase in duties associated with the current changes in the academic world (more grant writing, audits, more PhD students, etc.). This puts postdocs in often quite overwhelming situations. Yet, this is hardly acknowledged as problematic by the group leaders and sometimes not even by the postdocs themselves. Rather, this kind of overload is reframed as indicative of their future work and life in academia, and learning how to deal with it is considered necessary for postdocs if they want to advance to the next stage of their careers. This framing puts normative pressure on postdocs to show that they can cope and hence are suitable candidates for an academic career.

How, then, do postdocs cope with this situation? One strategy is to maximize work time, in order to combine research and supervision work. Naturally, this strategy has limits, as even the most ambitious postdoc can only work so many hours without seriously compromising their physical and mental health. A second strategy therefore often complements this first approach: unable to fully compensate for the time consumed by supervision work, postdocs gradually reframe their supervision activities as potential investments in co-authorships on their students' publications. This is a strategy not unlike the standard procedure in the life sciences lab, where group leaders generally receive last authorships on all of their group members' publications, since they provide the intellectual and practical space and the resources for conducting the work.

At first glance, this might appear as a mutually beneficial solution for both the postdoc and the PhD student. Yet, in practice this arrangement is indicative of a more general move towards subjugating educational relations to the dogma of competitive production. As scientists increasingly depend more on their students' successful production than on their proper education, spaces primarily dedicated to education become marginalized. Yet, successful production is not equivalent to successful education. Fruitful learning experiences cannot be measured in units of output, nor do they necessarily depend on productive success: failure can be a rich learning experience, too. Yet, the need to be productive in quantitative terms pervades academic spaces ever more thoroughly, governing ever earlier stages of scientists' development.

What about this situation implies betrayal? Who is being betrayed? While many PhD students will still enjoy a proper education, and might also succeed career-wise due to publishing early on, the betrayal rests in the cooptation of educational spaces and the marginalization of failure as an educational tool. If supervising scientists increasingly depend on their students to be successful producers instead of or on top of being eager learners, failure becomes increasingly threatening and needs to be avoided. The students' right to fail – and the space and the time to do so without consequence – becomes increasingly compromised.

At first glance, depending on their students' successful production might appear to raise postdocs' stakes in their students' development. However, as it is not

educational success but productive output that is career-building for the postdoc, what if the student fails to be a productive resource? What if her learning progress does not comply with the tight time regimes of publishing? With hardly any incentive to protect spaces entirely devoted to learning in PhD and also postdoctoral education, the temporalities and values of learning increasingly give way to the rationales of production. Hence, if learning and education are experiences and values to be preserved in academia, then supervising and educating students needs to be considered career-relevant in and of itself, decoupled from its productive output. We need to invent tools that assess the proper education of a student and that do not mistake successful production for successful education.

A Crisis in Academic Subjectivation

I started this chapter by arguing that there is crisis in academia that pertains to, as Ylijoki put it, "*the moral order of academic work: what is academic work all about, what is its purpose, who determines its content, which duties form the core of the profession, to whom it is directed, and which commitments and assumptions are the most fundamental*" (2005, 570). Postdocs often experience this academic "identity crisis" (Ylijoki 2005, 571) quite vividly. Many feel an intense mismatch between their expectations about what work in science would be like and their actual experiences of working as scientists. One postdoc in a group interview expressed her experience of mismatch so very aptly when she asked her colleagues if they, too, felt that *"the structure of a scientific career [was] such that it tend[ed] to make you forget why you're doing the science? (PDoc 21f, 986)."*

Interviews with postdoctoral life scientists are rife with remarks about such alienating effects of academic career rationales – how they alienate researchers from each other and from themselves. The effects of the neoliberal university on researchers' subjectivities are an issue that is slowly emerging as a topic of research (Sigl 2019). Gradually, it has become clear that these effects should not be underestimated. As Zabrodska et al. (2011) put it: *"Few guessed, as they embraced some aspects of neoliberalism's managerialism and grumbled about others, the extent to which these systemic transformations, with their heightened competitiveness and individualism, would shape both their subjectivities and the nature of their work (710)2."* It is becoming obvious that what is at stake is onto-epistemological transformation (Barad 2007). As the conditions of academic work change, so do research practices and academic subjectivities.

Within these processes of onto-epistemological transformation, 'career rationales' figure as governmental technologies in a Foucauldian sense. Foucault argues that contemporary forms of governance exert power less through visibly forcing subjects into compliance but rather through "structuring and shaping the field of possible action of subjects" (Lemke 2002, 52). Through a dense web of implicit and explicit processes of discursive interpellation, they encourage the governed to modify their subjectivities in correspondence with the needs and desires of the

governing. In the context of academic life science worlds, mundane practices such as writing or reading a curriculum vitae as part of a job application can serve as examples for such forms of governance: by encouraging scientists to document their work in specific ways and to emphasize specific activities and qualities and not others, and by applying specific emergent standards for assessing these records, these procedures establish norms for what counts as more and less desirable behavior. They thereby encourage specific forms of self-monitoring, self-assessment and self-governance, eventually becoming intrinsic parts of academic subjectivity by "internalizing imperatives which were previously externally imposed" (Power 1997, 3).

If a postdoc ends his narrative about having to leave his current lab if it does not provide him with more publishable data soon by saying "I'm sorry, but it's kind of business" (PDoc_1m, 744), then he describes the boundaries of what appear to him as possible choices that he can make. At the same time, he lays bare the moral dilemma he is facing as he experiences pressure to make this choice, whether or not he thinks it is morally – or epistemically – the right thing to do. This sense of being alienated by the rules of the game while at the same time feeling helpless to change them is characteristic of interviews with life science postdocs. I interpret this helplessness as the *inability to engage in critique*.

Foucault suggested that, at its core, critique is "the art of not being governed quite so much" (1997, 29). Queer theorist Judith Butler later added that, essentially, critique has "to do with objecting to that imposition of power, to its costs, to the way in which it is administered" (2001). It is this form of critique that seems largely precluded for postdocs. With a few exceptions, they consider themselves largely replaceable: so many aspire to an academic career; if they objected to the rules of the game, surely they would be quite expendable. This feeling of expendability creates a type of academic who is compliant and exploitable, who feels that they cannot critique let alone change their own circumstances. Yet, we expect these researchers to be the critical backbone of society, confident in affecting change in the world.

Many researchers have their own practices for coping with this situation. One is to connect to their initial motivations for becoming researchers. Some researchers talk about how, in the practice of gardening, they reconnect with their love for plants and other living creatures and with their desire to understand life itself. Others connect to their big whys: the possibility that their work might generate knowledge that could help to heal diseases, for example. They do this *despite* and not *because* of the current incentive structures in academia. It is a practice that keeps them going.

At the same time, these coping practices point to an enormous potential that often goes untapped. Many researchers, who are currently anxiously focusing on their own careers, their next publications and their own survival in academia, express a desire to work differently, more collaboratively and more oriented towards the common good. This might include applied forms of research as well as solving basic research questions. The distinction between basic and applied research is not really the point here: the point is rather if research practices are mainly oriented towards reaching specific career goals or if there is a larger purpose to them that is palpable and that permeates everyday work practices.

Such desires to work differently are voiced by researchers of all genders, yet, particularly often, they are voiced by female-identifying researchers. These desires are often framed as reasons why, ultimately, they might opt out of academia, tired of constantly working in a state of individualization and self-centered competition (Fochler et al. 2016). Common opt-out points are the end of the PhD or a few years into the first postdoc. This is but one example of how the current value structures of academic careers contribute to the continued discrimination against women in academia, stifling their potentials and contributions to the world.

Conclusions: Another World Is Already There

In this chapter, I have argued for taking the perception of a crisis in academic work seriously and for exploring what this perception of crisis is based in. I have argued that this perception of crisis is based in an experience of mismatch between the values that are supposed to govern academic work in principle – values that are often reaffirmed in university mission statements and official speeches – and those that govern academic work in practice. I have sketched three aspects of this crisis that become palpable in the accounts of life science postdocs: a crisis in collaboration, a crisis in education and a crisis of academic subjectivation. What all these aspects of crisis have in common is that, in each case, a logic of competition and individualism supersedes and eventually displaces other values, such as the values of collaboration, education, critique and care for the common good.

How do these insights help us reconceptualize the PhD at the end of the world? In this concluding section, I mainly want to make one point, which is that we cannot change the nature of PhD education without a significant change in the values and incentive structures of academia as such. The main purpose of this contribution, which centers on the postdoc period, is to show that there are larger systemic problems in academia that embed and are embedded in contemporary PhD education. It will hardly be possible to foster a type of PhD education that collaboratively, creatively and responsibly addresses the current social and ecological crises this Earth is facing, if the postdocs who supervise them do not have the same liberties. To enable a type of PhD education that can respond well to the aches of the world, we need to rethink practices of evaluating and incentivizing academic work as such. While PhD students are, to a certain extent, more protected from the sheer forces of academic careers, this status is temporary, fragile and gradually dissolving as ever more periods of academic careers undergo a certain "postdoctoralization." To argue for a different type of PhD education is thus to argue for different working conditions and modes of assessment for all researchers.

Such a shift could unleash a tremendous potential in academia that is today mostly stifled: a desire expressed by many researchers to care about and for more than just their own careers (cf. Barnacle 2018). In the conversations I had with researchers before, during and after their PhDs in different contexts, they often expressed worries that this impulse to care would constitute a weakness if they were

to strive for an academic career; that they worried they would only succeed if they adopted a more calculative approach, freed themselves from teaching obligations and selected their research topics opportunistically. These are concerns that worry me, and I hope they worry many other senior academics, too. If that is so, then it up to us, who hold more power in the academic system than our junior colleagues, to use this power to create new structures of evaluation and incentive that can gradually take this worry away. We can contribute to this endeavor any time we work in evaluation committees or in hiring boards or when we supervise our own PhD students. We can talk to our colleagues and interrogate which values guide our own hiring or promotion decisions. We can make a given into a question – even if the pressure to be silent and compliant might weigh heavily on us, too. Maria Puig de la Bellacasa (2017) reminds us that another world is not only possible, it is often also already there, in the cracks of this one. Critical conversations across career stages and disciplines are one way of widening these cracks and letting the seeds of other worlds take root.

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Chapter 10
Doctoral Creativity as an Epistemological Force in Saving and/or Destroying the World

Liezel Frick

The current state of the planet demands that researchers carefully consider how they might meaningfully contribute to addressing current and future socio-environmental issues. Doctoral research in STEM fields have a particular role to play in pushing the knowledge boundaries of how we view and exist within a post-industrialised and post-human world. Such knowledge creation demands creativity in terms of being creative (the creative person), doing research creatively (the creative process), creating a supportive environment for creative endeavours (the creative curriculum), and producing something deemed creative (the creative product). This chapter explores how this complex and multi-layered conceptualisation of doctoral creativity may be an epistemological force in saving and/or destroying the world in the context of STEM research, and, in doing so, problematises the notion of doctoral creativity as inherently "good."

Introduction

Scientists across the world are warning of imminent global destruction driven by global warming, which seems to be ignored by some governments, policymakers, industries, and large sectors of the public (Ripple et al. 2017). Such ignorance is borne out of what Latour (2016) describes as scientists' lack of public engagement and the failure of scientific evidence to trickle down to all sectors of society. Yet, scientists do not study the natural and social world in isolation, but form part of the same system they are criticizing – and may even have been responsible for part of the ongoing destruction through research-based technology and innovation.

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Particularly in STEM disciplines[1] – which is the focus of this chapter – there is a growing emphasis on contributing to knowledge production in tangible, applicable, and profitable ways through innovation while environmental and social responsibility and sustainability often seem less of a concern. Doctoral research is particularly disposed to scrutiny in this respect, as it is expected to push the boundaries of scientific endeavour by means of knowledge creation. Such acts of epistemic creation require creativity as a necessary underlying process (Baptista et al. 2015), hence the focus of this chapter on doctoral creativity as a key concern for the future of science in STEM areas.

Creativity is both an implied and explicit expectation within the original contribution a doctorate is expected to make (European Universities Association 2007; Frick 2011), meaning that doctoral creativity is complex and multi-faceted, which can be conceptualised in terms of doctoral becoming (the creative person), doctoral curriculum (the creative situation), and doctoral outcomes (the creative process and product) (Frick 2010). As such, doctoral creativity could easily be seen as a "force of good" – serving the interests of the scientific community by extending epistemological boundaries and serving society and the environment by ensuring a sustainable future. But with all creative endeavours come risk and responsibility. Within the context of doctoral education, it means that we need to question and problematise the notion that creativity is inherently "good" (Rauth et al. 2010). Creativity in research has consequences and the potential for harm. Though particularly STEM doctoral research may, of course, be a meaningful creative force that contributes towards saving the world amidst the rising awareness of human impact on the environment, there is a potential destructive side to scientific endeavours where research can have (unintended) damaging consequences that also needs to be acknowledged.

This chapter therefore explores how creative forces at play during the doctorate might influence socio-environmental well-being, which is the interface where a major part of STEM research is situated. I here take a pedagogical stance, conceiving of pedagogy as a process where meaning is constantly (re)created, where the identities of those involved develop through discursive practices and power/knowledge relations in the co-creation of such knowledge (Howard and Turner-Nash 2011; Lusted 1986). Through pedagogy students become socialised into the academic community, which provides a sense of collective direction (McWilliam and Dawson 2008; McWilliam et al. 2008). Doctoral pedagogy thus involves the knowers (including both students and supervisors), the known, and the unknown and what the rules of engagement are under which these elements combine to eventually produce knowledge – the ultimate goal of a doctorate – with creativity as the epistemological force driving this process.

[1] Even though I fully acknowledge that creativity is an aspect present in all doctoral research regardless of the discipline(s) in which it is situated, I have chosen in this chapter to focus the argument on doctoral creativity in STEM fields of study, as such research is often positioned at the interface between the human and non-human worlds and thus also often has bearing on how we (as humans) live within and how we have an effect on these interlaced worlds.

Defining Doctoral Creativity as an Epistemological Force

Creativity demands a thorough understanding of the basic principles of and knowledge within a field of study through often lengthy, purposeful and arduous engagement with the existing knowledge in the field of study (Hennesey and Armabile 1988; MacKinnon 1970; Sternberg and Lubart 1999). The importance of knowledge and immersion in the field of study in identifying problems and gaps in order to move beyond the existing perspectives and to create something new has been well recognised (Dewett et al. 2005; Nickerson 1999; Sternberg and Lubart 1999). Thus, in the doctorate, the saying *knowledge is power* holds true. However, such knowledge needs to extend beyond mastering the specifics of the discipline(s) within which the study takes place. At the doctoral level, creativity may manifest in transforming the field of study and/or extending the current boundaries thereof, and – if we follow Latour's (2016) argument – extending the reach of such knowledge beyond the confines of narrow scientific ivory towers. Doctoral creativity thus becomes an epistemological force, driving knowledge creation, application, and change.

Libby (1970) describes scientific creativity as discovery through research and creativity as the purpose of science. He furthermore distinguishes between science and technology: science discovers natural law, while technology applies the discoveries of science. Yet, creativity extends beyond a technicist view of scientific discovery to the person(s) behind the science. Pope (2005: xvi, 11) defines creativity as "the capability to make, do or become something fresh and valuable with respect to others as well as ourselves," which involves "a grappling deep within the self and within one's relations with others: an attempt to wrest from the complexities and contradictions we have internalised" – thus facing the complex and nuanced interplay between creativity as both potentially constructive and/or destructive within the science and within ourselves. Those in STEM areas might argue that such a focus on researcher positionality may not be relevant in areas claiming objectivity. Yet, Latour (2000, 2004) highlights the contested nature of the notion of objectivity in both social and natural sciences, while the National Research Council of the United States of America (2002: 2) defines all scientific inquiry as:

> *Scientific inquiry is the same in all fields. Scientific research, whether in education, physics, anthropology, molecular biology, or economics, is a continual process of rigorous reasoning supported by a dynamic interplay among methods, theories, and findings. It builds understandings in the form of models or theories that can be tested. Advances in scientific knowledge are achieved by the self regulating norms of the scientific community over time, not, as sometimes believed, by the mechanistic application of a particular scientific method to a static set of questions.*

And so although science itself may be concerned with ideas regardless of power, relationships, impact, or consequence, the practice of science is not immune to these factors. It is thus not surprising that Watson (2007) emphasises the socio-ecological responsivity and responsibility of all those engaged in higher education, regardless of their discipline.

Following this line of argument, it is helpful to consider the doctorate as a perpetual desire and search for wisdom (Barnacle 2005), thus moving beyond the notion of knowledge for the sake of knowledge. Wisdom refers to a comprehensive understanding of knowledge, sound judgement, and insight relevant to the context in which it operates. The doctoral graduate is therefore more than a mechanic of knowledge, but can judge knowledge and can advise with insight, which speaks to Freire's (1970, in Lin and Cranton, 2005: 458) notion of a student as someone having "the courage and confidence to take risks, to make mistakes, to invent and reinvent knowledge, and to pursue critical and lifelong inquiries in the world, with the world, and with each other." This notion of wisdom implies an understanding of the responsibility researchers have to think about the consequences of the knowledge they create, the power they wield in creating knowledge, and finding ways of managing the possible tension between knowledge creation as a force of innovation and as a pursuit of wisdom.

As the production of knowledge has come to be of increasing importance to national economies, university research is expected to better serve the needs of industry, through innovation in science and technology in particular. The Lisbon Declaration (European Universities Association 2007) on the purpose of Europe's universities strongly links university research with innovation, emphasising the importance of universities' "capacity for promoting cultural, social and technological innovation" and that "to meet the challenges of the twenty-first century (…) [requires] technological and social innovation which will solve problems as they arise and ensure economic success." The doctorate is increasingly economically positioned as an important source of skilled and innovative knowledge workers, as required by a knowledge-based economy with a strong emphasis on research and development (Bastalich 2010; Halse and Mowbray 2011). This position has led to an exponential growth in the number of doctorates awarded internationally, especially in STEM-related disciplines (Cyranoski et al. 2011), and a shift in expectations of employment after the doctorate away from academia and towards industry, government, and private enterprise (Auriol 2010; Enders 2005). Innovation has claimed a prominent place in defining a key purpose of the doctorate as preparing the candidate for a future or current career in either academia or industry and developing skills for employability. Thus, innovation as part of doctoral research privileges the production of knowledge that is economically useful. The extent to which these developments have changed the conditions under which knowledge is produced in doctoral theses and science in general is unclear (Geiger 2004).

The unease between creating (applicable) knowledge and developing wisdom is amplified in doctoral education as wisdom is not easily commodified nor does it develop overnight. In addition, it may be difficult to foresee the outcome (and possible unintended consequences) of a project at the onset thereof, particularly as doctoral research is expected to be at the cutting edge of the discipline. Defining doctoral creativity as an epistemological pursuit in search of wisdom leads us to think about the doctorate beyond a mere knowledge product – in the form of the so-called original contribution contained in a thesis, a collection of scholarly articles, a patent, or an artefact – and resultant social and technological innovations

often prized within the current highly competitive higher education environment (even though it is sometimes criticised by scholars, e.g. Bastalich 2010). Creativity in doctoral education is therefore as much about *what* is created as about *how* it is created and by *whom*. It also speaks to the convoluted nature inherent to the creative process, where what we create now might have unintended uses, adaptations, and consequences in future for both ourselves, others, and the environment.

The Risky Business of Doctoral Creativity

Research by its very nature is a risky endeavour (Frick et al. 2014). Being creative raises serious risk-related ethical issues, including possibly breaking rules and standard operating procedures; challenging authority and avoiding tradition; creating conflict, competition and stress and raking risks (Baucus et al. 2008), which is a particular concern within STEM areas where research often lies at a social and environmental interface. The outcome of the creative endeavour may have dire socio-ecological consequences, even though it might at the same time advance scientific understanding in the area of study. CRISPR gene editing and other genetic modification technologies, nuclear energy, synthetic polymer science, and artificial intelligence systems are but some of the many current examples of research areas where scientific advances have greatly contributed to both science and our everyday lives, but where there have also been questions about the potential impact of research in these areas on the planet and all its life forms. These might be obvious examples, but all research projects contain an element of risk. Herein lies a pedagogical paradox – in as much as doctoral education has to foster creativity, there is also the responsibility to ensure that students understand their moral responsibility to carefully consider the social and ecological risks and consequences of their research (a responsibility also referred to by Kampylis and Valtanen 2010).

But the notion of risk in doctoral education is not a simple dichotomy between risk/no risk. There is a risk to taking risks, but equally, there is risk to fearing or avoiding all risk. A basic scientific premise is *doubt*. Yet, in order to be constructively doubtful, in, for example, coming up with a hypothesis, the scientist needs to build such a hypothesis on a set of assumptions that need to provide some (pseudo-) certainty as a point of departure. This interplay between certainty and doubt is not always easily managed, and the fear of failure may inhibit doctoral creativity. So although untethered risk-taking may not be ideal in science in general and doctoral education in particular, fearing and avoiding all risk may stifle creativity and limit the contribution a doctorate can make. If creativity is not explicitly facilitated and valued, one cannot expect doctoral students to bring about future epistemological changes as responsible scholars, and innovation becomes less likely. More likely, only moderate contributions to knowledge development will be made (Brodin and Frick 2011). The most pressing problems facing science and society will not be solved if they are viewed from a limited perspective (Manathunga et al. 2006; Max-Neef 2005), and thus risk is an unavoidable part of the doctorate.

It therefore becomes necessary to conceptualise risk-taking in the context of doctoral education as adaptive risk. Adaptive risk-taking does not avoid all risk but rather pursues some (acceptable) risks while avoiding so-called hazardous risks (Byrnes et al. 1999). The Lisbon Declaration (European Universities Association 2007: 3) argues that universities "should encourage a culture of risk-taking (…) in order to produce an institutional milieu favourable to creativity, knowledge creation and innovation," which underlines the idea that the doctorate requires a certain amount of risk-taking. In addition, Reichert (2006) emphasises the need for universities that optimise and nurture the creative potential of individuals and teams, which requires resources, time, and opportunities to conduct high-risk unpredictable research.

From a pedagogical perspective, the context, relationships in the supervisory process, and individual characteristics of doctoral students and supervisors all play determining roles in calculating acceptable levels of risk. In terms of context, it is necessary to (re)consider the purpose of a doctorate within a super-complex and uncertain society (Barnett 2000; Park 2005, 2007) and how this influences pedagogical roles and responsibilities. In addition, the interplay between individuals' subjective perceptions of risk and related perceptions of the larger community has pedagogical implications, as risk may be interpreted differently by different role players (including students and supervisors, which may influence their relationships and study foci). Furthermore, individual characteristics determine the extent of possible risk – for example, a study may be less risky if the doctoral student/supervisor has particular research and/or subject expertise. Finally, context determines "who can take what risks and how" (Hood et al. 1992: 136). A project may be less risky when expert supervision and/or particular resources are available. Hence the supervisor becomes a risk manager and risk mitigator, mediating between the demands of society, the discipline(s) involved, the institution, and the doctoral candidate (Evans 2004). This means balancing rather than controlling risk – containing risk in a responsible manner – while encouraging creativity.

Following the Master, or Not

Whose responsibility is it to develop doctoral creativity? Doctoral students are not the only role players in developing creativity. Supervisors are also key role players in this power-laden pedagogical relationship, particularly in lieu of the new generation of students who prefer "pedagogical exchange as a form of *value creation* rather than *knowledge transmission*" (McWilliam et al. 2008: 228). This speaks to MacKinnon's (1970) idea that creativity should not be seen as something to be taught but rather as developed by leading through example. In doctoral education, this would mean "cognitive apprenticeship" (Austin 2009: 175) by involving students in all the phases of supervisors' own research – including conceptualisation, planning, implementation, and eventual reporting. Such an approach makes experts' thinking processes in understanding and addressing problems visible. It also

enhances students' meta-cognitive abilities – that is, awareness and control over implementing their knowledge in a practical and unpredictable professional setting and subsequent reflection on performance (Lizzio and Wilson 2004).

Supervisors need to create nurturing, student-centred learning environments that provide a solid scientific foundation yet value divergence and diversity. Exercises that require the transference of knowledge from one area to another; searching for common principles where facts from different areas of knowledge can be related; developing analogies, metaphors, and symbolic equivalent experiences; engaging in imaginative play and experimentation, and helping students to step back from facts to gain a greater perspective may foster creativity. Problematising of subjects and the deconstruction of knowledge may encourage creativity (Belluigi 2009; Pope 2005). Examples of such pedagogic practices cited by supervisors in the STEM areas required students to transfer knowledge from one area to another, search for common principles where facts from different areas of knowledge can be related, and engage in imaginative experimentation. In this way, supervisors helped students to step back from facts to gain a greater perspective. Such supervisors were also able to create a space for debate through problematising and deconstructing knowledge, which promoted a respectful yet challenging learning environment (Austin 2009; Frick 2012).

Yet we also need to acknowledge that it is difficult to develop a sense of responsible creativity in doctoral students. Creativity takes time to develop and needs to be fostered in an atmosphere that allows exploration and expression (even failure!), regardless of the discipline or programme format (Jones 1972). It is therefore not surprising that the doctorate is seen as a process of becoming, which is not straight forward or linear and, as we know, neither is the research process itself (Archer 2008; Barnacle 2005; Batchelor and Di Napoli 2006). Becoming a researcher may entail conflict, feelings of inauthenticity, marginalisation, and exclusion, and data from various studies show that doctoral students often experience stress and feelings of anxiety (Stubb et al. 2011; Pyhältö et al. 2012). In addition, students immersed in creative processes often act in ways that may make supervision difficult (MacKinnon 1970). These students may be characterised as non-conformists, which may result in tension and adjustment problems. They often strive for independence, are curious and perceptive, search widely for related information, act intuitively, do not like being confined to pre-determined courses, and need to explore options – even though some options may lead to failure (Jones 1972). In addition, not all students will develop their creativity in similar ways, or in a linear fashion, or to the same level of manifestation equally across all the research phases.

Knowledge production is furthermore highly contextualised. Contextual factors (including bureaucratic institutional systems, ethics, and funding policies) act as determinants of the extent to which risk-taking is possible in doctoral studies (Backhouse 2009; Frick 2012; Holligan 2005; Wildavsky et al. 2015). Further tension may result from the difference between institutional demands for completion and students' needs to engage with ideas over time through incubation (Brew 2001). The current emphasis on doctoral throughput in the minimum allocated time may lead to risk-avoidance, steering clear of complex and less defined problems. In

addition, only about 10% of all innovations are ultimately successful, which makes trial and error essential but risky (see Florida et al. 2010, Reichert 2006, Uyarra 2008 and Youtie and Shapira 2008 for more extensive arguments on the role of universities in innovation-driven agendas). Ultimately, the process of doctoral education is influenced by the various cultures in which creative work takes place. In particular, how such cultures define innovative knowledge outcomes is highly relevant (Baptista et al. 2015).

A pedagogical understanding of developing creativity in STEM doctorates therefore demands a nuanced appreciation of the interplay between doctoral students' inherent qualities, supervisory practices, and environmental factors that interact in the process of doctoral becoming. Future debates on doctoral pedagogies may have to focus on how an implicit notion of creativity can be made more explicit.

Hurtling Towards the End of the World, but All Is Not Lost

Does the STEM doctorate still have relevance in a world shaped by forces sceptical of what science might add to our understanding of this world, where universities are no longer considered the authoritative vanguards of knowledge creation? Latour's (2016: 2) work seems to suggest that it could – if we are willing to rediscover (or research, if you may). Latour (2016: 10) notes that such rediscovery "should create as much creative energy as during the period that had been called the 'age of discovery'. Especially that now the project of reinventing how to live on the planet might be a project shared with the formerly dispossessed."

What role can the doctorate play in shaping change (rather than trying to stop it)? The existence of so-called wicked problems (Brown et al. 2010), the emphasis on applied knowledge (Enders 2005; Enders and De Weert 2004; Gibbons 1998), and public demands for higher education accountability (Barron and Zeegers 2006) force doctoral students, supervisors, and universities to look at research problems more holistically and "mobilize our forces in a different way" (Latour 2016: 10). This requires some creativity from all the role-players concerned. The idea of being a creative university (Reichert 2006) does not exclude being efficient or economically viable, but it takes a longer-term view on the benefit it might add to society and the economy and allows more space for creativity, dialogue, experimentation, and innovation (Florida et al. 2010). A narrow focus on the economy of the system (both in terms of fiscal and efficiency indicators) may inadvertently infringe on the potential for innovative knowledge transfer, creation, and production through both teaching and research, and the eventual positive contribution the higher education sector can potentially make to industry and society.

From a pedagogical point of view, how do we enable both individual doctoral students and such individuals as part of groups to become creative? We need more research that explores universities' potential to nurture the creative potential of both individuals and groups, which requires time, resources, and space for more flexible programme structures, improved student support structures, and an investment in

developing creative higher education pedagogies (even leading up to the doctorate), as well as research that may not have an immediate and applied impact. A more holistic notion of doctoral development that acknowledges the importance is essential to positioning creativity as an epistemological force that can help save the world.

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Chapter 11
The Contribution to Climate Change Research of the Professional Doctorate and PhD: More of the Same but of a Different Flavour?

Paul Gibbs

'The comparison of the types of doctorate and the structure of their programs in particular highlights the educational similarities between the two. The major difference between them lies in the target populations and selection criteria for students'(Neumann 2005: 186).

Abstract This chapter proposes that the professional doctorate and the doctor of philosophy are the same in genus but differ in the way in which they contribute to the study of climate change. It is argued from a position that, given the changes in doctoral forms since 2005, there is no epistemological or educational reason to distinguish by some notion of importance or quality between professional doctorates under the rubric of Aristotelian notion of *Gnosis* nor from the perspective of the complexity of expertise, capabilities and transferable skills. In this they are the same but different. I will, however, suggest that there are subtle differences that do exist in the two approaches based on praxis and poiesis that might support different research agendas in terms of the climate crisis.

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Introduction

This chapter supports the conclusion of this early but important paper by Neumann based on work undertaken in Australia. Argued from a different and non-empirical position, this chapter supports the idea that given the changes in doctoral forms since 2005, there is no epistemological or educational reason to distinguish by some notion of importance or quality between professional doctorates (PDs) from PhDs under the wide Aristotelian notion of *Gnosis*. Neither does a difference appear significantly in the complex issues of expertise, capabilities and transferable skills. In this they are the same but different.

In this chapter, I try to develop this argument with the help of the purposes of the degree in terms of a more nuanced difference between the two generalised models in relation to poiesis and praxis, and this clarification avoids the conflation of research aims of the two models (see Barnacle et al. 2018). Finally, I suggest how the subtle differences that exist in the two approaches of PD and PhD might support research agendas in terms of the climate crisis.

The Argument

Doctorates have a long and vocational history and have served to indicate excellent and professional competency in law, medicine and theology since the twelfth century. They have mutated in different forms and purposes while resting in their development as a form of recognition of academic proficiency that is now being challenged to face the neo-liberal embraces of universities as structural elements of a performative reality. Boud and Lee (2009) suggest that postgraduate research has undergone unprecedented change in the past ten years, in response to major shifts in the role of the university, the disciplines in knowledge production and the management of intellectual work. New kinds of doctorates have been established that have expanded the scope and direction of doctoral education. Indeed, (Usher 2002) has suggested that the accepted purpose of the doctorate has been academic knowledge production and the supply of new university staff, more recently extended to the production of researchers for the 'knowledge economy'. In this process, the vocational orientation of the doctorate has, as Jones suggests, 'risen from the ashes of history to find a very comfortable and viable place in modern society' (2018: 814). This 'rebirth' has been from the cocoon of research-focused degrees that took hold worldwide in the late nineteenth and early twentieth centuries and can be reasoned as a response by the university to four pressures from society as it, the university, becomes more accountable to a movement in neoliberal ideologies. This is causing doctoral education to go through a period of transition that is evident in the many varieties of doctoral degrees currently offered in higher education institutions worldwide, from the traditional research-based Doctor of Philosophy (PhD) to the Professional Doctorate (PDs).

Robinson (2018) suggests that since the early 1990s, there has been a huge increase in the range and nature of PDs in Australia, New Zealand and the United Kingdom, although the growth in PD provision has been relatively slow in Europe and America (NQAI 2006). Graf (2017) found that 35% of the professional doctorates in management worldwide are offered in North America, 38% in Europe, 21% in Asia-Pacific, 5% in Africa and 1% in Latin America.

In a recent study of Australia, China and Iceland by Wildy, Peden and Chan (2015), they showed that the emergence of professional doctorates worldwide is having a significant impact on the status and structure of traditional research-based PhDs. In Europe, the organisation of doctoral education has undergone a rapid transformation over the past decade. As universities have increasingly assumed institutional responsibility for early-stage researchers, a wide diversity of practices, policies and structures have been implemented to deliver more robust training and support for various aspects related to doctoral research (EUA 2019). However, according to Barnacle, Schmidt and Cuthbert, there is growing discontent with the outcome of PhDs: 'Governments, policy agents and industry groups particularly in the developed world contend that the PhD is no longer fit for purpose and that a different kind of PhD is needed, one more attuned to the needs of end-users and capable of producing graduates who can move seamlessly from the university to industry where it is hoped they will drive knowledge-based innovation and economic growth' (2019: 169).

The causal force of these concerns has fostered the reemergence of the vocation in doctoral education. These four forces are articulated by Jones as (1) a reduction of employment options within academe; (2) employers becoming more demanding in what they expect from holders of doctorates, more demanding in their ability to function readily in new and different work places; (3) greater accountability from government and society demanding a research degree that is more relevant to the needs of business and the growth of the economy and (4) universities seeing the economic value of increasing student numbers and creating better alignments with industry.

Doctoral research, which pays attention to practitioner knowledge to bring about innovation in thinking and practice in organisations and sectors, has fuelled demand for professional doctorates and industry- and practice-based PhDs. The aim of this chapter is to begin to contribute to a praxis which addresses the opportunities of this growing proximity between the work worlds of business and the academy. We suggest here that a professional doctorate opens up the opportunity to undertake inter-/multidisciplinary epistemological spaces within the profession and do this with a fundamental sameness that is experienced in all doctorates when the work context is considered. In this, it is claimed, all doctorates are onto-epistemological at their root and all create ontological tensions. In discussing non-PhD doctorates, I am referring to what might generally be called professional doctorates, which are common in the United States, United Kingdom and Australia, covering a range of professional sectors, including education, arts, engineering, nursing, law and business. The aims of these doctorates include the development of professional practice and practitioners as critical thinkers and change agents. It is expected that they will

make a contribution to theory, practice and professional knowledge and they demonstrate a shift in the production of knowledge. Within the profession, professional practices have an ontological intelligibility. They matter to the manner in which a practitioner adopts being a professional and being among others, whether professional or lay. Such practices, among other legitimising characteristics such as a shared knowledge base and moral code of conduct, call forth a way of being that regards clients not as objects, for use through calculative expedient thinking, but as real and genuine entities in their own right.

Form

Doctoral education can be categorised as one form of education in terms of attainment levels and outcome. They hold, according to the Quality Assurance Agency for Higher Education (QAA), common basic characteristics regarding the forms they evidence. In the United Kingdom, the Qualifications Frameworks level descriptor for the doctoral degree includes generic information about what all holders of the doctorate will be able to do and the qualities and skills that they will have (Fig. 11.1).

Furthermore, doctoral researchers are increasingly being encouraged to develop their foreign language and enterprise skills and to cultivate business acumen. All doctoral graduates will have developed, during the course of their research, additional specialist knowledge within their discipline, while those who have studied a professional doctorate are likely to have been required to have particular professional experience that informs the topic of their research studies. They may well also have been required to engage in further study related to that professional field as part of their doctorate.

All doctoral graduates should be able to:
- search for, discover, access, retrieve, sift, interpret, analyse, evaluate, manage, conserve and communicate an ever-increasing volume of knowledge from a range of sources.
- think critically about problems to produce innovative solutions and create new knowledge, plan, manage and deliver projects, selecting and justifying appropriate methodological processes while recognising, evaluating and minimising the risks involved and impact on the environment.
- exercise professional standards in research and research integrity, and engage in professional practice, including ethical, legal, and health and safety aspects, bringing enthusiasm, perseverance and integrity to bear on their work activities.
- support, collaborate with and lead colleagues, using a range of teaching, communication and networking skills to influence practice and policy in diverse environments.
- appreciate the need to engage in research with impact and to be able to communicate it to diverse audiences, including the public.
- build relationships with peers, senior colleagues, students and stakeholders with sensitivity to equality, diversity and cultural issues.

Fig. 11.1 Doctoral characteristics (QAA 2015: 15)

Difference and Sameness in Doctorate Education

Much has been written as an exploration of how professional doctorates are different from PhDs (see QAA Characteristics Statement for Doctorates 2015), and for sure this is correct; they are not identical, nor should they be, but neither are they opposites. For instance, the sameness of these doctorates, according to the QAA and regardless of their form, is that all continue to require the main focus of the candidates' work to demonstrate an original contribution to knowledge in their subject, field or profession, through original research or the original application of existing knowledge or understanding. They come from the same genus of endeavour, which is exposed by the use of learning outcomes and seek to extend our knowledge of being in this world with others. They do this in ways which reflect their different work world, that of the academic and that of the professional workplace. They share more than a title; they share a fundamental aim to seek new knowledge either as a first principle in 'pure research' or more readily to find knowledge and understanding which helps in the way we and others live their lives in this world. I argue that the sameness of doctors is that which will sustain the different forms, provided that which is essential to them being a doctor is retained. The degree of sameness is in their notion of action intent on revelation and that they are contextual, albeit in different contexts, and so have different *telos*. All forms of doctorate have this and, depending upon your view, the value of doctoral work might well depend on your view of that *telos*. That opinion, however, is just that and although real ought not be the basis upon which we as academics consider the value of all doctorates.

It might briefly be worth considering the sameness and difference in the QAA characteristics above. Both require the accumulation of new understanding and knowledge through personal research or guided lectures (but at the assumed same level), both framed in a methodological approach which has an acceptable epistemological justification. Both concern the work of research, assessment evidenced through appropriate artefacts and justification. Both are also related to a specific work and are described in how success in this work leads to specific work opportunities or more general capabilities to find work, and both are governed by external influencers such as disciplinary conventions of professional hegemonies. The difference, I feel, is not in the actual but in the perception. Given the external influence on universities in terms of government policies, research-granter criteria for funding, the growing influence of research 'grand challenges' and the incorporation of university agendas, it is becoming very hard to see the individual choice in doctoral education of any sort.

At this level the sameness seems clear, but the forms within the genus that I talk about show great diversity. There is more general uniformity on the purpose of a PhD, its forms and its examination, although there is still considerable variation as to the transparency of its assessment. For professional doctorates, differences occur within its category as to its purpose: licence to practice or to enhance experience and in a perceived inconsistency in types of assessment (although not rigour) and variations in realised learning outcomes. However, these are more superficial than central

to the essence of the doctoral degree. Tangible evidence to support this position is the way in which both degree forms are migrating in response to the changing socio-economic and onto-epistemological demands of society and the academy. Finally, Taylor (2008) has argued that the professional doctorate and the PhD are actually different routes to the same endpoint category: the doctorate which 'might suit the different circumstances of individual students'. By this interpretation, the professional doctorate is awarded for work of an equal standard as the PhD (2008: 71). Barnacle, Schmidt and Cuthbert have indicated that 't there is sufficient scope within the so-called traditional PhD, not just the professional doctorate' (2018: 178), that is scope to satisfy criticism of the PhD which, I think, could only be conceptually valid should they both fall within the same category of levels of knowledge. A similar tangential rationale is found in Kot and Hendel, whose research shows that 'while the U.S., U.K. and Australia showed a steady increase in professional doctorates, Canada presented an opposite trend, as universities in this country have been pressured to rethink the PhD and make it more flexible, rather than establish new professional doctorate programs' (2012: 361).

Different Work Worlds, Different Doctorates

In Europe, as Kehm (2014) has written, the university can be considered to be one of two enduring societal institutions (the other one being the church) that have survived centuries. This long-term survival could not have happened without change. Despite the fact that universities have often been characterised by an unwillingness to reform, they nevertheless have continuously adapted to new circumstances and societal change, and this is reflected in their relationships to society and economy. Their nature has mutated and their role transmuted into a reflector or mirror of society with little or no reflection and as a workplace within a workplace where knowledge is produced almost to order and whose purpose is settled by grant allocation and the issues of accountability to society and the powerful within it.

Heidegger suggests that work is the universal condition of humans as producers and is a way in which we experience life, through varied engagements with beings. This idea is perhaps best encapsulated by the Greek origin of the word *poiesis*, meaning 'bringing forth'. Poiesis relates to all the ways in which humans produce things but, unlike Plato's totalising utopia of poiesis, Heidegger tends to favour Aristotle's distinction between poiesis and praxis. Praxis retains its sense of action without a defined end, as distinct from poiesis' blueprinted intention (Taminiaux 1987). In this sense, praxis works as a notion which transcends work worlds and the people within them. It recognises difference but seeks to find ways to integrate the worlds to create a new and effective space consisting of features from, in this case, both worlds interwoven to create a third research world for the researchers and their support within which a praxis of research and practice can reveal the world in ways that differ from both the existing world views. Heidegger's notion of circumspection, seeing our situatedness not in a theoretical way but in the sense of praxis, helps us to conceptually underpin the notion that what we are moving towards is the

negotiation of different realities through understanding a piece of something in the context of the wider totality (Nielsen 2006, 459). This requires being open to the possibility of 'concerned discovering' and 'concerned seeing' (Heidegger 1992: 274) and going beyond what already is at hand so that learning from the workplace and the academy merges into a praxis. Something being available or at hand does not make it relevant. Praxis, through a collaborative model of supervision that exchanges skill sets, reveals the possibilities of new identities for the researcher and ways of comfortably being in, and acting in and on, more than one set of realities.

Knowledge Production

Several approaches have been developed to answer the question of what knowledge is (its function, its constitution, its genealogy and its rationale) and, though parts of these theories are understood as useful for the task in hand, on their own they do not amount to a complete theory of knowledge and therefore of learning. These failures are often contingent upon disaggregated notions of knowledge (*gnosis*) turning into epistemology and ontology, creating an onto-theo-epistemological narrative that is intent on informing practice but is often restrictive of freedom of thought, expression and innovation, which are the consequences of the ontological incongruities evident in discipline-based knowledge approaches.

The need to change such knowledge positions applies equally well to the issues in emergent worlds that seemingly defy traditional, methodologically-inspired, empirical investigation. Costley (2013) suggests that for PhDs it 'could be argued that even as a broad and disparate group of awards, PhDs are more likely to produce what Gibbons et al. (1994), and re-addressed by Nowotny et al. (2001; Nowotny 2003), called "mode 1" discipline-based knowledge that becomes part of the research stock of the university' (2013: 11). The acceptance of 'mode 2' knowledge as more usually generated by PDs, within a context of application and supplementing the knowledge production that used to be primarily produced, codified and held in scientific institutions, as of equivalent value in the university is far from established. At least in work-based PD, Costley and Lester (2012: 259) propose this has led to an epistemology which draws on three traditions: an action-based pragmatism that emphasises the interdependence of knowing and doing, a constructivist and to some extent phenomenological perspective that sees the learner as making sense of situations from an individual and autonomous position, and an action research or praxis-oriented philosophy where there is a concern to create and learn from change through enquiry-driven processes. This understanding links with what Pratt and Shaughnessy (2018) propose, that a model of an epistemological shift offers an explanatory framework from which to understand the interplay between common sense and critical discourse. They attribute that to an understanding that arises out of pedagogic relations. Costley (2013) goes further to suggest that PDs provide a way of addressing knowledge that is to an extent outside disciplinary cultures and can offer alternative views and values that have resonance with practice, thereby engaging higher education more coherently with learning at work and shift attitudes

as to how what is valuable about academic knowledge and professional knowledge will be negotiated. It is a shift in terms of what matters and has led to more inclusive use of knowledge to explain researcher agency and engagement with data in terms difficult to discern conceptually, although seen clearer in practice, between PDs and PhDs. (Maguire 2018).

This has facilitated the emergence of transdisciplinarity, which has been in response to the often failed attempts of closed-system, discipline-based approaches to solving complex social problems (various reports and definitions can be found in projects reported by the OECD, UNESCO and the EU as indicated above). These failures are often contingent upon disaggregated notions of knowledge (*gnosis*) into epistemology and ontology creating an onto-epistemological narrative which is intent on informing practice. Changing such knowledge positions apply equally well to issues in emergent worlds that seemingly defy traditional, methodologically inspired empirical investigation.

However, given the ambiguity and ambition of transdisciplinarity, it is not surprising that a variety of interpretations of transdisciplinarity abound and finding an embracing definition shows Deleuzian multiplicity in its difficulty (see Pohl and Hadorn 2007; Lawrence 2010; Nicolescu 2010; and Klein 2010, as the most quoted authorities). Nevertheless, rather than focusing on the delineation of the approaches offered, an analysis of these contributions points to commonality in those problems that benefit from a transdisciplinary perspective. These tend towards:

- The complex and heterogeneous
- The specific, local and uncertain
- Epistemologically seeking satisfying explanations which enable, warrant and improve our ability to seize opportunities
- Involving practical action for the good of, and through, others.

These ideas are enshrined in the Charter of Transdisciplinarity (1994) requiring rigour, openness and tolerance in their implementation (Article 14). As Manderson proposes, '(T)ransdisciplinarity examines a particular site or sites of interest without a particular disciplinary strategy in mind' (1998).

This positioning statement has resonance with what is advocated in Flyvbjerg's (1998) *phronetic* method and the 'thick' analysis of the details of a phenomenon from which more general insights can be gained. Moreover, case studies do not have to be equivalent in order to be cumulative; all can have a characteristically sociological, political and ethical timbre. Transdisciplinary case studies are not seeking theoretical validation but the means to satisfactorily solve problems: they are epistemologically grounded in the pragmatism of Pierce and the judgment of practice of Dewey.

Within boundary-spanning definitions of transdisciplinary research that emerge from and are applied to transdisciplinary problems, the attempt to resolve value-laden issues requires judgment of practical alternatives that affect others. These concerns are too important to be hampered by constraints of disciplines, and the forms of knowledge and the veracity that they sanction. The knowledge needed is both in the means to solve the problem and the goal of the solution. Transdisciplinary knowledge is in the liberation of reason from formality and in the multi-realities of the presenting problem. To seek such insights often requires collaboration,

contextualization and reflection, leading to reasoning that is a collective, ethical, problem-based, 'explanatory' engagement.

Supervision

The research illustrates the complexity of supervisors' pedagogical approaches and doctoral practices (Pratt and Shaughnessy 2018), while earlier proposals from Costley and Boud (2007) highlight a requirement for a number of capabilities (academic and professional) that are recognised as being beyond those needed for conventional PhD supervision such as advising and facilitation. The potential different world has led researchers, according to Bengstsen (2020), to talk of a call for a more 'ecological approach where the doctoral curriculum integrates and builds synergies between the various claims of external stakeholders and stakeholders within the university' (2020: 147[1]). Calling for the recognition of a third type of non-formal learning alongside formal, which he argues, is a recognition of the ecologies of research which allows researchers to better contextualise their work in the world of workspaces. It is in the integration of these three spaces that professional doctorates might already lead, and it is where supervision is critical to facilitate this integration. The role of supervision roles is this ecology which has attracted significant interest in regard of professional doctorates. Two recent reports, a European studies Erasmus-funded 'Superprofdoc' project (2017) and a Society for Research into Higher Education (SRHE) report authored by Pratt and Shaughnessy (2018), address this issue. Fillery-Travis et al. (2017) have summarised the literature surrounding these phenomena and emphasised it as a transformational process which embeds notions of employability outside academia. Extending this work, Lee (2018), commenting on the findings from the first project to emphasise the common challenges and the similarities in supervisor approaches, concludes that it will become increasingly important for even experienced supervisors to keep up to date and that 'academic and workplace supervisors need to understand more about the growing field of research ethics and intellectual property, and both need to know where to go to find the latest regulations that will affect their candidates' (2018).

Student Support, Selection and Progression

There are many issues which might contribute to the difference in actuality of the PDs and PhDs. Clearly one is students, where the nature of candidates varies considerably, with PhDs having a tendency to have younger, full-time students than PDs, who tend to be part-time. These are demographic as well as contextual differences and would be expected given the two work worlds from which the candidates

[1] See also Maguire (2018) and Maguire et al. (2018).

tend to be drawn. The differences are evidenced in the annual results of the UK Postgraduate Research Experience Survey, but there is reason to expect that they would also be relevant to other geographic domains. It is also true that in the national UK survey (PRES 2019) of doctoral education, measures on the seven pillars of satisfaction record an overall PD score slightly higher than PhDs at 83% compared to 81%. In areas for progression and in understanding personal research responsibilities and those of their research support team, PDs score clearly better than PhDs. However, the key point is that overall the experience is equally satisfying, which again focuses the sameness of the experience of both forms of doctorates.

Quality

In 2005, the Salzburg Principles were established in the Bologna Process as the basis of the reforms for doctoral education. In 2010, the European University Association (EUA) launched the Salzburg II Recommendations, a product of consultation with European universities to collect the experiences of the reforms, including quality assurance. Here it was stated that it is necessary to develop specific systems for quality assurance in doctoral education based on the diverse institutional missions and, crucially, linked to the institutional research strategy. For this reason, there is a strong link between the assessment of the research of the institution and the assessment of the research environments that form the basis of doctoral education. Assessment of the academic quality of doctoral education should be based on peer review and be sensitive to disciplinary differences. In order to be accountable for the quality of doctoral programmes, institutions should develop indicators based on institutional priorities such as individual progression, net research time, completion rate, transferable skills, career tracking and dissemination of research results for early stage researchers, taking into consideration the professional development of the researcher as well as the progress of the research project. As is clear from this quote, the basis for quality assurance in doctoral education should be research: the quality of the research environment is the basis of the whole notion of quality in doctoral education and this will require different approaches from the quality assurance developed for the first and second cycles. However, accountability and enhancement as factors of quality assurance and the demand for transparency are just as relevant for doctoral education as for the first two cycles.

The Benefits

In developing countries, compelling evidence that gaining a doctorate contributes to the common good is elusive, yet there is growing evidence of personal benefit in economic terms as well as in personal flourishing. In the United Kingdom, the benefits are recognised as substantial, at approximately 16–17% (BIS 2011, p. 13), over

one's working life. Moreover, yet less quantifiably, there are benefits to self and to others that can be considered as a social return (Boud et al. 2018). The economic returns to society are harder to estimate. There is a correlation between the number of doctorates awarded by a country and its gross national product (GNP), as revealed by the Organisation for Economic Cooperation and Development (OECD 2016: 147), and the countries with the most developed economies still tend to have the highest number of doctorates despite the increase in doctoral enrolments and completions in emerging economies. The OECD has commented that emerging economies have expanded their higher education training capacities; however, as already indicated, concrete evidence of the wider economic impact of doctorates, on the profile of doctoral students and programmes, the aspirations and career paths of graduates and in diverse institutional, social, economic, political and policy contexts, is not obvious in our era of rapid global transformation. The arguments revolve around both the production of understanding and knowledge and their transmission and application to supplying goods and services. In this respect, Casey (2009) suggested that there is evidence for a contribution to society beyond that by the individual.

The inclusion of doctoral study in the Bologna Process has been linked to the policy objectives of the European Union Lisbon Strategy, which focused on making Europe a competitive, knowledge-based economy and society by increasing the numbers of researchers and enhancing research capacity, innovation and economic growth. This strategy has facilitated innovative growth in applied doctorates. Scott et al. (2004) linked the emergence of applied professional and practice doctorates to the changing role of the university and society. This encompasses the production and use of knowledge, pressure for diversification and for more professionally relevant programmes, massification of higher education, demand from some professions and workplace requirements for high-level skills and knowledge and wider acceptance by professionals of the concepts of evidence-based practice and the reflective practitioner, together with development of work-based learning.

So Is This All an Illusion: The Difference That Isn't?

Certainly Zusman's (2017) findings might suggest that demand for PDs are driven more by professional body and university administration financial and policy requirements than they are by the workplaces in which they work. In his study he concluded that professional associations or professional school administrators spearheaded the creation of new doctoral credentials 'primarily to increase the professions' or practitioners' status, autonomy, and income or to raise institutional standing—rather than to respond to labour market needs or more complex professional work environments' (2017: 33). This seems a much more dangerous threat to the idea of doctorate education than its mere designation as a practice-based or research-based doctorate if they are both judged by fundamentally the same criteria.

To conclude, my argument is that doctoral level achievement ought to be recognised by programmes that adequately reveal in those who gain them the knowledges, skills and disposition which they each warrant. From what I have argued, both degrees fall within the same category of credential on many criteria, and on that basis their shared deep sameness outweighs their more superficial differences in form; they are substantially the same.

What Does This Mean for Climate Change Research?

Perhaps we might best look again at the praxis/poiesis difference, for here the subtlety of differences between the forms of doctorate might directly impact on their use in first an analysis of climate change per se and then secondly on securing the behavioural changes to reverse or ameliorate it. These ought not to be conflated as epistemic problems. To recap, the appropriateness of *poiesis* can be determined by judging the quality of the product or end achieved that is the solution to a problem, and this may favour an approach where the object produced is determined by the quality of agents' skills and knowledge creation focused on the defined problem. That might be good climate change practice which involves both the knowledge of planning communicative interventions and the rhetorical practical skills to be able to convince, plus the generalisable knowledge of policy creation and academic disciplines. *Praxis*-based PhDs, on the other hand, are concerned with a different kind of end. The end or *telos* of *praxis* is not an end in the usual sense at all, but some indeterminate outcome, the effective use of which cannot be determined in advance but must be discovered in particular contexts and situations. That is, we might understand how the degeneration of the ozone layer happens, but this is not sufficient to stop it happening. What is required is to consider the form of engagement with this crisis. Many aspects of climate-change research, particularly dealing with adaptation and impacts, require a much broader perspective and greater scientific knowledge than a PhD candidate typically gains in a traditional discipline.

The use of results from both doctorates can contribute to the management of the climate crisis, but neither provides a research approach which can resolve the problems. Simply adding training in communicative or transferable skills will not bridge the epistemological difference which is inherent in the onto-epistemological stance chosen by the researcher. This argues for teams of researchers with different epistemological approaches working in teams of inter- and mono-disciplinary science following a PhD model and transdisciplinary *poiesis* to understand the problem of climate change as an existential as well as an empirical problem. The different epistemological stances both separately and integratively provide a weave of cultural, political and scientific crises created by, and hopefully resolvable by, humanity with a humility based on merit.

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Part IV
Theorising an Earthy PhD

Chapter 12
Expert Not Specialist: Doctoral Ecologies for Focused Frogs and High-Flying Birds

Ross Gibson

Abstract This chapter commences with an etymological exploration of key terminologies which are necessary to (or unavoidable in) discussions of the PhD, university research, experimentation, knowledge and wisdom. The etymological filigrees and histories of these words remind of us significances, which may have been lost in time or in the busyness of higher education. To experiment is to experience, to become a doctor is primarily to become a teacher and an instructor. The chapter then turns to the interrelations between wisdom, ecology and complexity and the challenges entailed in bringing experiential knowledge and wisdom, which are the intended outcomes of advanced study – such as the PhD – to the problem of the environment. Drawing on a range of thinkers, including Dawkins, Bateson, Benjamin and others, the chapter finally settles on an ecological metaphor – drawn from Freeman Dyson – that of the focused frogs (working on one disciplinary problem at a time) and high-flying birds (capable of soaring above the problems of individual disciplines to see the larger patterns between them) to imagine a hybrid creature capable of both modes of inquiry and to pose challenges to educators to produce the conditions necessary for these hybrids to thrive.

Introduction

This book has arisen from the editors' observation that, on a global scale, two notes of crisis are currently resounding off each other: (1) first there is the note that education in universities, particularly research-based education at the doctoral level, is failing many of the students who undertake it as well as the society that auspices it; and (2) there is the alarm that the ecological systems that host every vital activity on the planet – education included – are close to collapse.

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While research students are routinely taught that correlation does not necessarily mean causation, in this instance intuition cajoles me to investigate how entangled the two crises might be, how the fixing of one might involve the fixing of the other. It's the global nature of the problems, as well as the concomitant need for a comprehensive system-assay of contemporary knowledge-production, that puts the two crises together. Examining the connections between the educational and the environmental distress will take us into complexity theory and ecological accounts of consciousness. But first to help us understand the concepts that animate some of the keywords we use habitually, it is helpful to pursue some etymology.

Etymology

We should start with **knowledge**, that thing (or is it a *state*?) which educators try to lead their students toward. In the Australian Federal Government's policies concerning publicly funded research, knowledge appears to be a given thing that glows in common sense:

> Research is defined as the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings. This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes.
>
> This definition of research is consistent with a broad notion of research and experimental development (R&D) as comprising of creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications (Australian Government 2012).

A close reading of this definition shows that in the systems that govern university research cultures, knowledge has an operational connection to understanding; and while they are often assumed to be synonymous, knowledge and understanding are crucially different even as they are both legitimate outcomes of the research-driven education that is enacted during the pursuit of a PhD. With the English word 'knowledge', deriving from the Greek 'gnosis', there is a sense of an external force or radiance, something powerful out there, explicit and independently existent. A noumenon that can also be regarded, paradoxically, as a pre-existent phenomenon, knowledge can be construed as an external, stockpiled entity which a seeker can approach and imbibe. Potentially, the seeker can bring some enhancement to it too. There is a sense that knowledge can be thickened, as it were, *from the outside*. No matter whether it is pure or applied, knowledge is an object that can be appliquéd so that it grows, increment by increment.

Understanding is different. Understanding is a good deal more subcutaneous. Understanding so saturates the seeker that it gets inside them, becomes implicit, becomes intimate. The word 'understanding' actually visualises the concept: the seeker gets immersively close to the noumenon, so close as to stand under it, so

overborne as to be enveloped in it as if in a rainstorm. 'Comprehension' – the direct synonym for understanding – has a similar connotation. Deriving from the French 'comprendre', comprehension is a process of taking or grasping ('prendre') an element with ('com') another element with another element with another element, until the seeker and the comprehensible phenomenon begin to be in and of each other, immersed in each other's grasp. There is a sense that understanding thickens *inside* the seeker. Thus, it is different from knowledge. Only when the absorbed, implicit qualities of understanding get explicated to become an externalised entity can understanding be figured as knowledge. For the best and most influential exposition of these notions, see Polanyi (2009).

This distinction is important because it shows how experience is crucial to the accrual of understanding and therefore to the generation and eventual communication of knowledge. Etymologically explained, experience is the process of going out (*ex*) into the world-not fully-known, where risks (or *perils*) abide and where learning is availed. In the process of gathering experience, of being tuitionally immersed in the perilous flux of the world, the venturer can begin to understand or become inculcated with some principles of the larger world. The tuition can make intuition, which can be explicated as knowledge. By grasping principles via immersed investigation, the venturer can become an expert, someone who has emerged from experience.

Notably, the French infinitive for 'to experiment' is 'experiencer'. Which helps us understand that the expert researcher is someone who has been fashioned in experimentation. Expertise can be garnered in the social scientist's observed 'field' of investigation or in the laboratories of the hard sciences or in the studios of the creative arts or in the libraries and archives of the humanities. The point is that these domains all serve as concentrated versions of the world-that-must-be-known; and the investigator's task is to plunge in so as to absorb, synthesise and then emerge to communicate fresh insights from that world.

So, a researcher is an experiencer. The researcher must range through the world in order to discern its often-covert patterns, to trace the implicit activity-meshes that put an integrated vitality into the system that hosts every phenomenon and noumenon. This emphasis on experience is important because it leads us to the gist of the PhD: wisdom. For the moment, let me define 'wisdom' thus: it arises from an investigator having encountered, accrued and then synthesised an extensive understanding of the dynamics in existence. A Doctor of Philosophy is someone who is so inculcated and expert in a topic that they have been fortified with wisdom, so much so that they can teach ('docere') others how to experiment, how to venture into the perils of unknowing while enacting an enamoured ('philo') devotion to wisdom ('sophia'). By definition, a wise person has experienced a great deal, which means they have begun to grasp the tendencies in the systems of existence, and from that state of inculcation they have begun to understand how to proffer informed visions of what might transpire in the future as the ramifications of every single worldly action shimmer reactively through the tensile integrity of the lively world.

I have traced this etymological filigree so we can see a fundamental characteristic of the Doctorate of Philosophy: with all its centuries of history dating back long before the enlightenment, and notwithstanding its recent cladding in the verbiage of

skills-acquisition and employability, the PhD remains a self-fashioning ordeal or apprenticeship that is designed to *accelerate* a scholar's investiture as a wise, integrative type of expert. Over an extended duration and usually by dint of some ordeals designed to stimulate personal transformation, this acceleration occurs via repetitive experimentation governed by experienced supervision. On graduation, a PhD graduate should be a person steeped and galvanised with a good modicum of wisdom; the doctor should have become a significantly experienced person capable of teaching others how to venture into cognitive peril.

Wisdom, Ecology, Complexity

Having threaded this etymological line from 'understanding' via 'experience' to 'knowledge' through to 'wisdom', we can begin to grasp how the PhD has always been amenable to the investigation of the complex, globally scaled problem of environmental collapse that roils around us today. Due to its nature as an extensive network of complex urgencies skittishly governed by a system-wide feedback-behaviour, the global ecology needs people who can connect their expertise to form a multi-disciplinary community that considers the full, dynamic extent of the environment. This collegiality is needed so that we can attain an overview or holistic understanding of how the dynamics are tending to play out across the changeful world of experience.

Diversity within collegiality is necessary because, frankly, one can never be sure where the disruption (or indeed the amelioration) may be residing ready to course within complexity, which is always tensed to fall out of balance. Each node of expertise must know how to partake of a vibrant network of expertise in order to harvest full-coverage information from the whole system and in order, concomitantly, to propose interventions that could ramify beneficially across the entire environment. The crisis needs a community of connected, outreaching experts, not a grid of specialists whose intensive focus prevents them from seeing the dynamics that tend to surge in a non-linear or networked fashion, moment to moment, across disciplinary boundaries, in the numberless, emerging directions through the complex dynamic system of the living, human-inhabited environment. For more detailed discussion of these ideas, see Millgram (2015). In the current environmental emergency, we need people whose training directs them to merge or extensify rather than intensify. And we need people who are amenable to receiving and acting on insights gleaming in from outside their nodal expertise. Expertise needs to be not only absorbed and centripetal but also curious and centrifugal. For the sake of system-wide vitality, expert intelligence needs to be relational rather than segregational.

A text crucial to such thinking is Gregory Bateson's *Steps to an Ecology of Mind,* which first appeared in 1972. Assembled well before the notion of 'the anthropocene' was abroad, *Steps* is a book that, despite its frequent opacities, resounds ever more forcefully through contemporary experience. It resounds because it tries to draw its readers into a larger systemic comprehension, into an 'immanent' intelligence

which Bateson calls 'Mind', which he asserts is a mentality that shimmers through all the worldly vitality with which human beings interact.

Contemporaneous and consonant with Fernand Braudel's writing on the historical *mentalités* in Europe, but emerging from radically different scholarship, Bateson is one of the first thinkers to advertise the cybernetic idea that there is a friction-free, global galvanism of thought-and-feeling that self-organises, evolves and devolves like an ecology. (Aspects of this idea would be powerfully simplified as 'the meme' by Richard Dawkins during the 1970s.) 'The individual mind is immanent but not only in the body,' Bateson contends, 'it is immanent also in pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a subsystem. This larger Mind is comparable to God … but it is still immanent in the total interconnected social system and planetary ecology' (Bateson 1972, p. 467). When any one person is thinking with their own mind, they are already immersed interactively in the larger Mind, which is the dynamic set of systemically governed contingencies that render our host environment both vital and fragile, both nutritious and pernicious. As Bateson asserts, the 'lack of systemic wisdom is always punished. We may say that the biological systems – the individual, the culture, and the ecology – are partly living sustainers of their component cells or organisms. But the systems are nonetheless punishing of any species unwise enough to quarrel with its ecology' (Bateson 1972, p. 440).

'Lack of systemic wisdom is always punished'. For all its Old Testament tone, this statement focusses the modern scholar's mind on what is to be done, right now, with wisdom. 'Wisdom I take to be the knowledge of the larger interactive system – that system which, if disturbed, is likely to generate exponential curves of change,' says Bateson (1972, p.439). So, wisdom is the ability to see holistically and to improvise beneficially within flux. It is the faculty that we must apply to the management or the amelioration of systems that we inhabit and that are complex, ever-emerging and often-devolving. Systems such as the global ecology. Systems too, such as tertiary, research-based education.

Walter Benjamin's essay on the art of the storyteller helps us understand better the broad efficacy of wisdom. As he observes, wisdom results from accumulated experience. And much of that experience can be 'passed on from mouth to mouth' via reiterative narrative accounting (which Benjamin's English translator Zohn calls 'counsel'). 'Counsel woven into the fabric of real life is wisdom,' he proclaims (Benjamin 1995/2007, pp. 86–7).

In Benjamin's view, training in the acquisition of wisdom within European cultures was at its best during pre-modern, journeyman-training. Before the advent of the printing press, this was an oral culture that organised artisanal guilds. In artisanal pedagogy, trainees engaged in daily, hands-on fabrication; but more importantly their activities were threaded through, day after day, year after year, with stories or counsel narrated by the master, counsel that dramatised specific, palpably imaginable instances of the improvisatory, material poiesis that had to occur within the peril of each unprecedented instance of creation-from-raw-materials. A master leather-worker, for example, might tell a dozen stories about a dozen different commissions in a dozen different climatic conditions using a dozen differently behaving

swathes of leather. Absorbing this tangle of accounts across days and years, the trainees would begin to curate within themselves many lively scenes of structured plausibilities-and-possibilities: events that had happened, events that might happen. Thereby the neophytes deepened their understanding of all the variabilities that must be factored into the risky process of converting raw and volatile materials into finessed products.

Over time, interweaving hands-on experience with ears-on narrative counsel, the neophyte could become expert and wise. Adaptable, trained to be innovative and improvisatory, the wise expert would not be so specialised as to be bamboozled by variances in materials and by unprecedented contingencies in each new work context. Trained into wisdom, the master-artisan could reach past precedented normalities, into a complex world of possibilities so as to imagine the right course of action. This right course of action, which would sometimes be unprecedented, would get envisaged in a process in which stored histories (experiential records indicating plausibility) and imaginatively charged stories (prospects of possibility) are brokered into practicable commission. As Benjamin declares, 'counsel is less an answer to a question than a proposal concerning the continuation of a story which is just unfolding' (1995/2007, p. 86).

'A story unfolding': This, according to Paul Cilliers, is the key to understanding and negotiating complexity. In his increasingly influential book *Complexity and Postmodernism,* Cilliers explains how a complex system 'cannot be reduced to simple, coherent and universally valid discourses' (1998, p.130). Neither stable nor objective, complexity emerges and evolves systematically within and around every entity that is participating in it.

Consider ecologies, for example. To begin understanding a complex system such as ecology, Cilliers observes, you must get inside it, thereby diminishing your distance from it so as to stand a chance of comprehending some of it; then you must 'repeat' the system virtually, by composing an account of what appears to be going on within the ceaseless dynamics; via this accounting you must take note of *whatever appear to you to be the system's cardinal qualities*, as they are discernible from the vantage point in space and time that you presently occupy; and paradoxically, while you are capturing these details, you must also acknowledge that the situation has always altered already and cannot be exactly repeated and therefore requires continuous fresh accounting. Tellingly, one of Cillier's most influential articles is titled, 'Why we cannot know complex things completely' (2002). Next, you also must attend to a profusion of other accounts that are simultaneously being transmitted from other agents elsewhere inside the complex system; you have to hear how the system seems to be tending as perceived from all these other specific vantage points. (This is where the phalanx of outward-looking interdisciplinary experts – nodes in a network – is crucial to the comprehension of complexity. This is where it becomes evident that we need a society of expansively communicative experts, not a preponderance of segregated specialists.) Then, at a 'meta-level', you must *make a mesh of all these stories* and accept that, with this mesh, you have not captured the situation; rather, you have just filtered it and collected a residue of some of the 'telling' factors and tendencies. You cannot freeze and model the situation, for a

frozen situation is no longer complex; but you can generate a polyvalent account of how the system has been tending. The counsel that is comprised of story-performance and story-witnessing thus offers the best of the definitively insufficient methods we have for understanding how a complex situation effloresces and how intervening agents can act wisely within it (Cilliers 1998, pp. 130–35).

Curious, Imaginative

David Epstein's recent book *RANGE: why generalists triumph in a specialized world* (2019) covers similar issues. The gist of the argument (and a nub of mine) is captured throughout the ninth chapter of the book, in which Epstein ruminates on a celebrated essay from 2009 by the theoretical physicist and mathematician Freeman Dyson. In an account of the contemporary culture of academic science, Dyson declared that the enterprise of science needs to be staffed by two radically different types of investigators: 'focused frogs' and 'high-flying birds'. The frogs are the types of scientists – deep and isolated – who burrow into a topic that is characterised by so much detail that the scientists never raise their eyes to look out at the horizon. Frogs solve problems serially, one at a time. Dyson tagged himself a frog. Contrarily, the birds survey broad vistas and perceive problems as non-linear patterns that stretch out beyond the perceptible horizon. Frogs are static, pinpointed and n*odal*. Birds launch out from standpoints, connecting *networks* across nodes, carrying and combining information from pinpoint to pinpoint, using their activity and mobility to mesh, in non-linear ways, their own expansive or lateral thinking into the deep insights that have been delineated inside the work of each nodal frog.

As Dyson complains, as Epstein bemoans (and as Millgram historicises in *The Great Endarkenment*), there is an overwhelming tendency in contemporary education to train intensive frogs rather than extensive birds. The birds (such as Bateson) are disappearing. And therefore, the extensive metaphorical ecology of global knowledge is close to collapsing into sinkholes of intensified specialist incoherence (as are the planet's literal ecologies which are becoming harder to know holistically amidst the isolated biological monocultures that litter the global environment).

The first step in solving the problem is, birdlike, to see that there is a problem. The next steps will activate a cosmopolitan kind of 'ethic' which will reshape education so that we are emboldened to train and reward scholars for venture in their ideas as well as for the defensibility of their assertions. In other words, the university domains and the employment domains will need to temper the currently preponderant 'specialty culture' so that education is world-making and imaginative, at least much as it is critical, deconstructive and niche-assertive in a 'policing' or fault-finding manner. We will need a little less of the practices of *critique* so that more projective *envisioning* becomes feasible without ever abandoning the need for evidence to substantiate declamations.

The programmatic details of such a re-fashioning of knowledge-culture are for another chapter. Indeed, many chapters in this book apply themselves to some of the opportunities. But first we must see how much we need the intellect birds as the extinction events loom around us.

Conclusion

To recap: at its core the PhD is an avid, experimental pursuit of wisdom. These qualities – wisdom-questing – have been in the PhD's underlying structure for centuries. Wisdom is a particular kind of knowledge, a comprehensive grasp of the systematic influences that play out in engulfing circumstances. Wisdom is an especially thick yet supple mode of understanding. It develops as the result of long experience in receiving and adopting viewpoints that have been transmitted from all across the lived experience that is under examination. The wise person has received and composed (and oftentimes imagined) a plethora of accounts of experience, a plethora delivered from a myriad different points in space and time within the system that is being examined. Thus, a wise person is someone who has been enmeshed in many concomitant (and often contentious) modes of knowing, such that the wise person can develop a holistic system-sense of how the dynamic, unpredictable circumstances might be tending.

Most importantly, to use the vernacular, a wise person 'has seen it all' (or heard it all in counsel) and is therefore not confined to a specialised enclave of constrained capability. A wise person can adopt a profusion of viewpoints in space and time and can envisage myriad lines of feasible actions through a story-world of plausibilities-and-possibilities, a story-world that intimately shadows the actual world. More than just being mercurial in the space and time of the system, the expansive expert can even accept an array of contending, ideological or discursive 'takes' on the system. Thus, a wise person, much like the well-counselled PhD, can cover every standpoint in the field and can thereby develop the ability to propose options-for-action that (even when they are unprecedented) are likely to be valid and defensible for that field. Drawing on enriched understanding founded in wisdom, the expert/doctor conjures new knowledge within the field.

Crucially too, wisdom also promotes imagination, encouraging the experienced analyst to model possibilities of what is not yet known or what might make fresh sense in a new and evolving situation. For as narrative cognition experts such as Benjamin Libet have shown, the prospective outlook that an imaginative seer can offer via a plausible fiction is always launched from the retrospective bank of experience that is stored as images and narratives in memory (see Libet 2004).

To conclude by bringing attention back to the PhD more pointedly, let me observe that a wise person is usually an old person, but not necessarily. Some regimes are designed to accelerate the acquisition of wisdom by younger people. Benjamin tells how the counselling regime in pre-modern artisan training was an expediter of wisdom. The PhD program can be such a regime too, in the way it can require the

PhD candidate to try to cover, *comprehensively*, every point of view and line of discourse that firstly addresses the topic under investigation and that secondly traverses the field in which the topic resides. In being so comprehensive, the candidate draws into themselves a profusion of perspectives and lines of disquisition that slowly, experientially mesh together to grasp the topic and to install *inside the investigator* an ever-thickening experience of developing that grasp. Implicitly, the candidate feels understanding grow inside them and then the writing of the thesis explicates that understanding in the form of communicable knowledge. In the best of circumstances, the candidate extracts new knowledge from deepened understanding so that they can put it *out there*, in that contested space where doctoral ratification occurs, and the expansion of research fields is overseen by an extensive network of nodal experts. Finally, because wisdom can foster imaginative acuity too, the PhD candidature can be more than the reductive process of training analysts and critics; the candidature can embolden prospective vision-forming too, provided the training gives the expert some palpable, feedback-affirmed experience in how to be efficaciously extensive and connective rather than mostly intensive and specialist.

Imagine not only a research culture comprised equably of some scholars who are 'frogs' and some who are 'birds' but also a large cohort of researchers, focussing in and flying out, who have been trained to become simultaneously both.

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Chapter 13
The PhD Revolution: World-Entangled and Hopeful Futures

Søren S. E. Bengtsen

Abstract This chapter provides an alternative conceptualization, and narrative, of the current state and aim of researcher education and the PhD. In a time where much scholarship highlights concerns about cohesion, relevance, and quality of the PhD, I aim to foreground an alternative PhD-narrative found in emerging research strands. I show that in the PhD, today, (1) we are witnessing new forms of doctoral student and supervisor agency within institutional contexts, (2) new sightings of how much social support beyond the institutional context influences on research momentum and creativity, and (3) new scope and magnitude of the importance and influence of research on biocultural and biopolitical negotiations. In contrast to the commonly held idea that the PhD foundation is eroding, I argue that we are witnessing a powerful PhD-revolution from within researcher environments, spreading like a pulse through social and professional domains, and reaching crescendo in societal and cultural contexts. Such institutional hope is crucial if the PhD should itself be filled with hope and find the courage to engage with climate issues and other global challenges. To be able to lift the researcher horizon towards global challenges requires courage and creativity within its institutional rooting and curricular nerve systems.

Introduction: Ruin and Disillusion – Or Glimpsing a New Hope?

One of the most prevalent narratives about the PhD, over the last two decades, has been one of institutional degeneration and ruin – and researcher alienation and disillusion, with a PhD de-attached from and distant to its societal and cultural surroundings. Readings (1997) voiced a rising concern in the 1990s, that the university "no longer participates in the historical project for humanity that was the legacy of the

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Enlightenment," and asked if we were entering the "twilight" of the university (1997, p. 5). In Goldman and Massy's (2001) perspective, graduate schools were, at the turn of the millennium, turning into "PhD factories," where the overproduction of PhD holders no longer created any clear private or public benefits and where the PhD was no longer seen as the response of the university to meet new and rising grand challenges.[1] Policy drivers such as the professionalization (Andres et al. 2015) of doctoral education, with a focus on generic competences relevant to a job market outside academia, started to erode the institutional cohesion of Graduate School and destablized the doctoral curriculum. As Pearson and Brew (2002), Manathunga (2005), and recently Barnacle, Schmidt, and Cuthbert (2019) have shown, such policy measures have resulted in tensions between institutional leadership levels, research environments, and doctoral supervisors and their students.

The institutional consequences have become visible through the rise in studies revealing the crumbling of the Graduate School leadership ethos, where doctoral students become alienated, lost and "orphaned" in the very systems set up initially to support and guide them (Wisker and Robinson 2012). Even when Graduate School leaders, research program directors, doctoral supervisors, and PhD administrators all want to recreate Graduate School cohesion and momentum, their discourses, initiatives, and visions not often and easily align (Bengtsen 2017). Not being aligned and cohesive within, Graduate Schools have struggled to become in sync with the surrounding society as well and to engage with commitment and originality to global concerns such as the climate crisis, together with challenges around health, security, equity, and social justice. Cassuto (2015) states that we are facing a Graduate School "mess," where we need to realize that "[a]cademic freedom comes with academic responsibility" and that doctoral researchers need to "turn their creative powers outward" (Cassuto 2015, p. 229 and 233). As Cassuto argues, we need a new Graduate School ethic, and such an "ethic would define a relation between the university and the community" and should pave the way for a genuine "ecological consciousness" of the PhD (Cassuto 2015, p. 228 and 227), where research across the disciplines aim to engage with climate change issues such as carbon dioxide levels, rising sea levels, increasingly extreme weather, melting permafrost, and threats to animal (and human) habitats.

Severe repercussions of the Graduate School mess have been felt by doctoral students as well as their supervisors. Burford (2018) has applied the term "cruel optimism" to describe how doctoral students and their supervisors are being encouraged by Graduate Schools, and national policy drivers, to complete in a restricted time frame due to the demand for researchers within the society – but in reality, employment prospects for researchers are poor. Acker and Haque (2017) have applied the term "hysteria," borrowed from Bourdieu, to describe the experienced

[1] Even though the literature I draw from is international, when I use the term "Graduate School" I have in mind the EU-based system, which relates to the Bologna process. Graduate Schools, and the notion of the PhD, in Europe, the United States, Australia, and other parts of the world differ in scope, focus, and goal (Andres et al. 2015), and my default understanding relates, due to my own national and institutional contexts, to the European model.

confusion and change of behavioral patterns (frustration, anger, criticism) in research environments and between doctoral researchers due to increasing pressures and demands from outside. Kelly (2017) has argued that the political, societal, and institutional state of confusion and uncertainty about the goal and purpose of the PhD has created a "schizophrenic" PhD "characterized by fragmentation (…) and pulled in different directions" (Kelly 2017, p. 59), which has led Bengtsen (2020) to suggest a possible torn PhD curriculum altogether. Also, doctoral supervisors have been reported to change their behavioral pattern due to the institutional and curricular changes in the PhD. As Halse (2011) and Wisker and Robinson (2016) have shown, doctoral supervisors display new forms of coping and self-protection strategies, when feeling the pressures from national policy translated into many-sided and unaligned Graduate School demands. More radically put, by Wisker and Bengtsen (2019), the increased policy focus on well-being and mental health in doctoral education is threatening to pathologize and creating a "sick" PhD.

The narrowing in of institutional and curricular horizons threaten to stifle creativity in the knowledge creation processes, draining the will and energy to move the PhD beyond merely academic circles and to fully engage in the discussion and solving of current grand challenges. As Barnett and Bengtsen (2017) have argued, the ecological awareness that links research, researcher formation, and global issues together depends on an inherent epistemic and academic "optimism" and hope. To engage with issues of climate change, and similar true global grand challenges, demands the ability to think into the unknown. The "optimistic university thinks from the world as we know it and it thinks from what the not-yet-ness of the world" (Barnett and Bengtsen 2017, p. 8). For the PhD to address ecological issues, the PhD itself needs to have an ecological foundation – both in its internal working within Graduate Schools and the wider institutional infrastructure, together with its outward projections and engagements.

My aim in this chapter is not to belittle or undermine the many scholarly studies disclosing a challenged Graduate system, but I argue that this picture is only half the truth and that we should take care not get stuck or become pulled down, in our research narratives, into the slippery slope of the (sometime much-needed) criticism of neoliberal regimes and focus on what the PhD is not, and what it can*not* be. The focus needs to be turned towards possible future and what it *could* be and *would* be, if it had the chance.

Firstly, I argue for a complementary perspective on the PhD that foregrounds the rise of new forms of agency and cohesion within Graduate Schools. These years are witnessing the constitution of PhD student unions, institutionally and nationally, who engage critically with institutional leadership and policymakers on the basis of mental health reports and research community feedback. Also, doctoral supervisors show agency and integrity in their interest in political spaces within Graduate Schools such as PhD committees and PhD program leadership. Similarly, institutional agency may be witnessed amongst Graduate School leaders searching for a new PhD ethic combining originality in research and contribution to societal and cultural agendas and value. In many ways, the PhD is not broken, and neither are our institutions, and many are fighting to find a new societal and political footing

and build up new institutional hope. Such institutional hope is crucial if the PhD should itself be filled with hope and find the courage to engage with climate issues and other global challenges. To be able to lift the researcher horizon and creativity towards global challenges requires courage and creativity within its institutional rooting and epistemic nerve systems.

Secondly, I show that what feeds creativity in doctoral research is being drawn from the social, cultural, and ecological reservoirs beyond the academy. Crucial social, practical, and emotional support, together with personal meaning-making, in the PhD, is often sapped from extracurricular and extra-institutional support and feedback systems. The degree to which our social and cultural realities shape the quality, momentum, and drive in research is rarely acknowledged. Indeed, the PhD is already world-entangled to an extent policymakers and institutional leaders are rarely aware of. The PhD is itself sustained by human culture, which again is sustained by wider biopolitical (Esposito 2008) and biodiverse reservoirs and resources, which often go beyond the awareness of the individual researcher and institution.

Finally, I argue that we are witnessing a PhD revolution taking place through rising academic activism and doctoral citizenship. Academic activism is spreading through student protest movements, strikes by academic staff, and through conference themes, keynote topics, and the work of academic societies and associations. Here, we do not only witness a political activism demanding a more humane, fair, and equal doctoral education, but we see new forms of doctoral citizenship centering around enhanced climate awareness, promotion of social justice, and the fight against "epistemicide" (de Sousa Santos 2016) and gender and ethnic inequality. Increasingly, PhD dissertations, either through funding policy or institutional focus, address the posthuman situation and the Anthropocene (Gildersleeve and Kleinhesselink 2019; Lysgaard et al. 2019), where "[d]ichotomies such as human-nature and human-Earth, no longer work or fit" (Gildersleeve and Kleinhesselink 2019, p. 5). This way seen, the PhD may be on the brink of becoming more societally, culturally, and *biopolitically* powerful and important than it ever was. Not in order to turn into ideology or become party political but to reclaim its social, cultural, and even bioethical mandate and responsibility.

New Doctoral Agency, New Institutional Hope

In a time where doctoral students are often described as frail, existentially insecure about the future (their own individually, and in a constantly changing society and culture, and even insecure of their future survival as a species), anxious, and stressed, it is important to balance the picture by foregrounding studies that show a different situation. In a recent study, Frick and Brodin (2019) pointed out the link between creativity in doctoral research and doctoral student agency. Being able to form networks, participate in researcher communities and wider collegial spaces within their home institutions and beyond, has a positive effect on the ability to develop creativity and originality in the research and to start imagining and being willing to

contribute to new societal and global futures. In a study by Jazvac-Martek et al. (2011), the many different and diverse interactions and tasks doctoral students undertake on a daily basis become visible. Besides focusing on their own research projects, doctoral students are also part of research programs, peer groups, journal clubs, writing groups, editorial committees, conference organizing committees, other research teams, etc. Some of these tasks are assigned to the individual doctoral student, while others are sought out and chosen voluntarily, and "a plenitude of supportive and critical interactions [are] occurring beyond the primary relationship with the supervisor" (Jazvac-Martek et al. 2011, p. 25). Where formalized support systems, such as supervision, often cast doctoral students in the role of individual agents separate from wider academic and social contexts, the active informal support systems doctoral students engage in reveal a much more community-based and collective version of the PhD, which is, however, not fully embraced by and integrated into the Graduate systems.

Doctoral learning journeys are full of living and vibrant, but often institutionally hidden or unacknowledged and unrecognized, forms of individual agency and active communities. Wisker et al. (2017) reveal this 'doctoral learning penumbra,' which shows how doctoral students rely not only on supervision but on coaching, mentoring, and even extra unofficial scholarly feedback and support from so-called guardian supervisors. Doctoral students seek out help from academics who may help "translate and encourage understanding," and some of these informal supporters "edit students' work, proofread, serve as sounding boards, providing empathy, containing anger and frustration, helping make choices,", and they provide "encouragement, suggest solutions to problems or difficulties, search for materials and articles, help in phrasing and rephrasing, and adjudicating" (Wisker et al. 2017, p. 534). The PhD is full with agency, courage, and community building, also in times when policy reports focus on doctoral students' isolation, loneliness, and anxiety.

Also, a more politically tainted form of doctoral student agency is on the rise. These years, we see the formation of an increasing number of doctoral student associations and councils complete with boards, statutes, and mission statements. We see doctoral students forming strong political groups within individual institutions and nationally across institutions. These associations engage into constructive and critical dialogues with senior leadership levels and Graduate School management around issues of well-being, gender and ethnic equality, work-life balance, and precarity in academic careers. Besides constituting a strong community of support between doctoral students and early career researchers, the associations and councils also constitute units of institutional power to be reckoned with. These forms of political agency show that discourses centered round pathology and illness will not pacify doctoral students. On the contrary, we see doctoral students being mindful of, and caring for, a shared future, and we see a strong and growing ecological awareness linking the individual researcher to their institutional and societal context, and even further yet towards commonly shared cultural and biopolitical futures.

We find an increase too in doctoral supervisor agency and researcher community agency. The notion of "Bildung" or the formation of doctoral researchers, has been continuously foregrounded in the literature. In Chris Golde (2007) and Mullen and

Tuten's (2010) work on journal clubs and cohort mentoring in doctoral education, we find that such cross-generational and semi-formal meeting and learning spaces inform the participants' research, strengthen the momentum and energy in the individual learning and research processes, and create a community within the larger institutional structure, where other rules, social codes, and cultural values may be co-defined and shared. The informal support of doctoral mentoring "involve[es] not merely a knowledge of institutional policies and procedures, but also a sense of the value and purpose of the doctorate and doctoral education as an important area of work" (Halse and Malfroy 2010, p. 87). As Sinclair et al. (2014) have shown, a central form of supervisor agency is the acknowledgement of doctoral students' autonomy and independence and the importance of building sustainable intellectual communities (Walker et al. 2008), where junior and senior researchers escape the supervisory dyadic, and hierarchical, relation and may research and work together in mutual and collegial respect and recognition. This awareness of the value in, and the competence in building, shared and sustainable intellectual communities is foundational to the wider global awareness of the shared climate challenge and the awareness of sustainable biopolitical futures. There is an inextricable link between the understanding of the importance of learning ecologies (Bengtsen 2020) on the individual and institutional levels and the wider societal and global biocultural ecologies.

Interestingly, we start to see a call for stronger and more practice-oriented leadership agency within Graduate Schools. We learn that Graduate School leaders themselves may feel ambivalent about "acknowledg[ing] the importance of centralising some of the power and responsibility in committees (the PhD committee, for example)," while also "recognising the importance of vibrant and inspiring research environments within the disciplines" (Bengtsen 2017, p. 265). The increasing centralization, and thereby often increase in size and complexity of Graduate Schools, may make Graduate School leaders perceive themselves "as (too) far away from doctoral supervisors and, especially, students in everyday doctoral education" (ibid.).

In a similar vein, Elliot, Bengtsen, Guccione, and Kobayahsi (2020) argue that besides showing an interest in and care for the activities and events taking place in the everyday life of the members of the Graduate School, "it is also important that Graduate School leaders know very clearly what goes on in the community. Not only in relation to merging the levels of policy and practice within the Graduate School, but also in relation to being *there* as a *member* herself or himself" (Elliot et al. 2020; italics [original]). Also, Clarke et al. (2016) call for stronger links between "institutional structures and local cultures of supervision" (Clarke et al. 2016, p. 286) and underline that what is needed is not ad hoc patchwork initiatives but "a larger process of institutional reform [and] educational leadership" (p. 287). To create new institutional hope within doctoral education, agency must connect across all levels of Graduate Schools and involve not only doctoral students and their supervisors but also research program leaders, department heads, and directors of graduate studies.

After decades of Graduate School leadership concentrating on translating policy reforms into structural changes within the PhD and the strengthening of Graduate School infrastructure, we now witness a much-needed change, or turn, in Graduate School *culture*, where doctoral students, their supervisors, research program leaders, and directors of graduate studies begin to reach out to each other and to form a new PhD ethic and a new community foundation, lending doctoral students the much-needed intellectual optimism and moral nerve and vitality that may direct their attention to even larger and more far-reaching biocultural and -political challenges.

World-Entanglement

The PhD cannot be contained within its disciplinary cloaking and dissertation format. We need to fully understand that the PhD is a wild-growth, overflowing its institutional, curricular, and disciplinary boundaries and mandates. In this section, I wish to shed light on the world-entanglement of the PhD. Students draw support, inspiration, energy, and ideas not only from beyond their supervisory teams, as shown in the section above, but even beyond the institutional and curricular contexts. As McAlpine and McKinnon (2013) show that "on a day-to-day basis, students depended as frequently on peers, friends, and family as they did on their supervisors, drawing on each relationship for different kinds of support" (McAlpine and McKinnon 2013, p. 265), concluding that "supervisors, while important, are not paramount in the doctoral journey" (McAlpine and McKinnon 2013, p. 278). While feedback relating to disciplinary expertise and professional support is very important in the PhD, doctoral students report that equally important to completion and quality in the learning journey are practical support, moral support, and emotional support (Cornér et al. 2018; Mantai 2019). The wider societal, socio-geographical, and even environmental surroundings affect our lives and the focus and energy we may put into our academic efforts and endeavors during the PhD.

It is beginning to dawn on us that quality and originality in research is strongly linked to a more holistic, or ecological (Barnett 2018; Barnett and Bengtsen 2019), picture. The force with which doctoral students manage to push the boundaries for their own thinking and learning depends not only on supervision pedagogy but also very much on existential meaning-making and access to reservoirs of deeper social and emotional support. As Bryan and Guccione (2018) show, doctoral education and research drive are as much about personal meaning-making, existential beliefs, and reflections about the wider societal relevance and cultural value of their research. During their PhD, many doctoral students start up their own family, have children, and spend time on maternity and paternity leave. Some get married, some get divorced. Some have elderly parents to attend to and care for, and some become ill or have spouses or children who become ill. As Hopwood and colleagues underline, we often forget that doctoral students are also "parents, siblings, daughters/sons,

and friends; they have other interests to pursue, health and finance to maintain, and domestic lives to run" (Hopwood et al. 2011, p. 218).

Also, cultural integration and realities to a large extent influence doctoral students' access to institutional infrastructure, supervisory and technical support, personal meaning-making, and even happiness. Elliot and her research team have shown how important, especially for international PhD students, cultural integration is to both research focus and momentum. Often, cultural integration does not happen at the institution itself, or even in the research environments at universities, but takes place in "third spaces" such as job contexts and professional networks outside the university, NGO volunteer work around wider societal issues, and through membership of sports clubs and interest societies, together with wider socialization with friends and family (Elliot et al. 2016; Cai et al. 2019).

Manathunga argues that the PhD is often understood as existing in a social and cultural vacuum and where its epistemic and pedagogical cultures are implicitly favoring some cultural identities and norms over others (Manathunga 2014). This is unfortunate as we witness our current "chronological bureaucratic approaches to doctoral education timescapes adopt assimilationist approaches to the supervision of women, working class, culturally diverse and Indigenous candidates which positions these candidates as lacking the capabilities, organisational skills and commitment deemed necessary to fit with dominant temporalities" (Manathunga 2019, p. 11). The world-entanglement of the PhD, paradoxically, becomes more and more visible in a time where policymakers and Graduate Schools search for a generic curriculum and wish to harness transferrable skills that transcend contextual differences and different sociocultural realities.

The world-entanglement of the PhD is equally visible when tracking post-PhD careers (McAlpine and Amundsen 2016; McAlpine and Amundsen 2018). Geographically the PhD(-holders) move between disciplines, departments, universities, cities, countries, and parts of the world, depending on the individual PhD-holder's willingness to relocate for a better position, a higher salary, to be closer to family (elderly parents), and to follow spouses moving jobs. In recent studies by Barnacle and her research team (Barnacle et al. 2019) and Guerin (2019), we see world-entanglement relating to the kinds of jobs PhD-holders find outside the university, including government positions, employment in state and federal departments, NGOs and not-for-profit organizations, private industry, and self-employment as freelancers.

The PhD disperse "throughout the workforce" (Guerin 2019, p. 13) in different shades of writing (editorial work, grant application writing, creative writing), researching (research analyses, research librarian work), teaching (high school teaching, staff training, and development officer work), and managing (project management, communication, and business management, team management) (ibid.). The world-entanglement of the PhD is powerful, and when "doctoral graduates take their knowledge and skills out of the ivory tower and into the broader workforce, they are at the forefront of breaking down boundaries between universities and wider society." (Guerin 2019, p. 17). The PhD has become a facilitator of change and an ecological driver through its ability to "facilitate engagement between

universities and industry, establishing collaborative research projects and offering internships for students," and the PhD-holders' "understanding of both university and industry needs places them in an ideal position to broker these exchanges" (ibid.).

This way, the PhD may become a biopolitical broker when connection stakeholders, communities, and even worldviews through the diverse forms of knowledge creation and knowledge work. Our knowledge of 'climate change is leading to mass civic and economic disturbance, quit apart from environmental degradation,' and we may find that "[m]oral norms may be challenged and political views may be unsettled' (Barnett and Bengtsen 2019, p. 116). The world-entanglement of the PhD stretches from the individual researcher, through researcher communities and institutional contexts, into societal knowledge practices and cultural and moral norms, and perhaps even resulting in push new biopolitical agendas and transforming global biocultural worldviews.

In contrast to the repeated policy mantras concerning greater societal impact and the ambition to move the PhD beyond the institutions and into society, it is clear that the PhD is already there – deeply entangled with the world through its "entanglement with life" (Barnett and Bengtsen 2019, p. 8). The PhD should be acknowledged as a true knowledge ecology (Wright 2016) and epistemic and ontological ecology (Barnett 2018; Barnett and Bengtsen 2017) and be met in its already far-progressed influences on research, researchers, organizations, companies, local communities, and families. The policy community and institutions have been on their heels awaiting rational curricular and career planning, while the PhD itself has been, in a more messy and organic way, spilling over from the institutions and into society for years.

As Fig. 13.1 shows, the PhD is situated within an ecological circuit mediating and transforming environmental, social, and cultural contexts and realities into original research and research momentum within doctoral education and spilling over into diverse societal, professional, and biopolitical futures. As I argue elsewhere (Bengtsen and Barnett 2019), the PhD is influenced not only by immediate national and institutional policies and strategies but by much wider environmental realities mediated through cultural and social contexts. The "darkness of higher education reveals that universities and higher education exist, and are being held up, *in addition* by stranger forces that we may not yet discern or even be willing to accept"

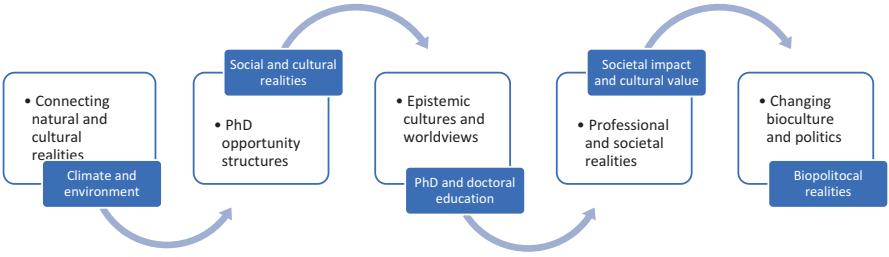

Fig. 13.1 The world-entangled PhD (the ecological circuit of the PhD)

(Bengtsen and Barnett 2019, p. 25). The first step to connect more closely the PhD with global issues of climate change is to make visible the ecological circuit that the PhD is a part of – and may be an active change-maker within!

Academic Activism and Citizenship

The cultural vibrancy of the PhD extends beyond institutional borders and societal rooting. Research and researcher formation, today, is being caught up in discussions around epistemicide (de Sousa Santos 2016) and the North-South cultural divide and the ambition from the researchers themselves to create the conditions of anti-instrumentalist and anti-racist change. The PhD is becoming visible as a societal and even political arena, and, following McArthur's argument on social justice (2018, p. 155), the research engagement itself "should be similarly active, critical and transformative" as there is a major "responsibility in how we frame and project the world in our research – and how we critically deal with our knowledge methodologies." Activism clings to discussions about the aims of research today, and Waghid and Davids (2018, p. 72) remind us of the often lack of critical voices from university staff and students in South Africa and argue that if the "decolonisation of knowledge were to be taken seriously, critique should invariably be invoked," so that we might arrive at "an African university of critique that will deal more poignantly and transformatively with higher educational matters, conflicts and concerns." Researchers today cannot avoid reflecting critically on questions such as: Who provide our funding and is that "funding genealogy' ethical and sincere? How may our research feed back into society and reach marginalized groups and societal peripheries, which forms the main driver in our research project? How may our research contribute to global concerns of climate change and health issues?

Today, the PhD is inescapably linked to societal and cultural ethics, where thought and cultural values are mirrored and where, for example in a New Zealand context, "the incommensurability of thought, and diverse and often marginalised, subjugated ways of knowing and being of indigenous knowledges might (re-)arise and flourish within the university" (Arndt and Mika 2018, p. 48). To Arndt and Mika, criticality in research and societal attitude are sworn together, and in this view "revolt is seen as a disturbance to the expected smoothness of the status quo, for example, of contemporary measurement and revenue raising systems and expectations" (ibid.). Research has an inbuilt political dissidence, and the dissident critical thought lies in its compulsion to "scrutinize, problematize and complicate thought and identity," and it aims to "disrupt familiarity, move language into improper, even obnoxious disturbances" (Arndt and Mika 2018, p. 52).

Australian researcher Frances Kelly (2017) argues that the PhD today finds itself with a peculiar, and perhaps unwanted (but also unavoidable), societal momentum and power. The natural strive in doctoral students, and PhD research, to destablize and unsettle existing paradigmatic hierarchies and epistemic authoritarian systems "tells us that there is an openness or perhaps even a desire to think outside or beyond

the modern Western episteme" (Kelly 2017, p. 120). Where the PhD earlier on has been almost clinically separated from societal and cultural discussions and identity formation, we see a clear connection between PhD research today and societal concerns. This is not without ambiguity as research funding and political agendas may influence research understandings to an extend that we cannot yet foresee or grasp.

With Gildersleeve's (2016, p. 1) wording, I argue that there is a 'knowledge imperative' embedded within the PhD, which signifies a "social contract between colleges and universities and society" around the promise to "safeguard knowledge – as an organizing system of social life – from partisanship, political whim, and undue influence from powerful factions." A similar perspective is found in Nixon's (2008) argument for universities and research constituting a "buffer zone" between the crude forces of personal self-interest and the impersonal interests of the state. Nixon's argument connects with the idea of a particular form of "Bildung," or formation, being embedded within doctoral education, which contributes to the harnessing of a moral and societal dimension of the PhD not yet fully realized.

Research and the PhD holds a dimension of care, as pointed out by Barnacle (2018). Barnacle argues that at the heart of knowledge creation at the highest level, there is a requirement for developing a "capacity to care" (Barnacle 2018, p. 77) to actually become able to carry out research and to become a researcher. In the PhD, we expect researchers to not only reproduce already known and existing knowledge but to create new and original knowledge through diligence and experiment, but also through an authentic respect, even esteem, for the aspects of the world being studied. Barnacle argues that the "conception of care is distinctive and important for learning because it involves a genuine openness to an other and the situation in which they find themselves" (Barnacle 2018, p. 81). Care makes us open to what lies beyond our preconceptions and social and cultural prejudices, and we become able to listen to and comprehend social identities, cultural value systems, or personal and religious worldviews that might otherwise escape us and create distance, confrontation, and conflict.

In the PhD, Barnett and Bengtsen (2019) argue, the aim is not to understand knowledge as being *about* life, but *from* life, and in the service *of* life. This understanding draws from a new realism that enhances the ontological empathy of research and argues that knowledge is not only of the world but from the world and from life. Knowledge lets us access dimensions of reality and experience otherwise beyond our grasp and to experience different aspects of the world afresh. Knowledge may be a living the life, and through knowledge we may "see with the eyes of tiger, or the space-traveller, or the prisoner of war, or listen with the ears of the diplomat or feel with the hands of the mountaineer. Knowledge is traversing life" (Barnett and Bengtsen 2019, p. 86).

The notion of researcher activism here links closely to an ethical dimension of academic citizenship (Macfarlane 2007; Nørgård and Bengtsen 2016, 2018) and the idea of the citizen scholar (Arvanitakis and Hornsby 2016). In line with my earlier work (Bengtsen 2020), I argue that we see a particular form of "doctoral citizenship" on the rise, which requires that Graduate Schools "understand themselves as embedded within the wider societal context and belonging to that context, but not

being limited and defined by it solely" (Bengtsen 2020, p. 154). In current times of climate change, virus outbreak, and culture meetings (clashes) due to refugees of war or ethnic segregation, frontline research has the ears of politicians and publics. Also, in a time of fake news and post-truth, the PhD, once again, needs to reestablish itself as a unique place of societal trust. Considering the PhD curriculum today means not only to consider disciplinary anchoring, dissertation formats, and where to draw the methodological line of demarcation in relation to dissertation assessment but also to acknowledge the rising, and very real, societal expectations and hopes put on research and researchers – which is an invitation to social and cultural engagement and leadership.

Conclusion – The PhD Revolution

Around the world, in Graduate schools, research environments, professional domains, and wider societal arenas, we are witnessing a PhD revolution. With the term "revolution" I mean, on the one hand, that the PhD is moving rapidly towards new (bio)political, institutional, societal, and curricular momentum; a re-volution. On the other hand, I also mean that the PhD is at the same time being transformed from within and is becoming a real contribution to a social and cultural transformation process. I have illustrated the trajectory of the PhD revolution in Fig. 13.2 below (inspired by the idea of the PhD and its "nested contexts" in the work of McAlpine and colleagues (McAlpine and Norton 2006; McAlpine and Amundsen 2016), showing how the PhD revolution spreads like a pulse through the institutional domain, into wider forms of world-entanglement beyond the institution, and even further transforming into forms of academic activism and citizenship.

In the institutional domain, we identify the PhD revolution through witnessed renewed forms of agency in doctoral students, their supervisors, and in Graduate School leadership. We see efforts in bridging and integrating formal, informal, and hidden curricula of the PhD (Elliot et al. 2020), and doctoral students and their supervisors fight for gaining a stronger political voice and institutional influence in a time where the eyes of politicians, external organizations, and companies are set on the PhD and its promise of financial and societal growth.

In the domain of world-entanglement, it becomes visible how the boundaries of the PhD have become still more permeable and how private life issues, sociocultural worldviews, and notions of professional competence mix with understandings of researcher creativity and quality in the research. The PhD, today, does not belong to the knowledge economy but to a knowledge ecology (Wright 2016) sustaining itself through environmental, cultural, and societal contexts.

In the domain of academic activism and citizenship, we see how the PhD, through enactments of research practices and researcher identity, influences not only the private, social, and professional contexts but reaches into negotiations of cultural values, societal agendas, and political cultures. This way seen, the PhD can no longer be understood as an isolated disciplinary endeavor, and core disciplinary

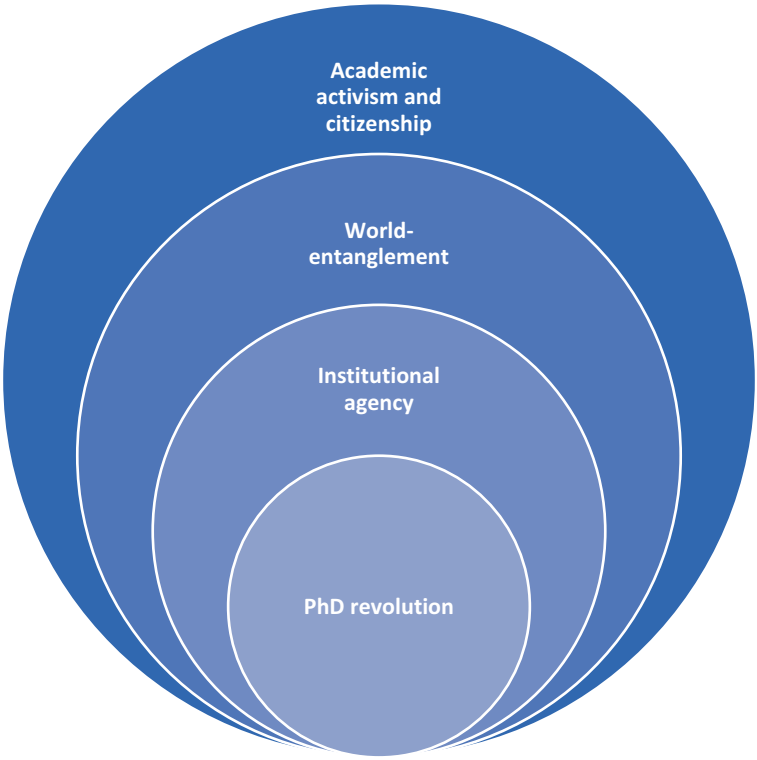

Fig. 13.2 The PhD-revolution-model

contribution must be seen as a form of engagement with, and endeavors in the service of, the natural, social, and cultural world around the degree.

The PhD is spiraling out and beyond institutional contexts and control, and one of the main challenges for Graduate School leaders and doctoral supervisors today is how to try to link and connect the individual doctoral student's research project with wider institutional, societal, and cultural contexts and how to help the doctoral students build synergy and cohesion across the domains in order help and sustain wider societal and cultural issues around them.

Situating the PhD successfully within a context of climate change and other major global concerns requires the development of an in-built ecological dynamo, where doctoral students become aware of their own institutional agency, societal belonging, cultural relevance, and biopolitical mandate. Being able to fully unleash the PhD into a climate context demands a graduate and carefully developed ecological awareness and mindset in the doctoral learning process. Establishing institutional agency and making the ecological circuit tangible to doctoral students and their supervisors may catalyze a more wide-ranging PhD revolution.

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Chapter 14
Resituating the PhD: Towards an Ecological Adeptness

Ronald Barnett

Abstract Ever since the dawn of its modern history at the start of the twentieth century, the PhD has undergone change as attempts are made to align it to felt needs of its times. And now, it may plausibly be suggested, the twenty-first century is presenting massive challenges which the PhD - in its present format - is entirely unable to address. A new framework is due, therefore, so as to resituate the PhD. Suggested here is an ecological approach, 'ecological' being extended beyond its customary associations with the natural environment, and seized upon for its suggestions of interconnectedness, systems, fragility, sustainability and humanity's responsibilities for the world.

This new PhD would be a trans-disciplinary voyage of discovery, a wisdom-doctorate, synoptic and far-reaching, of societal and even global value, and yielding moments of large insight as well as personal self-discovery on the part of the student. Such a programme calls for personal maturity on the part of candidates but it calls also for nimble footwork on the part of institutions, as they allow the student to draw on resources from beyond his/her discipline. The institution, the PhD programme, the supervisor(s) and the student would all become ecologically adept.

Introduction

The modern doctorate had its birth essentially in two sets of circumstances, one to impart intellectual fire-power to a Germany intent – at the start of the twentieth century – on making scientific and technological progress and putting itself at the heart of a conflicted Europe and the other to enable the universities of the United States to become the modernising engines of a social and globalising revolution in that country (cf. Simpson 1983) However, in both places and far beyond, the PhD has since been colonised by a new world order, a summary aphorism for which is

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'cognitive capitalism' (Boutang 2011). In short, the doctorate has always served and continues to serve particular interests, and those interests have changed substantially. The doctorate continues to respond to external promptings and therefore – it may be judged – always has unfulfilled potential.

Against such a background, the plausible possibility arises that – as it might be put – the PhD is particularly ill-matched for its present and impending times. The twenty-first century is faced with massive challenges which the PhD, in its present style, is entirely unable to address. A new framework is due, therefore, so as to resituate the PhD. Suggested here is an ecological approach, 'ecological' being extended beyond its customary associations with the natural environment and seized upon for its suggestions of interconnectedness, systems, fragility, sustainability and humanity's responsibilities for the world.

This new PhD would be a trans-disciplinary voyage of discovery, a wisdom-doctorate, synoptic and far-reaching, of societal and even global value and yielding moments of large insight as well as personal self-discovery on the part of the student. Such a programme calls for personal maturity on the part of candidates, but it calls also for nimble footwork on the part of institutions, as they allow the student to draw on resources from beyond his/her discipline. The institution, the PhD programme, the supervisor(s) and the student would all become ecologically adept.

Being Wise Before the Event

In the early incarnations of the PhD, especially in continental Europe, the general aim was to say something of significance that stood on its own two feet, independently of its author(s). This orientation was especially present in PhDs in the social sciences and the humanities, where it was a space in which one advanced a thesis that was not just original but was of such largeness that it could take on a field, critique the recognized authorities and even sketch out a new field. Such a conception of the PhD lent itself to immediate publication as a monograph, a practice that still holds in some universities in the northern parts of continental Europe. And a doctorate dissertation of this kind could pave the way for an early professorship, a professorial inaugural lecture of substance and a trajectory towards becoming a luminary in a field, and possibly even forming a new field.

We might say that this form of the PhD contained an inner orientation towards being wise *before* the event. This PhD engaged with the literature and did so head-on; that was much to the point. But then it went on from there to establish a thesis in its own right, a thesis that looked ahead, determined not merely to set up a new position but to take-off into the future. The dissertation was a launch-pad, providing energy for a high-velocity and steep personal trajectory and for a relocation of an intellectual field.

Admittedly, such a dissertation called for a large element of hubris. The PhD candidate was required to possess a high-blown self-belief. The doctorate viva, in turn, was expected to be a high-level conversation with intellectual peers. It was understood that the candidate, having delved deeply into a very particular issue, was

an expert – if not *the* expert – in the examination room. In the continental European tradition, where the final part of the examination was – and often still is – a public event, the occasion was a space for the successful candidate (for there was no doubt as to the candidate's success) to display her or his brilliance and formed the first step to a notable career, in which the student-as-academic would play a part in forging the whole field, if not actually creating a new field. As suggested, it was a display of wisdom before the event – of one's inaugural professorial lecture, of a forthcoming development in the intellectual field, of one's future relationships with the leading others in the field and so on. It was a foretaste of what was to come.

Of course, the stakes were very high. In taking on the authorities in a field, the candidate was subjecting her or himself to academic risk. An examiner could easily take umbrage if his (it was normally a 'he') favoured framework – or even his own framework – was being critiqued; and instances are not unknown of doctorate theses being rejected in such circumstances, only for the resourceful candidate still to make their way successfully into academic life and even to turn the failed dissertation into a groundbreaking book.

Doctoral candidates who held such a conception saw themselves as in the circus ring, riding two horses at once, and with hurdles in the way. Yes, the hurdle of the doctorate examination had to be surmounted, but the prize was well beyond that, in setting out an intellectual agenda for at least the next decade and possibly for a lifetime. The dissertation was crafted as the draft of the book to come. This was a true wisdom, with a perspicacity to put one's studies into a wider understanding where it had a contribution to make, even to the whole world.

Being Skilful After the Event

All that has changed. From being a matter of being wise before the event, the PhD has become a matter of being skilful *after* the event. Now, the dissertation is a vehicle for the demonstration of one's already-attained research skills, those skills being required to fall into a certain pattern. The very phrase 'writing up one's research' is testimony to the text being but an aftermath of the real event, the fieldwork and its analysis and the surrounding skills. It is the research skills that count; the text is a mere afterword. Once this PhD has been assembled, with its bricolage of parts, never again in the whole life of the candidate will something so arcane, and – on some estimations – so ridiculous, as an 80–100,000-word text be attempted. And so we are witnessing increasing efforts to move to a 'PhD by publication', where the PhD-as-assemblage becomes overt.

It would not be true to say of this kind of dissertation that it lacks an architecture. On the contrary, it exhibits an overtight architecture, and in three senses. Firstly, the components and their sequence are well-known and can be anticipated, even before the first page is opened: literature review, methodology, data collection, data analysis, discussion and closing reflections. No wonderment in embarking on a totally new journey and little room for serendipity or spontaneity here. Secondly, the parts

of the journey are kept tightly bounded. To use another metaphor, it is like encountering a mansion: it has an edifice and one that may, at first glance from the outside, seem impressive. The weighty tome sits there. However, venturing inside, the rooms turn out to be quite separated: no open-plan here. There is little opportunity for interchange between the rooms. There may even be people in the rooms – in the literature review, in the data analysis – but their communication is theirs alone. The sections of the dissertation stand separately from each other and so lend themselves to being converted quite readily into discrete papers in the literature.

Thirdly, the rooms are nowhere near equal in size. The rooms marked 'literature review', 'methodology' and 'data analysis' are sizeable. In a 300-page dissertation, the first two alone – which might have been thought to be preliminaries to the main event – may account for 150–180 pages. Noticeable, however, it is that the discussion section – where a thesis as such might have been identified and substantiated and allowed to flower – is quite truncated; it may amount to just twenty pages, if that. This deficit is entirely explicable, which I come onto below, but a brief reflection on the separate elements is in order here.

The lengthy literature review – aided by modern search engines – enables one to demonstrate that one has at least noticed several hundred papers in the relevant literatures that are contiguous with the topic of the dissertation. The length of the bibliography, accordingly, itself becomes a key element in the assessment of the dissertation. It is virtually impossible now for a doctorate dissertation to be passed by the examiners unless it contains a bibliography of some hundreds of items.

More importantly, though, the voluminous nature of the material being crammed into the literature review at best represents an opportunity to put on a show of a kind. Sentences follow each other with haste, each one ending in a bracketed string of references, leaving one to scratch one's head as to the part being played by the works cited to the sentence that one has just read. Often, one searches in vain for any connecting tissue even within a paragraph – which may extend to twenty-plus lines or even a whole page – let alone across paragraphs. The text skims across huge concepts and ideas, and as it refers to luminaries as if they were close acquaintances. A pretentiousness accompanies the narrative flow, inevitable given that the text flows across manifold sources. There is little attempt to delve deeply and authoritatively into a single issue and seriously to critique an oeuvre and even less attempt to expose tellingly any fundamental conflicts that there may.

Typically, the literature review is followed by a lengthy statement on methodology. Characteristically, what is proffered is a mix of a mini-textbook on methodology in the social sciences and an autobiography, describing the candidate's background and personal journey in pursuing the study. What one sees all too rarely is a careful and methodical laying out of the strategy adopted, with a tight relationship both to the key texts and to the topic at hand. Usually, a group of research questions is set out. Much less often is there a 'methodology' that sets out the logic flowing from such questions: 'Given these research questions, which stratagems suggest themselves and what are their advantages and disadvantages?' And 'how and why might a particular body of literature come into play, in burrowing into the matters to hand?' After all, the literature review has been dispatched in the previous section and can be left behind. As a result, the literature review and the methodology

stand proudly independent with little or no interchange between the two, reflecting – as they do – discrete sets of skills, of information extraction and processing and of data generation and analysis.

Tellingly, here, the candidates take pride in aligning themselves to a 'constructivist' methodology. This is crucial. The term 'ontological' may be used, even with relish, but with an inverted meaning from its proper sense. Instead of referring to considerations of the way the world is, the term is used to refer to the personal – and therefore changing – subjectivities of the interviewees. The idea that there might be a world independent of one's – or people's – constructions of it is not now permitted. (This has serious consequences, as I observe immediately below.)

There then follows a 'data analysis' section; but that phrase is overblown, for we receive lots of data but rather little in the way of analysis, despite the graphics and even photographs provided. Little attempt is made to identify the large themes that the data might open out to, themes that might connect the dissertation to even larger themes in intellectual life, still less in the wider world. Sub-headings emerge from the 'coding', and the data may be nicely arranged thereunder, but all too often the data are left to speak for themselves. Snippets – or even large portions – of interviews are presented with little or no following commentary, where one might have hoped for at least some allusions to be made to wider issues.

Moreover, despite the 'discourse analysis', opportunities are frequently missed even within the terms of the research contract, so to speak. The data are assumed to speak largely for themselves, the actual words of an interviewee unaddressed: Why this word? Why this phrasing, why this nuance (in the words of the interviewee)? What might they hint at? What might they be representing or even hiding? How might this word or this phrase link to the work of scholars in the literature review? The questions are not raised, and the data roll on, their resources largely unmined.

There is a pattern here, which follows from the constructivist approach now in vogue and which can be seen both in the fieldwork and in the data analysis. Awkward questions are never put to interviewees or to the transcripts that ensue. Interviewees are rarely if ever challenged: 'Why would you say – or think – that?' And that an interviewee says one thing on one page in the dissertation and a contradictory thing on another page goes unremarked. The possibility that an interviewee is deliberately lying is never entertained. For such critical stances on the part of our student-as-interviewer would precisely bring onto the horizon a world independent of (the interviewees') perceptions. The doctorate thesis is marked by a very limited level of criticality: a descriptive account of the interviewees' perceptions is felt to speak for itself. It is their world – as they have constructed it – that is all that matters.

The End of the Thesis

With it skimming so effortless across literatures and data, the text comes to exhibit an argumentative thinness, and this has a number of aspects. Firstly, there is a thinness in the substance of the central issue being attacked if, indeed, a central issue has been identified with precision. The sense that the dissertation lacks a central and

very specific issue is given weight by the abstract, where one may look in vain for a sentence that pinpoints the key claim being made, whether it be an empirical finding, a concept being articulated, a theoretical position being taken, or a policy being advanced. Bets are hedged in the abstract, which so often contain the non-specific verbs of 'explore' and/or 'discuss' ('This thesis explores such and such …' or '… discusses x and y.) The idea that a doctorate dissertation should stake out a definite thesis is now no longer held.

To forge a definite claim – or thesis – such that it lies at the heart of a text would place three demands on the candidate. Firstly, it calls for capacities to reason forensically, to home in on a multitude of data, evidence, ideas, theories, interpretations and positions, many of which will be pointing in different directions. To put it simply, this calls for not just the capacity but also the willingness to think; and thinking is hard. John Henry Newman, theologian, poet and scholar (who produced a vast body of work, including (1976) 'The Idea of a University', perhaps the most famous text in the English language on the matter and, for many, the most eloquent), spoke of 'the bodily pain' that writing caused him; such pain – we can reasonably surmise – arising from his stoic and tenacious disposition to think through matters so as to write with a rare clarity and beauty (Faber 1954). Most – in England at any rate – will understandably shun such cognitive discipline. Bertrand Russell is alleged to have remarked that 'Most of the English would sooner die than think', and then he added 'and most of them do'.

There is a second component in forging a thesis that is intimately connected with human virtues. To set out a thesis with such sharpness that it can form a single sentence within the abstract, so that the reader is in turn clear as to what the candidate is wanting to put into the world, calls for courage. It was also said of Bertrand Russell that he would never hit a large array of notes in the hope that one of them would carry the day (Hampshire 1971). He would simply put his finger on one note.

To write with such clarity requires a willingness to put oneself forward, to expose oneself, and to run a degree of risk. The abstracts of this kind of thinking – and, indeed, writing – will baldly state a thesis (as do the best abstracts in the academic literature). And the propositions in the text will not be hedged around with qualifiers or with scare quote marks that set the text off at a distance from the writer, a text that then becomes unduly semantically dense. It has been forgotten that while it is easy to make the simple complex (and there is characteristically much talk in dissertations of 'complexity' and of situations being 'complex'), it is much more difficult to make the complex simple.

A third element that is required for the forging of a thesis is that of imagination. By 'imagination' is meant a preparedness to stand aside from the array of material that the student will have assembled over several years of study and to see into and around it in new ways, to glimpse possible paths, to open it out, to grab hold of intriguing words and make something of them and turn them into concepts that shed new light on the material to hand, to discern connections with large issues not just in the immediate field but more especially in contiguous fields and to place it all in the widest vista. To deploy this kind of imagination is to leap into spaces even unconnected immediately with the material to hand and which yet, carefully treated,

can help to draw the material into an entirely new space. It is to bring forth possibilities, even undreamt possibilities. This imagination is disruptive (Zizek 2008: xxv).

Is all this too much to ask of our PhD candidates? Actually, it is precisely what we ask, or used to ask, but have forgotten. For the PhD is, or should be, not merely an original contribution to knowledge but should be making a significant contribution to knowledge. The logic of this recollection is that the imagination is an absolute necessity. The only way to make a significant contribution to knowledge is to leap aside from the given – from the literature, from the immediate data, from the given frameworks – and to move into a different space and glimpse matters anew. The mind has to be cleared if new framings are to form.

The desk itself has to be cleared, literally and metaphorically, so that the student becomes a writer, giving herself the frightening space of using her own resources to find words, and to select words, from the millions in her language. And that depends upon a yearning to glimpse new orderings in the world. The PhD has to become a form of poetry, in its careful attention to detail while bringing forth an original creation that offers new insights into the given, the ready-to-hand (Heidegger 1998).

As an examiner, on several occasions and with a smile, I have shared with candidates – during the viva voce – the reflection that, in the English language, the word 'thesis' has come to have two meanings. On the one hand, it refers to a dominant claim that a scholar is putting into the world. On the other hand, it refers to a sizeable and physically weighty text (usually sitting on the table in front of the student in the examination room). Generally unnoticed, the second sense of 'thesis' has come to supplant the first sense, such that the first sense has now fallen by the wayside. The original sense of a thesis as constituting the core claim of a text is now largely not understood at all. (More than once I have been asked: 'What do you mean by "thesis"?') This discursive switch – for that is what it is – points to a fundamental change in and around the PhD in the social sciences.

It can be observed – without self-contradiction – that the thesis has come to lack a thesis, not only as a contingent fact but also as a conceptual fact. This extraordinary shift is quite understandable, for a thesis – in the proper sense of the term – is no longer required of the PhD. What is required is that it signify the possession of a set of discrete research skills.

Explaining the Transformation of the PhD

The argument here so far can be quickly summarised. The doctorate – at least in the social sciences and societally oriented humanities – has undergone one major transformation and is now in need of a further transformation. The shift that the PhD has witnessed can be easily stated. It is a shift from a conception of the PhD-as-scholarship to the PhD-as-a-set-of-research-skills.

In its first incarnation, the PhD was understood to be the process in which a person, already in possession of one or more degrees (at Bachelor's and/or Master's levels), came to demonstrate that they had acquired the accoutrements of being a

scholar. This required a deep and critical reading of key texts, as well as taking on the epistemic virtues of perspicacity, courage, communication and pronouncement. The candidate would be saying something of significance, in which the dissertation engaged forensically with other texts and staked out a position that was independent of those texts. This was scholarship in its foundational sense, namely a love of and a deep intimacy with texts (books even), but yet also demonstrating a capacity not to be consumed by those texts but to stand apart from them.

In its second incarnation, the PhD has become a vehicle of research skills, in which the successful candidate demonstrates the wherewithal independently to conduct research projects in the future. As such, new criteria come to the fore. There is a definite section termed 'literature review' in which candidates demonstrate the ability to drive search engines, compile a bibliography and glide, seemingly effortlessly, over the ground of the territory in view. There is a major section termed 'methodology', in which the candidate shows that they can set up a research project and provide a justification of the approach taken. There is a section providing a data analysis, containing an assembly of data and inferences drawn from it. And there will be some brief closing remarks, demonstrating self-serving meta-cognitive abilities in reflecting on the work having been undertaken and the student's personal journal.

It is irrelevant now that this PhD contains no thesis for that is not what is being sought, actually, the contrary. After all, thinking – and that is what the formulation of a thesis as such requires – is 'dangerous' (Deleuze and Guattari 2013:41). This PhD is nothing other than an exhibition of discrete research skills and demonstrates the candidate's capacities for conducting research unsupervised – wherever that might be – and for limited self-reflection.

This shift – from PhD as scholarship to the PhD as research skills – is not happenstance. Over the last 40 years or so, across the world, higher education has been subject to massive forces acting on it. The terms conjured in depicting these forces are familiar enough and include neoliberalism, global economy, the knowledge economy, marketisation, private benefit and employability. Yet other terms, at a deeper analytical level, include financialisation, algorithmic capitalism, knowledge capitalism, bio-informational modernity, cybernetic capitalism and cognitive capitalism (Peters 2013). Of these terms, I prefer cognitive capitalism and will use it here.

The term 'cognitive capitalism' is primarily that of Moulier Boutang (2011) (although others have also promoted it). Boutang offers 'a definition of cognitive capitalism' (p. 56–59), viz. 'a mode of accumulation in which the object of accumulation consists mainly of knowledge, which becomes the basic source of value. … Labour power does not disappear, but it loses its centrality in favour of a cooperation of brains in the production of the living by the living, via the new information technologies … The mode of production … is based on the cooperative labour of human brains joined together in networks by means of computers'.

Boutang suggests that – following mercantile and industrial capitalism – the world is witnessing a third stage of a 'globalised world economy'. This world economy is exhibited in 'fifteen markers' (p. 50). Among these are 'The weight of the

immaterial', 'innovation present in interactive cognitive processes', 'a socio-technical system characterised by information and communication technologies', 'the appropriation of knowledge' (from Castells), 'the network society' (from Levy), 'cooperation between brains' and 'interconnected digital networks', 'knowledge goods' and fluid working patterns (pp. 50–56).

Given this evolving economic-epistemic order, and given too the incorporation of universities into state-steered systems of higher education, the shift in the PhD identified here is explicable. Armed with Boutang's suggestions, we can hypothesise the following. Within cognitive capitalism, the PhD has become part of 'a mode of accumulation [that] consists mainly of knowledge, which becomes the basic source of value'. The PhD fosters 'a cooperation of brains in the production of the living by the living, via the new information technologies … joined together in networks by means of computers'. Accordingly, the PhD has become part of 'a globalised world economy' and is testimony to 'the weight of the immaterial' oriented to 'innovation present in interactive cognitive processes'.

In short, the PhD has been repositioned over the past 40 years or so through its becoming conditioned by huge global forces. This was inevitable, for universities have been swept up in the formation of higher education systems, themselves incorporated into the emerging world epistemic and bio-informational economy.

Towards an Ecological Adeptness

The PhD is evolving. We have identified two stages – the stage of scholarship and the stage of self-regarding information skills; and the suggestion here has been that this present stage of egoistic skills is totally inadequate for the present and foreseeable future The question is this: can a further stage be glimpsed?

Let us backtrack for a moment. While Boutang's theory is powerful, there are two weaknesses in it; and the weaknesses offer avenues of possibility. One weakness lies in the changes in persons that accompany the formation of cognitive capitalism. Boutang mentions 'bio-productive' aspects of invention-power', 'living labour' (p. 54) and, as noted, 'the production of the living by the living', a 'bio-power [that] has made it possible for humanity to produce the post-human' (p. 150). (Boutang has in mind instances of 'fashioning the human cyborg' and 'the production of [the] population' more generally.) There is, therefore, some recognition of human being as such being implicated in the formation of cognitive capitalism.

The weight of Boutang's analysis, however, lies in a forensic analysis of the structural aspects of the new order, especially in its economic and knowledge systems and their intertwining. Much less attention is paid to the formation of human being and to the potential role of universities. There is mention of universities, but it is confined to universities as quasi-corporate knowledge laboratories, run with the 'same intensity and importance as … businesses and enterprises' (p. 151) and their ambiguous relationship with the labour market (p. 154). The question here is this: in this 'production of the living by the living', are there not new opportunities in this

epistemic order for a completely new conception of the PhD that expands both the student and the link between the doctorate study and the wider society?

There is, however, a further key idea in Boutang's work that is helpful here, that of the pollination society (p. 110 et seq). Although not treated to a specific definition, the idea seems to be that of the fact that, mainly by digital means, individuals are now giving freely of their labour in an infinity of ways. Unpaid but of immense value, this cognitive labour is bringing about a completely new networked economy. (The freely given time of contributors to Wikipedia is the stand-out example typically given here.) However, this concept of pollination deserves to be pressed further, not least in the present context.

We may observe that the modern doctorate is doubly implicated in this pollination. Firstly, the doctorate was essentially a guarantee of a path into the academic life (especially since when it was quite rare in the social sciences and humanities), and now it has proliferated such that PhD holders proceed mainly into professional life in the wider society. Secondly, as noted, the PhD is a means of developing information generation and processing skills, and so doctorate holders can be counted on as super-pollinators.

A post-human world beckons here, in which individuality is lost as human being becomes extensions of, if not actually incorporated into, the digital world. Some, such as Michael Peters, see here the alternative possibility of a 'knowledge socialism' (Peters and Besley 2006), in which knowledge is both produced by all and is freely available to all. On this view, presumably, not only would the doctorate dissertation be made freely available in universities' research repositories and other open access platforms, freely available and outside publishers' fire-walls, but also doctoral students would be encouraged to take advantage of social media to broadcast their ideas and findings to the world at large.

However, much larger possibilities for the PhD are opening here; indeed, much larger responsibilities. We have charted in this essay a shift from PhD as scholarly knowledge to the PhD as self-regarding cognitive labour, in which the student demonstrates the capacity for productive epistemic skills (and for limited self-reflection on those skills). But a combination of elements now present open the possibility of a fundamentally different, and therefore a third, stage in the PhD's evolution.

The elements are these: an interconnected world, the digital age with its opportunities for both creativity and mass communication, the release of doctoral students into their own resources, the porosity of epistemic borders (across disciplines, professions and the world of work), a worldly interest in the total environment and a drive for creativity and 'innovation'. Opening here, therefore, is a new age for the PhD, which we can justifiably term the ecological PhD. By 'ecological' is meant here not a reference to the natural environment as such but to embrace the total world as a collectivity of collectivities. This would elevate the PhD itself into a super-pollinator.

Now, the PhD has to be seen as a node (to use a term from Castells (1997)) in an entire web of networks. To see it merely as situated in networks of scholarship (Mode 1, as we might term it (Gibbons et al. 1994)) or, now, in networks of pragmatic informational-economism (Mode 2, we might say) is to diminish its

possibilities and its responsibilities. Recognized or not, the PhD is now situated in a multitude of ecosystems, for example of knowledge, learning, social institutions, the economy, persons, culture and the natural environment itself. Moreover, again whether recognized or not, not only is the PhD influenced – if only tacitly – by each of these ecosystems, but it is intertwined with them.

Here, the personal aspect takes on a heightened dimension, for PhD students will be engaged in forging their own learning ecologies (Barnett and Jackson 2020). Such students are characteristically encountering the world in a variety of ways and are taking their own personal learning journey. Each student engages with many if not all of the ecosystems just identified, of knowledge, learning, the natural environment, social institutions, persons, the economy and so on (Barnett 2018). Guattari's (2000) 'three ecologies' was unduly parsimonious for there are many more ecologies circulating in the world and which advanced study – such as the doctorate – should heed. Admittedly, there are nice questions as to whether – across the many ecologies just picked out – a hierarchy of ecologies can be discerned (is the natural environment the capstone ecology as it were or does the knowledge ecology retain its dominance, albeit now conscious of its responsibilities to the total world?). But these questions must wait for another day.

In the process, as their study unfolds, so doctoral students – embarked on this kind of programme – would be learning in its fullest sense. Their sheer being as persons is pulled this way and that as they venture forward. Their networks – in the senses implied here – accumulate across pertinent ecosystems and become more intricate. This learning journey is always on the move, always revealing new sights and always testing the student at the edges of their human capacities, not least as ethical beings.

Consider the matter of the Coronavirus. It is evident that the Coronavirus implicates virology, biology, medicine, the human body, statistics, engineering, health policy and organization, transnational relations, culture, zoology, agricultural practices, food distribution, human rights, animal rights, the state and its relationships with the polity, societal communication, psychological responses to aloneness, well-being, the matter of community, being a professional, the role of public intellectuals, decision-making (at personal, family, organizational, national and world levels), concepts of citizenship and fairness and much else besides. It follows that wherever a PhD study enters this maze, so it could branch into any of the others. The Coronavirus is a wonderful – in a bizarre sense of 'wonder' – example of the networks and their potential for different modes of experience to which Latour ((2007), Latour et al. (2011)) has directed our attention.

A Personal Journey

We observed earlier that, over recent years, the personal dimension has radically entered the PhD. The first-person pronoun form of propositions – 'I believe', 'I think', 'I decided to do x', 'I learnt that' – proliferates to such an extent that the text

has become an autobiographical space (whether or not an autoethnographic methodology is deployed). The PhD is now a place for interiorising in public. The text can stray towards solipsism, such that we end up having much insight into the student's learning biography and rather less about the world. In the process, Descartes' self-serving cogito – 'I think, therefore I am' – has been weakened even further into 'I act, therefore I am'.

In contrast, the ecological PhD – as understood here – does not abandon the sense of it being an unfolding personal learning journey, but it looks out to the world. Of course, a single PhD cannot and should not attempt to traverse the whole world; a degree of reticence is required.

In the wake of the ecological turn in social theory, 'relationality' has become a favoured term; and that is entirely legitimate. But care should be taken so as not to reach for the term in facile ways. In an interconnected world, in a world in which no entity and no concept stands in its own ground (Harman 2018), the PhD should demonstrate not merely a sensitivity to interconnectedness but also a way of revealing a pertinent set of interconnections. This would import a high seriousness into the PhD, that it should scrupulously peel back coverings to the world, so as to reveal in careful detail a little of its interconnections and their complexity and, indeed, their supercomplexity (Barnett 2000).

This would be a personal 'deep ecology' (Plumwood 2002). Much like the images of moving fractals, with their mesmerizing branching patterns, this is persons as unfolding webs of complexity. The pattern may not feel like a pattern to the individual student – indeed, it may be more like trauma, for a pattern can only be discerned post the event, looking back after graduation. (No wonder that the study process typically generates much anxiety.)

Such a PhD would be accomplishing much. It would reveal a set of particulars within an intellectual field (much as in stage one), and it would call for sophisticated research skills (as in stage two), but, now, it would reveal something of the pertinent ecological territory and would argue a definite thesis. To bring this off, the student would be immersed in the matter to hand, seeking to reveal its intricacies, but would also stand off from it and reveal something of the forces, settings or discourses acting upon it. The fragility of the object in question would be revealed but also its potentialities. A study of this kind would constitute a profound learning journey, for the student would come to sense him or herself in a very wide context and would encounter him or herself anew. If wisdom contains a capacity to stand off from the world and oneself, and to understand oneself and the immediate sense data in the widest context, then this PhD would be a journey into a wisdom-for-the-world. (cf. Maxwell 2014).

The PhD would become, thereby, a trans-disciplinary voyage of discovery, a wisdom-doctorate, synoptic and far-reaching, of societal and even global value and yielding moments of large insight by the student. Such a programme calls for personal maturity, but it calls also for nimble footwork on the part of institutions, as they allow the student to draw on resources beyond the immediate discipline and also encourage a spirit of epistemic generosity. The institutions, PhD programme, supervisor(s) and student(s) would all become ecologically adept.

Conclusion

The doctorate has been evolving for 900 years, serving as an emblem of the highest function of the university as differently understood in each era. In the Middle Ages, it denoted the right to teach. In subsequent centuries, it marked a lifetime of scholarship. In the nineteenth century, it began to be associated with original research in an intellectual field, a practice solidified through the twentieth century as research-favouring universities developed and as PhD programmes were established. And then, in the second half of the twentieth century, a fundamental shift occurred as the PhD came to mark not only the possession of research competencies but of research capital. Now, attaining a PhD demonstrates to the world that one can go on contributing to the informational capital of the world.

As the twenty-first century gathers pace, a yet further stage in the evolution of the PhD beckons. The world is interconnected; that has become a truism. But we should go further. The world may be understood as a heterogeneity of ecosystems, swirling in, out and across each other. To study and to undertake research in any field is to enter this ecological messiness. And so from the PhD as scholarship through to the PhD as cognitive capital and now to the PhD as ecological adeptness. This PhD – of the twenty-first century – would be a space for deep and incisive study of a phenomenon or entity or situation but crucially would place that study in its wider context. It would show how relevant ecosystems – for example of knowledge, social institutions, the natural world, the economy, persons, culture or of learning – bear in on the object in question. The Coronavirus crisis is but an example. A study within the field would naturally open out into any of those ecosystems.

This ecological PhD would not leave behind its former incarnations. On the contrary, it would incorporate them and build on them. It would call for deep scholarship and research capability and would provide working capital for the wider world, not least as it would reveal something about the interconnectedness of every entity in the world. Moreover, far from being an exercise in in-dwelling, where the student folds in upon him or herself, this PhD would open out into the world. It would display something of the intricate and often fragile interdependency among the infinite entities that constitute the world. And this PhD would contain a thesis, and a thesis about the world at that. This would reconstitute the PhD as a learning journey into a state of wisdom, offering foresight and even a wonder in the world. It would be a PhD for the world.

Admittedly, all this may be too late: the world may be fast – much faster than hitherto thought – approaching its end, and the proposals here may constitute a feeble gesture. But if the university is to be an active participant in striving for a better world – rather than a contributor to its degradation – turning the PhD towards an ecological adeptness has surely to be a necessary component of such activism.

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Afterword

Robyn Barnacle and Denise Cuthbert

The idea for this volume was developed in a series of conversations about the deteriorating state of the world's climate, the escalation of the invidious politics of climate change and post-truth challenges to evidence-based science and our desire to explore how doctoral education might be brought to bear on all of this. Additional prompts for this conversation were our university's debates on how to integrate the sustainable development goals (SDGs) into curriculum at all degree levels and the significant political pressures on all Australian PhD providers to produce industry-ready graduates to drive economic growth. For the two of us and our Australian colleagues, the volume took shape in what is now known as Australia's Black Summer of catastrophic climate-induced bush fire. For all contributors, final drafts of chapters were brought to completion in the midst of the COVID-19 pandemic. Anthropocenic ideations of end-times took on concrete reality in the production of this volume.

As we worked with our diverse contributors as they shaped their individual chapters and as we shaped the volume as a whole, we became persuaded of several things of which we had hunches as we embarked on this process. Some of these are:

- The PhD has always been historically and contextually inflected. The alignment of the modern/modernising PhD with the industrial aspirations of countries, such as Germany, the United States and more recently Australia and other colonial settler societies such as South Africa, does not preclude the possibility of a reformed or reoriented PhD aligned with the urgent project of planetary survival.
- The continual evolution of the PhD has not completely unmoored it from its origins as a license to teach, to instruct and by extension to provide thought leadership. The degree is directed to knowledge – philosophy – and gestures at

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expertise which lies beyond the boundaries of particular disciplines. These are all points worth remembering and enacting as we envisage ways of educating doctoral students for our future on this planet.

- While governed by individual universities, which are in many cases further governed by national regulations and standards, the PhD – its shape, its focus and who gets to undertake one – is much more squarely in the hands of us (researchers, scholars, supervisors, advisors and examiners) than we perhaps realize. This is also worth noting and enacting. We, in our roles as researchers, scholars, supervisors, advisors and examiners, should exercise the agency we already possess to mould – indeed insist on – a PhD which meets the needs of the current crisis. We can do this with our students, guiding them to understanding how their work may be translated to have impact, working with them to develop methodologies which shift the paradigm towards work which is normative and genuinely supportive of life on earth, and the economies, the technologies, the societies which we will need in order to survive. Several authors have bravely contributed rich suggestions for how this might be done.
- In relation to the issue flagged in the point above about who gets to do a PhD, we need all to insist on genuine diversity and inclusion in our doctoral programs. Are our universities making this possible? If not, we can all work to make this so. We cannot settle for the status quo as this has proved itself insufficient to get us out of this predicament. The great challenges we face will only be met if the very best students from a diversity of backgrounds and experiences bring their skills and talents to bear on these challenges.
- And finally, as we debate and rethink the PhD, we need to do so in the spirit of the critical tradition through which universities have been founded. Critique is essential to what a university does and to its function within societies in the service to knowledge and, ultimately, truth. This includes questioning the role universities have played in advancing the conditions that have led to the ecological crisis and redressing the gulf between universities and the communities they are meant to serve – what Latour calls the failure of 'trickle down epistemology'.

We hope that reading this volume is a stimulating, provocative and unsettling experience. We hope that individual chapters will raise questions, challenge assumptions and articulate challenges and opportunities for the change, redevelopment and resituation of doctoral curricula and approaches to this highest level of formal education. We also hope that the volume will seed and enable important conversations in universities and beyond about the importance of research, research literacy and research communication. Our hope is to see some of the ideas scoped out by our contributors taking shape in doctoral programs in the very near future. We sense urgency in this: time is not on our side in this matter.